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PHENOTYPIC STABILITY OF DRY FODDER YIELD IN CLUSTERBEAN

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ABSTRACT

Genotype-environment interactions were studied by growing 10 genotypes of clusterbean *(Cyamopsis tetragonoloba* (L.) Taub.*)* in five different years for dry fodder yield. Genotype-environment interactions were present and a significant portion of these was accounted for by the linear function of the environmental means. However, some of the interaction was independent of this linear component. No simple association existed between the mean velues and both the parameters of stability. No. 2, a local variety, was found to be most stable for poor environmental conditions, whereas genotype HFG 119 could be considered as most stable under all the environments. The practical implications of this study for future breeding programmes are discussed briefly.

Leguminous crops, show unpredictable trend in respect of yield due to genotype-environmental interactions. The situation becomes more precarious when one sees that ranking pattern is different in different years and due to this, it is generally not possible to draw conclusion regarding suitability of a particular variety. In this type of situation, the study of genotype environment interaction, which has become possible largely due to analytical approaches given by Finlay and Wilkinson, 1963, Eberhart and Russell, 1966 and Perkins and Jinks, 1968a, is important. Dry fodder yield, which has recently become important forage character over green fodder yield, is also generally affected by genotype-environment interaction. The present investigation, which has so far not been done in *guar* forage, therefore, was undertaken to study the phenotypic stability of 10 clusterbean genotypes.

MATERIAL AND METHODS

Ten genotypes of clusterbean, including two local checks, No. 2 and FS 277 were tested during *kharif* seasons of 1972-77. The genotypes were HFG 119, HFG 128, HFG 227, HFG 281, HFG 313, HFG 315, HFG 320 and HFG 371. In each year, the crops were grown in a randomized block design with three replications. The plots of 10×10m each were harvested after 70 days of sowing and data on green fodder yield/plot were recorded. A sample of 1 kg was taken from each replicate and oven dried at 60°C to calculate dry matter percentage. Dry fodder yield (q/ha) was computed after multiplying dry matter percentage and green fodder

yield. The stastical analysis was done according to the methods proposed by Eberhart and Russell (1966) and Perkins and Jinks (1968a & b).

RESULTS AND DISCUSSION

Mean dry fodder yield (q/ha) and the two parameters of stability b and S_b for the ten genotypes studied in five different years are given in Table 1. On the basis of environmental mean values, the highest yields were obtained in 1972 and the lowest yield in 1975. The highest overall mean yield was given by the genotype No. 2 followed by HFG 119. The lowest yield was recorded in HFG 320.

Pooled analysis of variance (Table 2) showed that the mean differences between the genotypes and environments were highly significant. This not only revealed that the amount of variability existed among the different environment but also reflected the presence of genetic

TABLE 1

Pooled analysis of variance for dry matter yield

Source	M. S.		Variance ratio against		
			Pooled error	Remainder	G X E
Genotype (G)	9	868.44	40.54**	18.12**	2.99**
Environment (E)	4	2250.15	105.04*	46.96**	7.75**
Genotypes Environments (G × E)	36	289 97	13.53**	6.05**	
Heterogeneity between Regression	9	1016.00	47·43**	21.20**	
Remainder	27	47.91	2 23**		
Pooled error	90	21.42			

TABLE 2

Mean dry matter yield (q/ha) and parameters of stability for 10 genotypes of clusterbean grown in five different environments

Variety	1972	1973	1975	1976	1977	Mean	b	S_b
HFG 119	80 70	46.91	44.27	55.72	63.90	58.36	0.90**	0.22
HFG 128	80.90	57.78	39.87	40.41	46 80	53.15	1.08**	0.21
HFG 227	77.60	63 52	31.11	44.85	57.10	54.84	1.04**	0.33
HFG 281	77.90	40.74	40.64	42.26	50.00	50.31	1.03**	0.13
HFG 313	74.70	47.20	35.34	50.00	50.70	51 59	0 92**	0.14
HFG 315	78.70	45.80	36.62	51.58	45 20	51.58	1.02**	0.19
HFG 320	78.60	49.23	31.52	29.22	47.14	47.14	1.26**	0.34
HFG 371	84.80	40.93	55.18	44.57	50.40	55.18	1.00**	0.34
No. 2	82.70	53.64	56.30	57.69	58.10	61.69	0.75**	0.15
FS 277	75.20	51.85	34.96	41.64	55 10	51.75	0.99**	0.15
Mean	79.18	49.76	40.61	45.79	52.44	53.56		
C. D. at 5%	N. S.	−3.72	N. S.	3.16	14.80			
I_j	25.62	−3.79	−12.96	−7.76	−1.11			

$r(\bar{X}$ and b) = −0.8358**

$r(\bar{X}$ and S_b) = 0.1676

r(b and S_b) = 0.2510

variability among the genotypes included in the present investigation. The mean square due to genotype-environment interactions was highly significant. Most of the variation due to genotype environment interaction was attributed to differences between the linear regression lines of the ten genotypes, whereas the deviation around the regression line was also significant. The significance of remainder could be accounted for by the wide genetic diversity of matierial used (Perkins and Jinks, 1968b).

Against the remainder mean square, the heterogeneity between regression mean square was also found to be significant. This indicated that prediction of genotype environmental interaction in general, for each line included in this study, would be possible from the linear regression on the environmental values. This is further confirmed by testing b value against their standard error (S_b), which showed that b value for each line was significant (Table 2). It is, therefore, concluded that in the present material, prediction of all the genotypes is possible.

The study of genotype environment interactions leads to successful evaluation of stable genotypes which could be used in future breeding programme (Finlay and Wilkinson, 1963; Eberhart and Russell, 1966; Perkins and Jinks, 1968a). In this investigation, It was possible to judge the phenotypic stability of ten genotypes using analytical approaches and definition of the term stability given by above workers.

The estimates of S_b showed that genotypes HFG 320 and HFG 227 had considerable variation around the regression slope and were phenotypically unstable. The most stable genotypes were HFG 281, HFG 315, No. 2 and FS 277 but except for No. 2, the mean performance were below average. The other stable genotypes were HFG 119, HFG 128, HFG 315 and HFG 320. Among these genotypes also except in HFG 119, the mean performance of other genotypes was poor. Among genotypes HFG 119 and No. 2, which were stable with high mean performance, the former had shown average response ($b=0.90$) and the latter had shown trend of least responsive to the change in environmental condition ($b=0.83$). Thus, the exploitation of No. 2 in poor environmental condition and HFG 119 in all the environment would be desirable. Seeing all the merits in these two genotypes, their judicious exploitation in future breeding programme relating to clusterbean for fodders would be most desirable.

The correlation coefficient between magnitude of the linear regression and the mean performance of the genotypes was negative and highly significant ($r=-0.83$) and the correlation between mean values and the deviation around linear regression was very weak ($r=0.16$). Similarly, no simple relationship existed between b and S_b value. Thus, it was justified that no prediction would be possible about both the parameters of stability (b and S_b) of the genotypes on the basis of their mean performance (Perkins and Jinks, 1968a).

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REFERENCES

Eberhart, S. A. and Russell, W. A. 1966. Stability parameters for comparing varieties. *Crop. Sci.*, 6 : 36-40.

Finlay, K. W. and Wilkinson, G. N. 1963. The analysis of adaptation in a plant breeding programme. *Aust J. agric. Res.* 14 : 742-754.

Perkins, J. M., and Jinks, J. L. 1968a. Environmental and genotype-environmental components of variability. III. Multiplelines and crosses. *Heredity*, 23 : 339-366.

Perkins, J. M., and Jinks, J. L. 1968b. Environmental and genotype-environmental components of variability IV. Non-linear interaction for multiple inbred lines. *Heredity*, 23 : 525-535.

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STUDIES ON THE STORAGE BEHAVIOUR OF DIFFERENT TOMATO CULTIVARS

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ABSTRACT

Different tomato cultivars were screened for their storage behaviour under ordinary room storage conditions. Cultivars Punjab Chuhhara, HS-110 and Punjab Kesri could be stored for 14 to 16 days in a good acceptable form. After 6-8 days of storage, there was considerable loss in weight and decay caused by physico-chemical changes and various microbes, respectively. The least decay was found in Cv. Punjab Chuhhara fruits, when stored upto 12 days. Total soluble solids increased during storage upto 8 days, whereas acidity showed a gradual increase throughout the storage period and this increase varied with the cultivars which was maximum in Punjab Kesri and minimum in Punjab Chuhhara.

TOMATO is mainly grown during autumn in the Northern Plains of India. However, the shelf-life of tomato is very short and a large quantity of the fruits is lost every year because of biochemical changes (Craft and Heinze, 1954; Hall, 1966) and decay caused by micro-organisms (Chenulu and Thakur, 1968; Yadav and Thakur, 1970) during storage and marketing. Several reports have been made in other countries on the storage of tomato (Enachescu *et. al.*, 1976; Iordachescu *et. al.*, 1971). In India, enough attention has not been paid to this specific problem. The wastage of tomato fruit after harvest, is very serious and quality is affected by many factors in storage (Hall, 1966). Hance, Keeping this view present studies were undertaken to evaluate various tomato cultivars for their storage behaviour.

MATERIAL AND METHODS

The present studies were conducted in the Post-harvest Technology Laboratory of Department of Horticulture, Haryana Agricultural University, Hissar, during 1977-78 and 1978-79. Freshly harvested, green-mature and uniformsized fruits were taken from nine tomoto cultivars, viz., S-12, Sel-152, HS-101, HS-102, HS-110, Punjab Chuhhara, Punjab Kesri, La-Bonita and Kalyanpur No. 1. These were washed under running tap water and excess water was drained off. The fruits were packed in vented bamboo baskets of 4 Kg capacity, using newspaper as cushioning material in each pack. Four packs of fruits with 4 kg per pack were used for each cultivar and placed in storage room at a temperature of $21° \pm 4°C$. Observations on titrable

acidity (A. O. A. C., 1965), total soluble solids, general appearance, loss in weight and microbial decay were recorded at an interval of two days. Quality was appraised subjectively at arbitrary grades ranging from 0-5. To determine the extent of losses due to decay, the fruits were examined at the time of opening of packings. The decay was calculated according to the formula given below :

$$\text{Per cent Fruit decayed} = \frac{\text{Weight of the fruits decayed in the pack}}{\text{Total weight of the fruit in the pack}} \times 100$$

RESULTS AND DISCUSSION

Among the nine cultivars, Punjab Chuhhara was acceptable upto 16 days of storage, whereas, HS-110 and Punjab Kesri ranked second to this. However, other cultivars under study were not acceptable after 8 days of storage (Table 1). Similarly, Agnih tri and Ram (1970) and Enachascu *et. al* (1976) found the storage life of several tomato cultivars upto 12 and 16 days under room storage conditions. The physiological losses in weight were found to be the least in Punjab Chuhhara, HS-110 and Punjab Kesri in comparison to other cultivars (Table 2). The maximum weight loss was observed between 4th to 6th day of storage as the fruits approached to the red-ripe stage. These differences may be due to the skin texture of the fruits, especially thickness of the pericarp. Table 5 shows that Punjab Chuhhara was less susceptible to microbial decay (2 13%) even after 12 days of storage. The extent of decay was the highest (32.53%) in cultivar La-Bonita under the same storage period. A significant increase in the decay has been recorded with the subsequent increase of storage period. This may be due to presence of inoculum of rotting organism which was increased gradually in the packs and infected the adjacent fruits (Chundawat *et. al.*, 1976).

The data on the fruit-quality, as influenced by room storage conditions are given in Table 3 and 4. A continuous increase in acid content was observed with the progress of storage period. Cultivar Punjab Kesri had the maximum acid

TABLE 1

General appearance of different tomato cultivars during room storage

Sr. No.	Cultivars	Storage period (days)								
		0	2	4	6	8	10	12	14	16
1.	S-12	0	1	2	2	3	4	5	—	—
2.	Sel.-152	0	1	2	2	3	4	5	—	—
3.	HS-101	0	1	2	2	3	4	5	—	—
4.	HS-102	0	1	2	3	4	4	5	—	—
5.	HS-110	0	1	1	2	2	2	3	4	5
6.	Punjab Chuhhara	0	1	1	2	2	2	2	3	4
7.	Punjab Kesri	0	1	1	2	2	2	3	4	5
8.	La-Bonita	0	1	2	2	3	4	5	—	—
9.	Kalyanpur No. 1	0	1	2	2	3	4	5	—	—

Six grades ranging from 0 to 5, where 0=green—mature, 1=turning red, 2=red ripe, 3=over ripe, 4=poor, and 5=unacceptable (discarded).

TABLE 2

Cumulative percent loss in weight of different tomato cultivars during storage

Sr. No.	Cultivars	Storage period (days)								Mean upto 12th day
		2	4	6	8	10	12	14	16	
1.	S-12	1.93	3.62	13.81	16.31	20.05	23.55	—	—	13.21
2.	Sel-152	1.81	3.60	9.10	12.07	16.17	17.31	—	—	10.01
3.	HS-101	1.69	3.64	10.76	12.38	14.74	16.24	—	—	9.90
4.	HS-102	1.55	3.31	9.45	11.74	15.98	17.50	—	—	9.92
5.	HS-110	1.50	2.88	9.83	11.86	12.98	17.29	49.57	21.38	9.39
6.	Punjab Chuhhara	1.76	3.26	7.31	8 29	9.95	14.21	17.50	18.48	7.46
7.	Punjab Kesri	1.79	3.48	11.62	13 83	18.10	21.31	24.52	26.43	11.69
8.	La-Bonita	2.43	4.43	9.93	13.05	18.67	21.33	—	—	11.64
9.	Kalyanpur No. 1	1.60	3.38	9.12	14.33	19.36	21.02	—	—	11.47
	Mean	1.78	3.51	10.10	12.65	16.22	16.49			

C. D. at 5%
Cultivar=1.63
Days=2.40

TABLE 3

Acid content (%) of different tomato cultivars at subsequent stages of room-storage

Sr. No.	Cultivars	Storage period (days)									Mean upto 12th day
		0	2	4	6	8	10	12	14	16	
1.	S-12	0.03	0.07	0.10	0.22	0.21	0.20	0.19	—	—	0.15
2.	Sel 152	0.02	0.10	0.12	0.12	0.21	0.26	0.21	—	—	0.15
3.	HS-101	0.01	0.06	0.13	0.16	0.26	0.21	0.26	—	—	0.16
4.	HS-102	0.06	0.02	0.16	0.19	0.16	0.15	0.21	—	—	0.13
5.	HS-110	0.03	0.08	0.13	0.15	0.19	0.21	0.23	0.21	0.22	0.15
6.	Punjab Chuhhara	0.03	0.05	0.11	0.13	0.11	0.15	0.21	0.26	0.36	0.11
7.	Punjab Kesri	0.01	0.50	0.13	0.28	0.32	0 37	0.36	0.41	0.42	0.25
8.	La-Bonita	0.02	0 05	0.11	0.13	0.16	0.21	0.26	—	—	0.13
9.	Kalyanpur No. 1	0.01	0.04	0.12	0.19	0 26	0.21	0.31	—	—	0.16
	Mean	0.02	0.11	0.12	0.17	0.21	0.22	0.25			

C. D. at 5%
Days =0.08
Cultivar =0.03

TABLE 4

Total soluble solids (Brix) of different tomato cultivars during room storage

Sr. No.	Cultivars	Storage period (days)									
		0	2	4	6	8	10	12	14	16	Mean upto 12th day
1.	S-12	3.0	3.6	3.6	3.8	4.1	4.1	3.6	—	—	3.24
2.	S-152	4.0	4.3	4.4	4.6	4.8	4.3	4.1	—	—	4.35
3.	HS-101	2.5	4.0	4.2	4.6	5.1	4.8	4.8	—	—	4.29
3.	HS-102	4.0	4.2	4.6	4.9	5.4	5.2	4.6	—	—	4.70
5.	HS-110	2.5	3.2	3.5	4.0	5.1	5.3	4.0	3.6	3.5	3.94
6.	Punjab Chuhhara	3.1	3.2	4.0	4.0	4.3	4.3	4.0	3.7	3.5	3.83
7.	Punjab Kesri	3.0	3.6	3.8	4.0	4.4	4.6	4.2	4.0	3.9	3.93
8.	La-Bonita	4.0	4.2	4.6	4.8	5 0	4.6	4.0	—	—	4.46
9.	Kalyanpur No. 1	3.0	3.8	4.0	4.2	4.8	4.3	4.2	—	—	4.04
	Mean	3.22	3.77	4.08	4.25	4.77	4.50	4.16			

C. D. at 5%

Days (D) =0.58

Cultivar (c) =NS

Interaction between C×d =NS

TABLE 5

Decay (%) in different tomato cultivars during storage

Sr. No.	Cultivars	Storage period (days)					
		4	6	8	10	12	Mean
1.	S-12	0.00	0.42	17.13	21.00	29.62	15.33
		(1.00)	(3.14)	(4.24)	(4.65)	(5.85)	(3.73)
2.	Sel-152	2.41	10.50	17.64	25.44	33.55	17.91
		(1.83)	(3.28)	(4.25)	(5.14)	(5 86)	(4.07)
3.	HS-101	11 56	18.02	26.33	37.35	51.56	28.96
		(3.54)	(4.36)	(5 22)	(6.19)	(7.25)	(5.31)
4.	HS-102	1.18	8.35	16.36	25.75	28.28	15.95
		(1.43)	(3.01)	(4.07)	(4.83)	(5.74)	(3.75)
5.	HS-110	0.00	0.84	2.97	6.26	11.73	4 36
		(1.00)	(1.33)	(1.96)	(2.65)	(3.55)	(2.09)
6.	Punjab Chuhhara	0.00	0.00	0.00	2.00	8.63	2.13
		(1.00)	(1.00)	(1.00)	(1.81)	(3.10)	(1.58)
7.	Punjab Kesri	0.00	0.00	6.81	13.71	14.94	7.09
		(1.00)	(1.00)	(2.79)	(3.82)	(3.98)	(2.53)
8.	La-Bonita	5.76	15.08	31.84	47.10	62.87	32.53
		(2.59)	(4.00)	(5.73)	(6.78)	(7 98)	(5.41)
9.	Kalyanpur No. 1	5.69	14.30	20.14	23.89	30.76	18.97
		(2.54)	(3.84)	(4 55)	(4.96)	(5.61)	(4.30)
	Mean	2.95	8.44	15.47	22.50	30.22	
		(1 77)	(2.77)	(3.76	(4.54)	(5.76)	

Value in parenthesis is transferred value=$\sqrt{n+1}$

C. D. at 5% Cultivar =0.98

Days =0.26

content (0.25%) followed by HS-101 and Kalyanpur No. 1 while the least in Punjab Chuhhara (0.11%). However, total soluble solids (TSS) increased significantly during storage upto 8 days, followed by a decrease, probably attributed to the hydrolysis of polysaccharides and increased concentration of juice as a result of dehydration. This confirms the findings of Craft and Heinze (1954) and Hall (1966) on the same crop.

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REFERENCES

A. O. A. C. 1965. Official and tentative Methods of Analysis. 6th Edition, Washington, D. C.

Agnihotri, B. N. and Ram, H. B. 1970. Role of skin-coatings on the storage life of tomatoes. *Prog. Hortic.* 2 (3) : 61-67.

Chenulu, V. V. and Thakur, D. P. 1968. Survey for storage and market disease of certain fruits and vegetables in Delhi and control of soft-rot due to Rhizopus spp. *I. P. S. Bull No.* 4 : 65-70.

Chundawat, B. S., Singh, J. P., Kainsa, R. L. and Gupta, O. P. 1976. Post harvest studies on guava fruits : I. Effect of packing and storage period on the quality of fruits. *Haryana J. Hortic. Sci.* 5 (3 & 4) : 130-136.

Craft. C. C. and Heinze, P. H. 1954. Physiological studies of mature-green tomatoes. *Proc. Am. Soc. Hortic. Sci.* 64 : 343-350.

Enachescu, G., Iordachescu, O-., Dumitrescu, M., Tanasescu, C., Ianosi's and Iancu, E. 1976. Studies on the post-harvest fruit ripening of tomatoes as affected by maturation stage, harvest and keeping temperature. *Hortic. Abstr.* 48 (4) : 3604.

Hall, C. B. 1966. Quality changes in fruits of some tomato varieties and ripened at 68°C for various periods. *Proc. Flori. St. Hortic. Soc.* 79 : 222-227.

Iordachescu O., Dobreanu, M. and Heydnedorf, R. 1971. Duration of maturity stages of early tomato hybrids. *Hortic. Abstr.* 42 (4) : 7944.

Yadav, H. C. and Thakur, D. P. 1970. Fungal-rot of ripe tomato fruits in Haryana. *Haryana Agric. Univ. J. Res.* 1 : 1-3.

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MICRO CLASSIFICATION OF AGRICULTURAL LAND : A TECHNIQUE

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ABSTRACT

The present study was an attempt to give a simple technique for Micro-classification of Agricultural land. The agricultural land of the sample village for the study was divided into 5 land categories, based on the intensity of cropping and sub-categories of this classification were obtained on the basis of intensity of irrigation. Very good land, good land, medium land, poor land and very poor land, respectively, occupied 13.2, 39.7, 41.1, 5.8 and 0.2 per cent of the total cultivated land. The taxonomy of crop sequences of the study period was also analysed.

It is well understood that some agricultural land is better than other under the same cropping pattern and it becomes important to classify such lands according to their qualities. Numerous methods of assessing land quality have been proposed. The classification of land for agricultural use is also made on the basis of the physical characteristics. However, the socio-economic conditions that include the current value of land, particularly the intensity of land use, are equally important. The present study is represented only by a sample village Isher Heri.

Isher Heri village of tehsil and district Hissar, a small and newly inhabited fragmented type of settlement is located in Barwala Community Development Block. The village (lat. 29°-24'-22" N and long. 75°-49'-40" E) is situated at a distance of about 30 K. M. in north of Hissar (Fig. 1). It has an area of 1194 acres of which 94.6 per cent is under cultivation. The main source of irrigation is canal by which 86.1 per cent of the total cultivated area is irrigated. The remaining 13.9 per cent is rainfed. There are three major types of soils in the village namely; i) clay loamy rich soil, ii) loamy soil and iii) sandy soil. The climate on the whole is hot and dry. Of the annual rainfall, about 75 per cent occurs from July to September and about 10 per cent from December to February. The sowing of crops is determined by the date of commencement of adequate rainfall and the growing season by the duration of well distributed adequate rainfall. The hottest day temperature is about 48°C, and in winter, the coldest night temperature goes down to about −1°C. April to June is a very hot and dusty period, when dust storms are common which affect the growth of crop like cotton. The data regarding rainfall are given in Table 1 for Hissar station which may be taken as close approximation for this village.

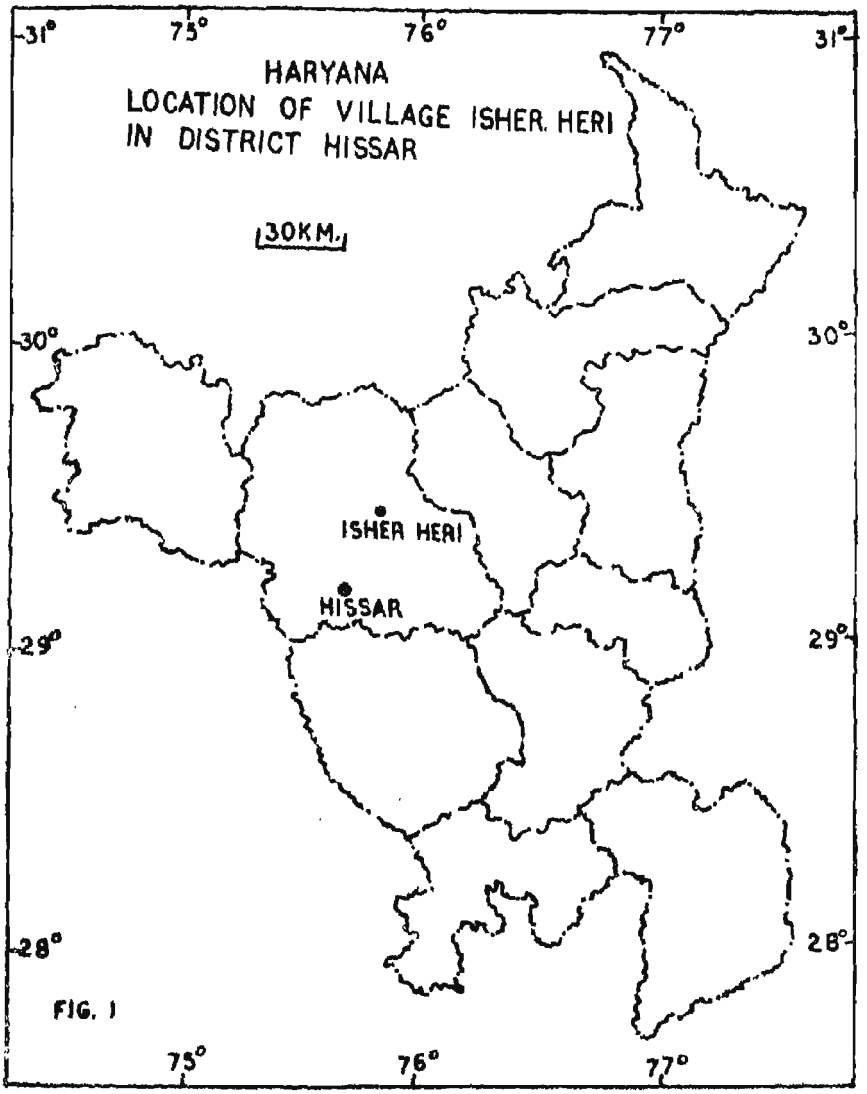

HARYANA
LOCATION OF VILLAGE ISHER HERI
IN DISTRICT HISSAR
30KM.
ISHER HERI
HISSAR
31°
75°
76°
77°
30°
29°
28°
FIG. 1

TABLE 1

Monthly rainfall in mm for Hissar Station (1975–1977)

Months	1975	1976	1977
January	13.6	13 8	15.7
February	1.8	22.3	—
March	8.7	—	8.4
April	—	3.5	25.8
May	0.2	33.2	51.8
June	53.4	53.2	67.8
July	100.7	180.0	197.7
August	101.2	159.4	109 2
September	79.0	70.7	64.3
October	12.5	—	—
November	—	—	0.2
December	—	4.3	6.9
Total	371.1	540 4	547.8

MATERIAL AND METHODS

The study was based on plotwise land-use data for two *kharif* seasons and two *rabi* seasons *(Kharif* 1975 to *rabi,* 1977), taken from the Khasra Girdawari maintained by the village Patwari. Map was designed with plot as the mapping unit. The average intensity of cropping (1975-77) for each plot was calculated as :

$$\frac{\text{Total cropped area}}{\text{Net area sown}} \times 100$$

All the plots of agricultural land were grouped in five categories (Table 4). Total irrigated area was put as the percentage of net area sown to find out the intensity of irrigation. The irrigated plots, having the same intensity of irrigation were also categorized as given in Table 5. The intensity of irrigation had a direct command over the intensity of cropping and, therefore, this influent was taken as a base for the sub-categories of land classification (Table 6). The total cultivated area of the village had been divided into 15 sub-categories of the land classification and crop sequences and crop damaged area were also calculated for each type of land. Thus, a micro-level method was used for the classification of agricultural land and the study of its crop sequence taxonomy.

RESULTS AND DISCUSSION

The general land use pattern of the village is presented in Table 6 and Fig. 2. The use of agricultural land in both the seasons under irrigated and rainfed conditions are given in Table 3. Out of the total cultivated land 38.0 per cent area was devoted to *kharif* crops as compared to 62.0 per cent to *rabi* crops under irrigated conditions. Cotton dominates in *kharif* season and gram in *rabi* season. On the other hand, *kharif* season covered 74.6 per cent of the total cultivated land, whereas only 25.4 per cent was under *rabi* crops under rainfed conditions. Table 6 sums up the following discussion.

A. **very good land :** This type of land, with more than 180 per cent intensity of cropping, covered 13.2 per cent of the total cultivated land. The area

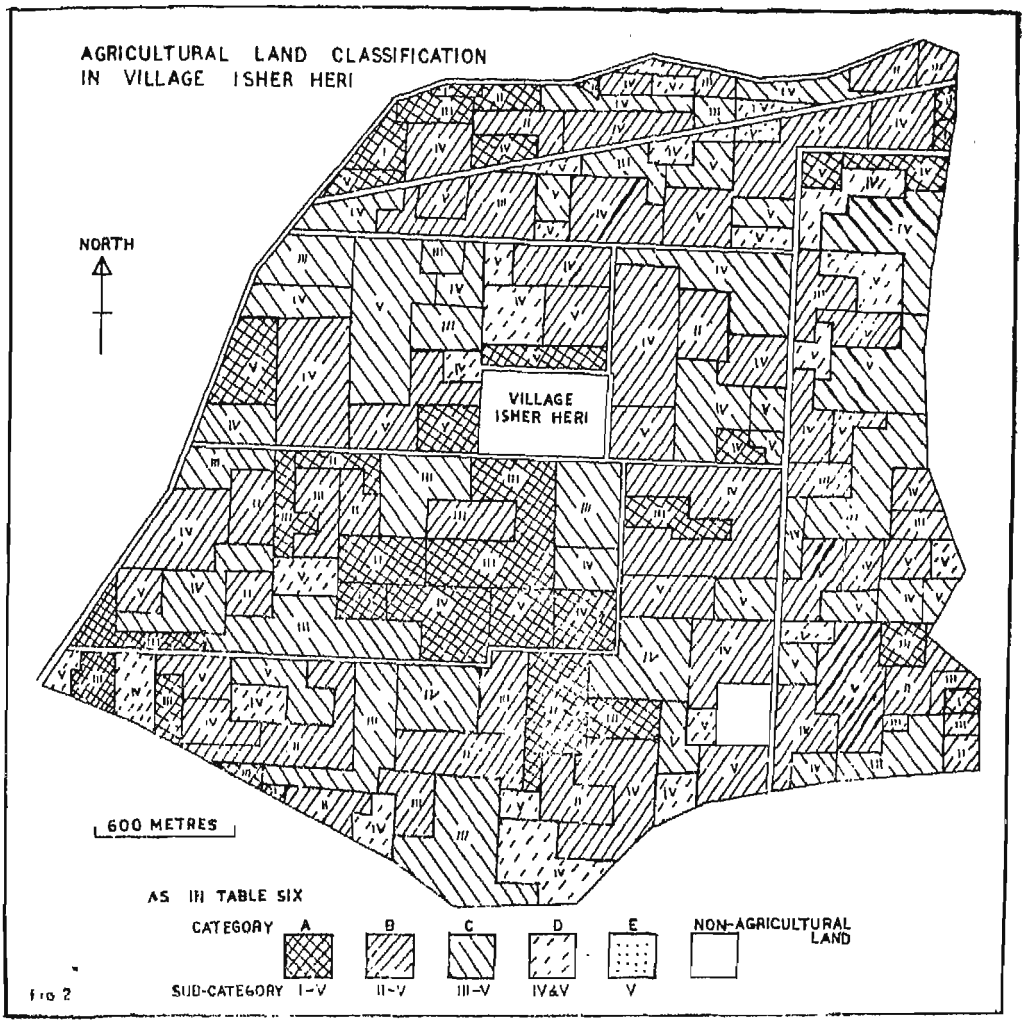


Fig 2

under crop failure was 11.4 per cent of the total crop failure land.

(i) **Very good land with high irrigation :** It covered 3.3 per cent of the total cultivated area. The cultivators grew cotton in *kharif* and wheat or gram in *rabi*, i.e., cotton/wheat and cotton/gram.

(ii) **Very good land with medium irrigation :** This sub-category accounted for 4.0 per cent of the total cultivated land bajra/gram and cotton/wheat were the main crop sequences.

(iii) **Very good land with low irrigation :** It had 3.4 per cent of the total cultivated area and the crop sequences were cotton/gram and bajra/gram.

(iv) **Very good land with very low irrigation :** Only 1.6 per cent of the total cultivated land was covered by this

TABLE 2

Land Use (1975–77)

Categories	% of total geographical area
Cultivated area	94.6
Barren land	0.1
Non-agricultural land	5.3
Total	100.0

TABLE 3

Cropping pattern (Average 1975–77)
(Percentage of total cropped area)

Crops	Irrigated	Unirrigated
Cotton	21.4	—
Sugarcane	1.4	—
Bajra	2.3	58.6
Guara	3.6	11.7
Jowar	4.0	1.8
Kharif fodder	5.2	2.2
Moong	0.1	0.3
Kharif total	38.0	74.6
Wheat	15.6	—
Gram	38.5	21.3
Barley	0.4	0.3
Sarson	4.2	3.4
Taramira	0.5	0.4
Methi	2.2	—
Rabi Fodder	0.6	—
Rabi Total	62.0	25.4

TABLE 4

Land classification based on intensity of cropping

Quality of land	Intensity of cropping (%)	Area as the %age of total cultivated land
Very good land	Above 180	13.2
Good land	*150–180*	39.7
Medium land	120–150	41.1
Poor land	Below 120	5.8
Very poor land	Not sown	0.2

TABLE 5

Intensity of irrigation as the percentage of net area sown

Categories	Intensity of Irrigation	Area as the %age of total cultivated land
High	Above 75	3.3
Medium	50–75	19.6
Low	25–50	38.5
Very low	Below 25	24.7
Without irrigation	Not irrigated	13.9

TABLE 6

Categories and sub-categories of agricultural land

Symbols	Categories of land (Intensity of cropping*/crop failure**/ area coverage***)	Sub categories of land based on intensity of irrigation (Intensity of irrigation*/crop sequence***/area coverage**)				
		(i)	(ii)	(iii)	(iv)	(v)
A	Very good land Above 180 11.4 13.2	Above 75 C/W-C/G 3.3	50-75 B/G-C/W 4.0	25-50 C/G-B/G 3.4	Below 25 B/G-B/G 1.6	Nil B/G-B/G 0.9
B	Good land 150-180 17.6 39.7		50-75 F/W-C/G Kf/G-F/W 15.6	25-50 C/F-B/G B/G-F/G 11.2	Below 25 B/G- GU/F C/F-B/G 6.3	Nil B/G-B/F B/G-F/G 6.6
C	Medium land 120-150 33.5 41.1			25-50 C/F-F/W F/W-C/F 23.9	Below 25 F/G-B/F B/G-F/F 11.6	Nil B/F- B/F F/G-B/F 5.6
D	Poor land Below 120 37.5 5.8				Below 25 C/F-F/F GU/F-F/F 5.2	Nil GU/F-F/F F/T-F/F 0.6
E	Very poor land Nil Nil 0.2					Nil F/F-F/F 0.2

*Per cent

**As the percentage of total crop failure land.

***As the percentage of total cultivated land.

C for cotton, G for gram, B for bajra, W for Wheat, F for fallow, Kf for kharif fodder, GU for guara and T for taramira.

sub-category. Bajra and gram were the two major crops representing bajra/gram and bajra/gram crop sequences.

(v) **Very good land without irrigation :** Such type of land depended upon rainfall and it accounted for only 0.9 per cent of the total cultivated land. The crop sequences consisted of bajra/gram.

B. **Good land :** (i) All the plots, having 150 to 180 per cent cropping intensity, were identified into four sub-categories on the basis of intensity of irrigation. This land occupied 39.7 per cent of the total cultivated area. This category shared about 17.6 per cent of the total area over which the crops failed.

(ii) **Good land with medium irrigation :** It was as an important sub-category covering 15.6 per cent of the total cultivated land. Two crop sequences were recognised, viz., fallow/wheat cotton/gram and *kharif* fodder/gram-fallow/wheat.

(iii) **Good land with low irrigation :** Cotton/fallow-bajra/gram and bajra/gram-fallow/gram crop sequences were of prime importance in this sub-category.

(iv) **Good land with very low irrigation :** Most of the area of this sub-category had bajra/gram-guara/fallow and cotton/fallow-bajra/gram crop sequences.

(v) **Good land without irrigation :** Bajra/gram-bajra/fallow and bajra/gram-fallow/gram crop sequences were found under rainfed conditions.

C. **Medium land :** This category, having intensity of cropping between 120 to 150 per cent, occupied 41.1 per cent of the total cultivated land. Area under crop failure was 33.5 per cent of the total failure cropped area. Three sub-categories were recognised after taking into consideration the intensity of irrigation.

(ii) **Medium land with low irrigation :** This type of land was the most important in the village as it covered the highest percentage of cultivated area (Table 6). The existing crop sequences were cotton/fallow-fallow/wheat and fallow/wheat-cotton/fallow.

(iii) **Medium land with very low irrigation :** It had 11.6 per cent of the total cultivated area. Two crop sequences were important, namely, fallow/gram-bajra/fallow and bajra/gram-fallow/fallow.

(iv) **Medium land without irrigation :** Bajra/fallow-bajra/fallow and fallow/gram-bajra/fallow were the existing crop sequences.

D. **Poor land :** This type of land occupied only 5.8 per cent of the total cultivated area and that might be devided into two sub-categories. This category shared 37.5 per cent of the total crop failure land.

(i) **Poor land with very low irrigation :** The important crop sequences were cotton/fallow-fallow/fallow and guara/fallow-fallow/fallow.

(ii) **Poor land without irrigation :** Guara/fallow-fallow/fallow and fallow/taramira-fallow/fallow were the major crop sequences.

E. **Very poor land (Ev) :** This type of land was negligible in the village as it

vered only 0.2 per cent of the total ltivated land and the land remained low during the four agricultural seasons is land was unirrigated and its inten- y of cropping was nil.

CONCLUSION

Some land is already under double- ıpping, but there is considerable scope increase the intensity of cropping on dium irrigated land. Farmers should ıw deep rooted and shallow rooted ıps in rotation (cotton-wheat) on such type of land, so that the soil may be benefitted. The cash crop like groundnut should be introduced in the crop sequences of low or very low irrigated plots. On 13.2 per cent (the very good land) of the cultivated land, productivity may be increased with the introduction of high yielding variety of seed and new farming systems. In order to obtain high yield from good land, medium land and poor land, first of all crop damaged areas require great attention and the factors affecting crop maturity should be studied.

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GENETIC DIVERGENCE IN BREAD WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

Forty strains of bread wheat including varieties of Indian and Mexican origin and their derivatives were studied for genetic divergence using Mahalanobis's D^2 technique. Plant height was found to be the most potent factor for genetic divergence, whereas tillering capacity contributed the least to the total divergence. Out of the 12 clusters formed, about half of the strains got grouped in only two clusters. The multivariate analysis indicated that cluster III comprising of tall Indian varieties exhibited great diversity from clusters VII, I and VIII, which constituted triple dwarf genotypes. The present findings revealed that selection of parents should be made from distant groups based on desirable component traits. The cross combinations HD 1925×C 306, HD 1925×NP 876, HD 1981×C 306 and HD 1981×NP 876 were expected to exhibit high heterotic response and might yield desirable segregants.

The importance of choosing the genetically diverse parents for hybridization has long been appreciated by the plant breeders. The precise information about the genetic divergence is crucial for a productive heterosis breeding programme, as the genetically diverse plants are known to produce high heterotic effects and consequently yield desirable segregants Very often, the geographic and phenotypic diversity has been taken as an index of genetic diversity. This being only an inferential criterion, as such, it could not be practicable in quantifying and genetically discriminating between biological populations. Moreover, it has now been well established by many recent reports in various crop plants that the geographic diversity is not an adequate index of genetic diversity (Murty *et al.*, 1965; Arunachalam and Ram, 1967; Singh and Bains, 1969; Somayajulu *et al.*, 1970; Mehndiratta and Singh, 1971; Chaudhary *et al.*, 1975; Bainiwal and Jatasra, 1978).

The Mahalanobis' D^2 statistic which is based on multiple characters seems to be a powerful tool in indicating divergence among groups. Unfortunately, barring a few reports (Somayajulu *et al.*, 1970; Lee and Kaltsikes, 1973), this statistic has rarely been used in wheat to measure the genetic diversity between parents before launching a hybridization programme. In recent years, however, a realization of the use of this statistic has been growing among the

hybridizers. Further, the use of multivariate analysis has become more imperative in wheat particularly after the advent of green revolution in the last decade, which has created a new spectrum of diversity. Accordingly, the present study was initiated to gather information on genetic divergence between Indian and Mexican varieties of wheat and many recently developed dwarf and high yielding strains having both Indian and Mexican germplasm.

MATERIAL AND METHODS

Forty diverse genotypes of wheat, both of Mexican and Indian origin, constituted the genetic material for the present investigation (appendix I). These cultivars were grown in a randomised block design providing three replications and a spacing of 30×15 cm at the Haryana Agricultural University Research Farm, Hissar. Five competative plants were selected at random from each single-row plot and observations were recorded on ear emergence, plant height, tillers per plant, 100-grain weight and grain yield. Transformation of original measurements to standardized variables was done by pivotal condensation method (Rao, 1952). The D^2 values for divergence between any two genotypes were obtained as sum of squares of differences in the values of their corresponding transformed variables. Based on these D^2 values, the forty genotypes were grouped into clusters by Tocher's method (Rao, 1952).

RESULTS AND DISCUSSION

The number of genotypes in each cluster and constituents of all the clusters are presented in Table 1. On the basis of D^2 values forty genotypes could be grouped into 12 clusters. Maximum number of strains got grouped in clusters I and II both of which together comprised about half of the total strains, whereas single strain constituted the last six clusters each The number of genotypes grouped into each of the clusters III and IV were five, whereas clusters V and VI comprised of only three genotypes each. Character means of the strains (Table 2) provide an interesting information on the nature of divergence among strains. All the strains comprising cluster I were three-gene dwarfs Strains grouped in cluster II were mostly double-dwarfs bred at different centres like Delhi, Ludhiana, Gurdaspur, Durgapura and Simla. All the indigenous tall varieties, except NP 809 formed a separate cluster. Three single-gene dwarf varieties which had maximum 100-grain weight also got grouped together. The within cluster variation was minimum for plant height and maximum for tillering capacity. Therefore, the plant height appeared to have contributed greatest towards genetic diversity among the evaluated strains.

Cluster means for various characters (Table 3) showed appreciable differences for most of the characters. The greatest differences were, however, observed for plant height. The higher variation between cluster means and low within-cluster itself for a certain character, is indicative of greater contribution, towards genetic divergence by that character. In the present case, plant height was found to be contributing the highest towards genetic differences between strains. Among the single strain clusters, the means were variable more or less to the same extent as were among the remaining ones. The rank totals in respect of five characters are also given in Table 3. Rank one was awarded to

TABLE 1

Distribution of 40 strains into different clusters

Cluster	Strains included	No. of strains
I	Hira, Moti, HD1977, HD2056, UP301, UP310, U319, WH111, WH114	9
II	HD1925, HD1981, HD1982, HD2016, WG377, WL396, Raj856, Raj857 HP916	9
III	C306, C281, C591, NP876, Agra Local	5
IV	Sonora 64, Kalyansona, PV18, WL303, UP315	5
V	WG357, HD2009, WH120	3
VI	Sonalika, Raj821, WL399	3
VII	WL112	1
VIII	WH113	1
IX	HD2021	1
X	M241	1
XI	Lerma Rojo	1
XII	NP809	1

TABLE 2

Character means of the strains (cluster-wise)

Sr. No.	Strain	Ear Emergence (days to ear)	Height (cm)	Tillers/ plant	100-grain weight (g)	Grain yield (g)
1	2	3	4	5	6	7
	Cluster I					
1.	Hira	96.7	70.1	17.5	3.5	29.1
2.	Moti	83.3	69.9	14.2	4 0	25.1
3.	HD1977	100.0	77.3	17.9	3.6	28.9
4.	HD2056	87.7	68.4	19 3	3.2	28.8
5.	UP301	106.7	68.1	15.7	3.4	24.4
6.	UP310	82.0	71.1	12.7	4.3	26.7
7.	UP319	84.0	71.0	14.4	4.2	28.3
8.	WH111	95.7	65.7	16.5	3.7	31.7
9.	WH114	88.7	69.6	20.3	3.4	28.2
	Cluster II					
1.	HD1925	83.7	90.9	17.9	4.3	41.7
2.	HD1981	86.7	82.2	15.4	4.1	30.3
3.	HD1982	82.3	85.7	16.8	4.3	37.8
4.	HD2016	83.3	82.7	14 1	3.8	27.4
5.	WG377	87.1	90.7	16.7	4.1	43.1
6.	WL396	83.0	81.6	13.4	3.5	25.0
7.	Raj856	82.0	81.8	12.7	4.3	33.3
8.	Raj857	85.7	87.3	17.1	4.3	45.7
9.	HP916	79.3	93.9	19.4	3 9	41.5
	Cluster III					
1.	C281	103.3	117.7	18.3	4.2	30.5
2.	C306	107.3	118.5	19.0	3.9	37.9

1	2	3	4	5	6	7
3.	C591	105.7	123.1	18.8	4.1	35.3
4.	NP876	94.0	120.3	16.4	4.5	31.9
5.	Agra Local	113.0	118.7	23.5	3.5	33.9
	Cluster IV					
1.	Sonora 64	93.7	87.8	14.0	3.5	24.0
2.	Kalyansona	113.0	92.0	14.8	3.0	23.7
3.	PV18	108.7	89.0	17.2	2.9	31.9
4.	WL303	96.3	88.6	15.5	3.0	28.5
5.	UP315	88 3	95.8	14.6	4.2	28.3
	Cluster V					
1.	WG357	103.3	92.5	18.5	4.2	36.3
2.	HD2009	102.7	85.5	18.7	3.8	41.6
3.	WH120	96.0	89.4	16.2	4.0	31.3
	Cluster VI					
1.	Sonalika	86.3	88.1	20.7	5.0	46.2
2.	Raj821	94.0	92.8	16.1	4.9	36.5
3.	WL399	82.7	89.9	14.6	4.7	32.3
	Cluster VII					
1.	WL212	87.7	66.8	14.7	2.7	17.7
	Cluster VIII					
1.	WH113	85.7	76.1	25.4	3.2	26.4
	Cluster IX					
1.	HD2021	89.0	101.2	17.9	4.4	42.3
	Cluster X					
1.	M241	86.0	98.1	12.3	3.7	28.3
	Cluster XI					
1.	Lerma Rojo	109.7	105.3	19.9	3.9	37.4
	Cluster XII					
1.	NP809	104.0	140.0	21.3	3.4	26.5

TABLE 3

Cluster means for various characters

Cluster No.	Ear emergence (day to ear)	Height (cm)	Tillars/ plant	100-grain weight (g)	Grain yield (g)
I	91.6	70.2	16.5	3.7	27.9
II	83.7	86.3	15.9	4.1	36.2
III	104.7	119.7	19 2	4.0	33.9
IV	100.0	90.6	15.2	3.3	27.3
V	100.7	89.1	17.8	4.0	36.4
VI	87.7	90 3	17.1	4.9	38.3
VII	87.7	66 8	14.7	2 7	17.7
VIII	85.7	76.1	25.4	3.2	26.4
IX	89.0	101.2	17 9	4.4	42.3
X	86.0	98.1	12.3	3.7	28.3
XI	109.7	105.3	19.9	3.9	37.4
XII	104.0	140.1	21.3	3.4	26.5
Rank total	2304	1444	3131	2609	2212

the character with highest contribution towards total genetic divergence. Ranks of all possible combinations were then added for each character. Thus, the lowest rank total for a character indicated highest contribution by that character to the total divergence. Plant height depicted the lowest rank total, thereby revealing that this was the most potent attribute for divergence in the present material. Plant height is known to be substantial contributor to genetic divergence in several crops including wheat (Murty and Arunachalam, 1966). Recentiy, Bainiwal and Jatasra (1978) in pigeon pea have also reported plant height to be the most potent factor for genetic divergence. The highest rank total observed for tillering capacity indicated least contribution by this trait towards divergence. Poor contribution of tillering towards genetic diversity might be because of the fact that this trait remained subjected to high selection pressure for more tillering in wheat resulting in narrow genetic base for this trait.

Inter and intra-cluster D^2 values between all possible pairs of 12 clusters are presented in Table 4. Out of the six multistrain clusters, the cluster number V, with its minimum intra-cluster D^2 value, was found to be the most compact cluster, whereas cluster IV was the least compact. Cluster VII followed by clusters I and VIII were the most divergent from cluster XII. Hence, crosses between the strains of these clusters, i. e., between WL 212 and NP 809 would be expected to give diverse combinations with high heterotic response. Since these varieties are susceptible to rusts, such a cross is not advisable. Cluster V, the most compact cluster, was genetically closer to clusters II, VI and IX. Minimum inter cluster distance was obtained between clusters IX and X. In general, the variety NP 809 belonging to cluster XII exhibited very high D^2 values and appeared to be the most distantly related to other strains. Relatively lower D^2 values of cluster II from other clusters revealed that the strains grouped in this cluster carried many common alleles from the gene pool of the present genetic material. Cluster I was closest to clusters VII and VIII, whereas it was most diverse from cluster XII. Cluster III comprising of only the tall Indian varieties was genetically most diverse from clusters VII, I, VIII, II and VI comprising Mexican dwarf genotypes. Therefore, the hybrids between the selected genotypes of these clusters are expected to give higher heterotic response. Since D^2 values are indicative of collective genetic diversity among the genotypes, attempting crosses merely based on these values may or may not give desirable segregants. For instance, a cross between most diverse parents WL 212 and NP 809 would give most of the segregants susceptible to rust. Therefore, other attributes like disease resistance, quality, stability etc. must be given due weightage while selecting perents for hybridization. Parents having desirable attributes must be selected from the diverse clusters. In the present material, the promising parents are HD 1925 and HD 1981 in the cluster II and C 306 and NP 876 in cluster III Therefore, the desirable recommended combinations from these varieties would be HD 1925 x C 306, HD 1925 X NP 876, HD 1981 X C 306 and HD 1981 X NP 876.

TABLE 4

Inter and intra-cluster distances (D^2 values) between all possible pairs of 12 clusters

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
I	15 14	50.12	315.19	88.48	61.76	75.66	37.49	37.72	128.19	96.70	177.98	613.62
II		13.81	178.96	50.95	25.69	29.11	92.83	64.22	37.94	33.31	93.18	41.66
III			11.36	143.73	120.91	150.37	393.20	295.99	69.71	92.56	29.68	74.82
IV				17.72	35.613	87.17	90.97	75.17	61.88	26.37	60.96	301.66
V					8.33	26.13	122.81	81.62	26.10	35.37	39.91	344.31
VI						13.18	171.91	111.64	31.57	58.40	73.11	399.79
VII							0.00	32.91	205.48	134.05	252.83	661.46
VIII								0.00	137.26	104.79	176.77	528.29
IX									0.00	23.47	28.46	250.49
X										0.00	49.84	250.93
XI											0.00	169.07
XII												0.00

Underlined figures denote the intra-cluser D^2 value

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REFERENCES

Arunachalam, V. and Ram, J. 1967. Geographic diversity in relation to genetic divergence in cultivated sorghum. *Indian J. Genet.* **27** : 369-80.

Bainiwal, C. R. and Jatasra, D. S. 1978. The application of Mahalanobis', generalized distance to measure genetic divergence in pigeon pea. *Indian J. Genet.* (In press).

Chaudhary, B. D., Bhat, P. N. and Singh, V. P. 1975. Genetic divergence in cluster-bean. *Indian J. Agric. Sci.* **45** : 530-35.

Lee, J. and Kaltsikes, P. J. 1973. The application of Mahalanobis's generalized distance to measure genetic divergence in durum wheat. *Euphytica* **22** : 124-31.

Mehndiratta, P. D. and Singh, K. B. 1971. Genetic diversity in respect of grain yield and its components in cowpea germplasm from Punjab. *Indian J. Genet.* **31** : 388-92.

Murty, B. R. and Arunachalam, V. 1965. The nature of genetic divergence in relation to breeding system in crop plants. *Indian J. Genet.* **26A** : 188-98.

Rao, C. R. 1952. *Advanced statistical Methods in Biometric Research.* Edn. 1. John Wiley and Sons. New York, P 390.

Singh, R. B. and Bains, S. S. 1968. Multivariate analysis of divergence in upland cotton. *Indian J. Genet.* **28** : 151-57.

Somayajula, P. L. N., Joshi, A. B. and Murty, B. R. 1970. Genetic divergence in wheat. *Indian J. Genet.* **39** : 47-58.

Upadhya, M. K. and Murty, B. R. 1970. Genetic divergence in relation to geographical distribution in pearl millet. *Indian J. Genet.* **30** : 704-15.

APPENDIX 1

Genotypes and their pedigrees

Sr. No.	Genotype	Pedigree
1.	Hira (HD1941)	E 5477 × Sonora 64
2.	Sonora 64	(Yaktana 54 × Norin 10-Baart) Yaqui 54
3.	Sonalika ((S 308)	(1153–388 × An) Y 54 × N 10 B × Lerma Rajo
4.	Kalyansona (K 227)	(Fn-K 58-N Th) × N 10-B × Gabo 55
5.	PV18	(Fn-K 58-N Th) × N 10-B × Gabo 55
6.	Lerma Rojo	Yaqui 50-N or 10-B × L 52/LR[2]
7.	C306	(Regent 1974 × Chz 3) C591[3] × (PLO × C281)
8.	NP809	(Democrat × C518) F_1 × (Spalding's Prolific × NP114 F_1) × E220
9.	UP301	Lerma Rojo × Sonora 64
10.	Agra Local	Local selection from Utter Pradesh
11.	C281	C591 × NP4
12.	C591	T88 × T9
13.	NP876	- -
14.	WG357	(PV18 × C273)
15.	Raj821	NP875/HD(M) 508
16.	HD1977*	E5477 × Sonora 64
17.	HD2009	L. Rojo 64A × Nai 60
18.	WH111*	(HD1508 × S308) × (H238 × C306)
19.	Moti (1949)	E5557 × NP852
20.	WL212*	(5376 × C273) × Kalyansona
21.	Raj 856*	Olsen's × Inia 66
22.	Raj 857*	Inia 66/7 cerrors/Inia 67
23.	HD1982	E5557 × HD845
24.	HP 916*	S 227 × S 308
25.	HD1925	Sonora 64A × L. Rojo 64A
26.	HD1981	E5557 × HD845
27.	HD2016*	E5557 × HD845
28.	HD2021*	S331 × NP 852
29.	HD2056*	NP875 × (Son. 64 × An 64A) × (E4853 × NP830)
30.	M241*	Mutant of Nadadores
31.	WG377	Wb143 × 48A255) × PV18
32.	WL303*	V18 × C281) × Kalyansona
33.	WL396*	(E4870 × NP852) HD1593) × (HD1508 × HD1356)
34.	WL399*	S308 × S339
35.	WH113*	(HD1508 × S308) (H238 × C306)
36.	WH114*	Ciano 'S' × Son64-Kl. Rend.
37.	WH120*	(S326 × C306) V17
38.	UP310	Kl. Pet. Ref. (2r 64 × S64)
39.	UP315	Ciano 'S' (S64 × Kl Rend)
40.	UP319	Ciano 'S' (S64 × Kl Rend)

Note : Genotypes with star represent strains and rest of the genotypes are released varieties.

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STUDIES ON WEED CONTROL IN MUNGBEAN *VIGNA RADIATA* (L)

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ABSTRACT

Chemical weedicides, viz., Prometryne, Treflan, Lasso, Tok E-25, Eptam and MCPB were tried at varying levels of application alongwith treatments of hand weeding in the mungbean variety 'Jawahar-45'. Prometryne 0.5 and 1.0 kg active ingredient (a. i.) per hectare and Treflan 1.5 kg a i. per hectare were found to be at par with weed-free and hand weeded treatments and were each superior to control (no weeding) by about 100 per cent in grain yield. Other herbicides too, except for MCPB, proved to be better than the weedy check, but were less effective than hand weeding or the best treatments of Prometryne and Treflan. Regression analysis revealed a negative association between yield of crop and weed growth.

Heavy weed infestation is a common feature in all the rainy season crops. Mungbean (*Vigna radiata*, L). is an important rainy season pulse crop. Grassy and broad leaved weeds create a great problem in its successful cultivation. Weed crop competition commences with germination of the crop and it continues upto maturity unless proper control measures are adopted. Reduction in yield of the crop due to weeds varies with the severeness of the weed infestation, and may be of the order of 70 per cent avoidable loss in certain cases. (Moolani and Singh, 1968). Therefore, weed control at an early stage is absolutely essential in order to realize high yield of this crop. Mechanical weeding, undoubtedly, is an effective measure for weed control in any crop. However, it is not possible to carry out hand weeding under certain circumstances like a wet spell of monsoon. On account of such factors, manual weed control operation may become either difficult or delayed beyond a reasonable time period. It is desirable under these circumstances to use herbicides which can kill the weeds either before or soon after their emergence, thus obviating unfavourable conditions of weed control. In the present paper, an effort has been made to identify chemicals which can be effectively used for weed-control in mungbean.

MATERIAL AND METHODS

Field experiments were conducted with mungbean variety' Jawahar-45' in rendomised block design having four replications during *kharif* seasons of 1971 and 1972 at the experiment station, Hissar. The methods of physical and

chemical weed control tried during 1971 were : (i) One hoeing by a local hand hoe; (ii) Weed free plot; (iii) Weedy check; (iv) Treflan (2,6 dinitro-N, N-dipropy-4-trifluormothyl anilins) at 0 5, 1.0 and 1.5 kg a.i. Per hectare; (v) Lasso (2-Chloro-2'-6'-diethyl-N-(methoxymethyl) acetanilide) at 1.5, 3.0 and 4.5 kg a.i. per hectare; (vi) Prometryne (4-6-bis-isopropylamine-2-methylthio-1-3-5-triazine) at 0.5, 1.0 and 1 5 kg a.i. per hectare; (vii) MCPB (4-chloro-2-methyl phenoxy butryic acid) at 0.5, 1.0 and 1.5 kg a.i. per hectare and (viii) Eptam (EPTC, S-Ethyl dipropylthiocarbamate) at 2.0, 4.0 and 8.0 kg a.i. per hectare. All the above treatments except for 0.5 kg. a.i. dose of MCPB were repeated during 1972, with following additional treatments.

(i) Lasso at 1.0 and 2.0 kg a.i. per hectare.

(ii) TOK E-25 at 1.0 kg and 2.0 kg a.i. per hectare.

(iii) Weeding by hand at 30 days after sowing.

Treflan and Eptam were applied as pre-planting, Prometryne, Lasso and TOK E-25 as pre-emergence and MCPB as post-emergence treatments. The herbicides were applied as spray at the rate of 1000 litres of aqueous solution per hectare. Pre-planting herbicides were thoroughly incorporated in the upper three inches surface soil immediately after spraying. Pre-emergence herbicides were applied just after sowing. MCPB was applied between rows, when the crop was at the first trifoliate leaf stage. Weed free plots were maintained by pulling out the weeds after every one week. In the manually weeded plots, one hoeing was done with a local hand hoe after 30 days and in addition, a treatment of weed-removal without disturbing the soil was carried out during 1972. Native weed population was allowed to grow unchecked in weedy control plots.

The crop was sown at optimum sowing time during both years in plots measuring 5.0×3.15 m. gross and 3.5×2.25 m. net in each replication. The row to row distance was 45 cm., while the plant to plant distance was kept at 10 cm. The soil was sandy loam with low in N. content, medium In P content and high in K content.

During 1971, few showers were received in last week of June and Ist and 2nd week of July, but during 1972, a good rainfall was received in 2nd week of June, 3rd and 4tn week of July and Ist week of August.

Data were recorded from each plot on the weed population and dry matter production of weeds per unit area (one meter square). Data on the *mungbean* crop were recorded on plot basis for grain yield and on single plant basis for plant height (cm), branches per plant, pods per plant, seeds per pod and dry matter production per plant (cm). Statistical analysis of the data was carried out by standard procedures as given by Panse and Sukhatma (1963). Correlation and regression analysis was also carried out between grain yield on the one hand and dry matter production of weeds and that of the crop on the other hand.

RESULTS AND DISCUSSION

Effect of weed control measures on crop yield

Of the various weed control treatments, the most effective in terms of

ultimate grain yield of the crop were Prometryne at 0.5 as well as 1.0 kg a.i. per hectare and Treflan at 1.5 kg a.i per hectare. On the basis of two years data they yielded on an average 8.87, 8.89 and 8.94 q/ha of grain (Table 1), which when compared to the yield of weedy check (control) worked out to nearly 225% of the latter. It appears therefore, that these chemicals are very useful in controlling weeds in the *mungbean* crop. The efficacy of these chemicals to successfully control weeds has been earlier demonstrated in peas by Singh *et al* (1973), in gram by Parkash and Singh (1973) and in Soybean by Bhan *et al* (1972).

The yield levels obtained in the present experiments from weed free and hand-weeded plots, however, were practically the same as for the above treatments of the chemicals. It appears, therefore, that one hoeing or weeding at 30 days after sowing, wherever possible should be considered as an effective means to control weeds in this crop. Since, however, it is difficult to forecast favourable conditions for manual weeding at this stage which synchronises with the

TABLE 1

Effect of weed-control treatments on the grain yield of mungbean

Treatments	Dose a.i kg ha	Grain yield Q/ha		
		1971	1972	Mean
Treflan	0.5	8.00	6.21	7.10*
	1.0	8.90	6 99*	7.94*
	1.5	9.25	8.64	8.94*
Lasso	1.0	N.T.	5.10	—
	1.5	6.34*	5.39*	5.86
	3.0	N.T.	7.28*	—
	4.5	6.41*	6.83	6.62
Tok E-25	2.0	N.T.	6.46*	—
	4.0	N.T.	5.27*	—
Eptam	2.0	5.47*	4.16	4.81
	4.0	6.09*	5.76*	5.92*
	6.0	6.06*	7.41	6.73*
Prometryne	0.5	9.84*	7.90*	8.87*
	1.0	9.38*	8.39*	8.88*
	1.5	1.41	4.77	3.09
MCPB	0.5	4.22	N.T.	—
	1.0	3.65	4.44	4.04
	1.5	4.28	3.87	4.07
Weed free		9.61*	7.90*	8.75*
Weeding at 30th day after sowing	—	N.T.	8.07*	—
One hoeing at 30th day after sowing	—	7.07*	8.06*	7.56*
Control (weedy check)	—	3.96	3.95	3.96
S. Em. ±		0.55	0.59	0.56
C. D. at 5%		1.16	1.22	1.19

N. T. = Treatment not tried

* = Significantly superior to weedy check.

wet spell in most of the monsoon areas, chemicals weed control assumes significance as an essential precautionary step.

While no treatment of other chemicals tested proved to be as effective as Prometryne or Treflan, it seems the applications of Lasso or TOK E-25 at 2.0 kg a.i. per hectare were better than others, resulting in substantial yield increase over the weedy check and being next only to the hand-weeded plots. Between Lasso and TOK E-25, the former appears to be the better one. Jain and Choubey (1969) also arrived at this conclusion while working in soybean crop. In view of precautionary significance of the weed control, these chemicals may be used when the better ones are not available.

It might appear from the 1972 rainfall data that the conditions were not really wet at 30 days after planting. It is, nevertheless, interesting that major changes in rainfall pattern between 1971 and 1972 failed to influence the yield performance of mungbean crop to any extent, the yield of weedy check being practically identical during the two years.

Effect of weed control measures on yield components and crop growth

There was apparently very little effect of weed control measures on the crop growth, as revealed by data on plant height, branching, pods per plant and seeds per pod (Table 2). In most cases, the differences for these characters among various treatments were not significant. However, in 1972, significant differences were obtained for pods per plant, which showed that weed control helped to increase the reproductive potential of the crop. The increase in yield due to weed control treatments could not be directly attributed to increase in pods per plant. Perhaps, the factor which off-set this expectation was the crop stand in various treatments. Although differences in crop stand per meter were also not significant, yet it could not be overlooked that crop mortality was caused by certain chemical treatments, especially Prometryne, as also reported by Johnson (1971). Moreover, the injurious effect of high doses of Lasso and Eptam was manifested at a level below plant mortality. Even with the MCPB treatment (all levels), which was not very effective in controlling weeds, there was an early set-back to the crop. Such influences which interfere with the normal metabolic activity cause inefficiency of the reproductive ability of the plant and hence, perhaps resulting in the failure to establish a direct association of yield with pods per plant under different weed control treatments.

Effect of weed control measures on weed population and its growth

Number of weeds per square meter under various treatments during the two years has been given in Table 3. It is apparent that number of weeds was the highest in weedy control plots. An examination of the weed population revealed about fourteen different species belonging to different families, *Patharchata (Trianthema monogvna), lahsua (Digera arvensis), doob (cynodon dactylon)* and *gokhru (Tribulus terrestris)*, were the most abundant in the experimental plots. Besides, *hulhul (Cleome gyandra), mokoy (solanum nigrum), cucumindo* var. monoretion, *motha (Cyperus rotundus), hirankhuri (Convolvulus arvensis), kankaua (Commelina*

TABLE 2

Effect of weed control treatments on the yield contributing characters of mungbean

Treatments	Dose	Pods per plant		Seeds per pod		Branches per plant		Plant height		Crop stand per meter row at maturity	
		1971	1972	1971	1972	1971	1972	1971	1972	1971	1972
Treflan	0.5	22.3	17.3	11.7	11.3	5.6	2.6	74.9	122.3	15.5	16.6
	1.0	16.5	23.1	12.9	10.6	4.4	3.7	75.6	127.0	15.5	16.3
	1.5	26.9	20.9	12.5	11.5	6.1	4.1	88.2	109.3	16.2	15.3
Lasso	1.0	N.T.	20.9	N.T.	11.3	N.T.	3.2	N.T.	122.0	N.T.	14.6
	1.5	19.3	29.3	12.6	11.3	4.6	4.3	76.8	188.3	15.0	16.0
	2.0	N.T.	23.2	N.T.	10.9	N.T.	4.1	N.T.	103.0	N.T.	15.6
	3.0	24.1	17.9	11.7	11.4	4.4	2.5	80.9	126 3	16.2	14.3
	4.5	20.1	19.4	12.4	11.9	5.1	2.9	79.9	107.0	15.0	13.6
Tok E-25	2.0	N.T.	18.9	N T.	10.9	N.T.	3.1	N.T.	129.0	N.T.	15.3
	4.0	N.T.	21.5	N T.	11.1	N T.	2.4	N.T.	107.0	N.T.	13.3
Eptam	2.0	25.3	24.2	11.9	10.8	4.9	3.7	85.3	112.0	15.1	14.0
	4.0	16 8	21.1	11.5	11.1	4.7	3.7	72 6	105.0	15.7	15.8
	6.0	21 5	22.6	11.1	10.5	5.0	3.5	71.7	115 0	16.2	17.3
Prometryne	0.5	25.0	24.3	12.5	10.7	5.8	3.7	77.2	115.0	15 5	16.6
	1.0	32.0	25.4	12.6	11.4	7.1	4.4	79.6	114.0	12 2	14.3
	1.5	18.5	26.3	11.3	11.2	6.3	3.4	72.2	113.0	6.2	9.0
MCPB	0 5	22.1	N.T.	12.9	N.T.	5.3	N.T.	73.2	N.T.	16.0	N.T.
	1.0	23.3	19.2	11.2	10.7	6.2	2.2	63.3	94.0	16.5	16.6
	1.5	27.1	12.9	11.7	10.9	5.5	2.4	64.6	113.0	15.5	15.3
Weed free		28.1	22.1	12.1	10.9	6.4	4 0	85.1	121.0	16.5	16.3
Weeding at 30th day		N.T.	24.5	N.T.	11.0	N.T.	3.0	N.T.	100.3	N.T.	16.3
One hoeing		22 8	23.2	12.5	11.2	4.9	2.6	75.1		15.0	15.3
Control		16.0	12.1	12.1	10 4	4.1	2.3	80.6	100.3	14.7	14.0
S. Em. ±		4.4	2.8	0.5	0.8	0.6	9.0	6.0	9.0	2.2	1.7
C. D. at 5%		N.S.	5.8	N.S.	N.S.	N S.	N.S.	N.S.	N.S.	N.S.	N.S.

N. T. = Treatment not tried.

N.S. = Statistically not significant.

TABLE 3

Effect of weed control treatments on population of weeds and dry matter production of crop and weeds measured at 60th day of crop growth

Treatment	Dose	Dry wt. of mungbean gm per plant		Dry wt. of weed gm/m²		Population of weeds/ m²	
		1971	1972	1971	1972	1971	1972
Treflan	0.5	28.5	23.3	190.5	197.3	63.0	28.7
	1.0	32.2	29.3	183.5	158.0	50.0	19.3
	1.5	34.5	36.3	172.2	65.0	44.2	16.0
Lasso	1.0	N.T.	21.3	N.T.	375.7	N.T.	61.0
	1.5	20.3	24.3	237.2	298.3	74.5	59.6
	2.0	N.T.	32.7	N.T.	61.0	N.T.	15.3
	3.0	25.5	26.7	226.5	63·3	63.2	30.0
	4.5	23.5	29.3	232.2	61.0	63.5	31.3
ToK E-25	2.0	N.T.	28.3	N.T.	236.7	N.T.	40.7
	4.0	N.T.	19.3	N.T.	223.0	N.T.	56.0
Eptam	2.0	19.5	15.0	329.5	345.0	94.5	73.6
	4.0	21.5	26.3	247.7	236.3	98.5	41.3
	6.0	22.5	34.3	250.0	106.0	74.0	21.0
Prometryne	0.5	39.5	34.3	149.2	73.0	35.2	16.6
	1.0	35.5	37.0	120.2	73.3	35.0	14.0
	1.5	20.5	31.7	117.2	60.0	30.2	12.0
MCPB	0.5	16.2	N.T.	663.0	N.T.	83.7	N.T.
	1.0	12.5	21.7	691.7	394.7	97.5	65.0
	1.5	18.0	20.3	692.5	404 0	82.7	76 3
Weed free		36.2	35.3	NIL	NIL	NIL	NIL
Weeding at 30th day		N.T.	34.3	N T.	85.7	N.T.	19.6
One hoeing		25.2	30 7	228.0	90.3	60.0	21.0
Control (weedy check)		11.5	18.7	718.7	397.3	129.5	80.0
S. Em. ±		1.4	2.4	36.4	22.7	4.4	3.2
C. D. at 5%		3.0	5.0	76.9	47.1	9.4	6.7

N. T. = Treatment not tried.

benghalensis), krishnaneel (Anagallis arvensis), and *hazardsna (Phyllanthus niruli)* were also present in a small number. *Kitkitiya (Xanthium spp.)* was very common in the first year, but in the second year the population of *Xanthium* was practically nil.

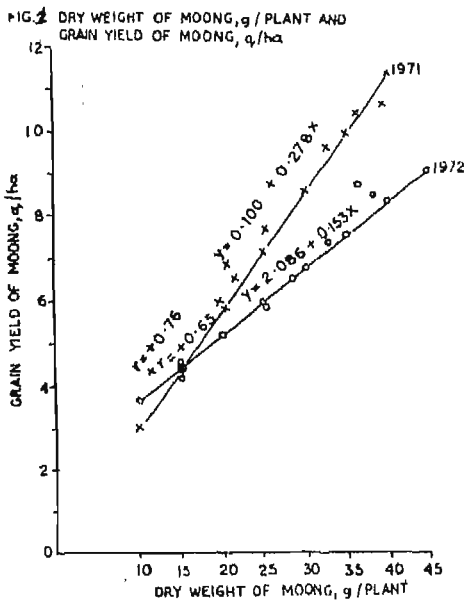
The intensity of weeds in 1971 was higher as compared to 1972 which might possibly be attributed to the frequent light rainfall in 1971. Dry matter of weeds/m² was also high in first year as compared to the second year because firstly, of number of weeds and secondly, of high infestation by *Xanthium* in the experimental plots.

A perusal of Table 3 further reveals that the number of weeds was the lowest in application of prometryne at 1.5 kg a.i./ha in both the years. However, this dose of weedicide is also toxic to the crop. The next best weed controller was prometryne at 1.0 kg a i./ha which incidentally gave high crop yield.

Prometryne at 0.5 kg a.i./ha and Treflan at 1.5 kg. a.i./ha were found to be equally effective. Higher number of weeds and dry weight of weeds in MCPB plots might have resulted from the inability of this herbicide to kill the weeds, which showed that it had little practical value in mungbean. The remaining chemicals tried were effective in checking the population of weeds and thus increased the yield, though not up to the level of weed free or one hoeing/ weeding.

Weed and Crop growth association

Correlation and regression analysis was carried out among seed yield of mungbean, dry matter production of mungbean per plant and dry matter production of weed per meter square so as to assess their inter-relationship. It was found that all possible correlations among the three estimates were highly significant, that between dry matter production per plant and seed yield of mungbean being positive while those with dry matter production of weeds being negative. The high positive correlation between single plant and plot yield of mungbean was expected (Yadav, 1972) and it was reflected in significantly improved pod number of higher yielding treatments. The regression equation (Fig. 1) indicated that a small contribution towards grain yield could be expected it single plant dry matter production increased. The negative association with weed growth of single plant as well as grain yield was also expected. But the regression value for yield-weed growth equation (Fig. 2) showed a rather small negative contribution. Likewise, the negative contribution of dry matter production of weeds on single plant yield of mungbean (Fig. 3) was relatively small. Yet, it is established from the regression analysis



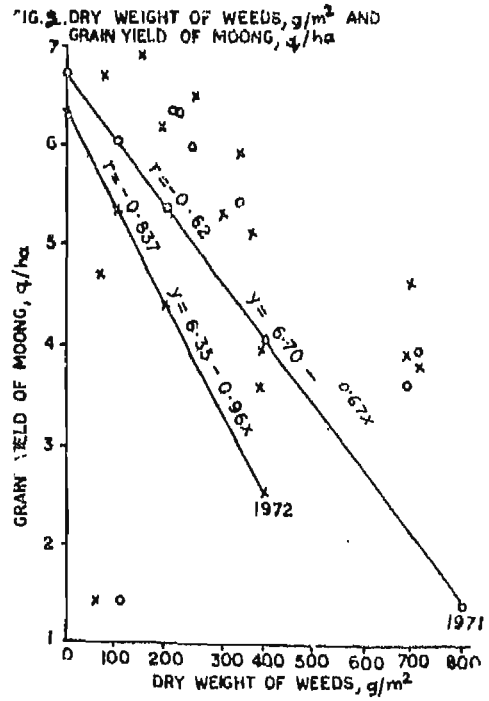
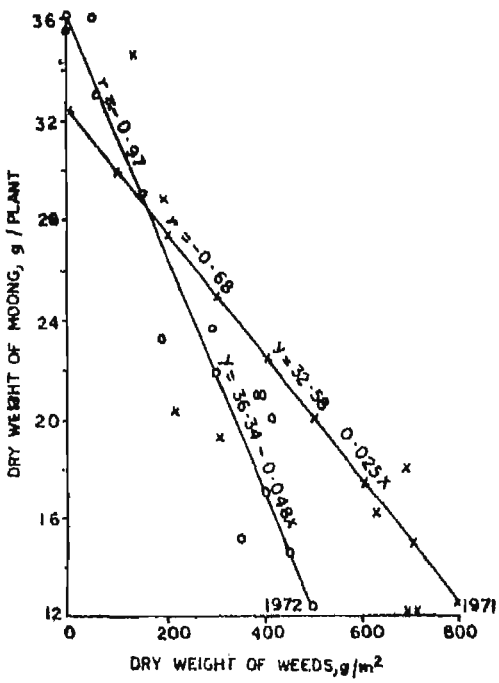


FIG. 3. DRY WEIGHT OF MOONG, g / PLANT AND DRY WEIGHT OF WEEDS, g/m²



that severe yield losses sometimes leading to complete loss of a crop could occur if a proper check was not kept on weeds.

It may be mentioned in conclusion that amongst the weeding methods tested, hand weeding at 30 days after sowing would be most beneficial. Where possible, a weedicide cover in the form of Lasso or TOK E-25 at 2.0 kg a.i. would be applied as pre-emergence treatment so as to obviate chances of unchecked weed growth during peak rainy season when it is difficult to carry out interculture.

REFERENCES

Bhan, V. M., Singh, M. and Maurya, R. A. 1972. Studies on chemical control of weeds in soybean. *Indian J. Weed Sci.* 4(1) : 16–22.

Jain, N. K. and Choubey, S. D. 1969. Weed control in soybean. *Indian J. Weed Sci.* 1(1) : 5–9.

Johnson, B. J. 1971. Effect of repeated application of herbicides on soybean. *Weed Sci.* 19(4) : 548-551

Moolani, M. K. and Singh R. P. 1968. *Weed control in field crops.* Published by Punjab Agricultural University, Hissar

Panse, V. G. and Sukhatme, P. V. 1963. *Statistical methods for Agricultural workers.* Published by Indian Council of Agricultural research, New Delhi.

Parkash, J. and Singh, I. 1973. Trials for chemical weed control in gram (*Cicer arietinum* L.) Paper presented at third All India Weed Control Seminar at Haryana Agricultural University, Hissar

Singh, K., Kumar, K., and Pandita, M. L. 1973. Herbicidal control of weeds in peas. *Indian J. Weed Sci.* 5(1) : 42-47

Yadav, A. K. 1972. Genetic Variability of Mung (*phaseolus aureus* Roxb.) with special reference to physiological basis of yield. M. Sc. Thesis Haryana Agricultural University, Hissar, Department of Plant Breeding

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GENETIC ARCHITECTURE OF EAR EMERGENCE IN WHEAT*

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ABSTRACT

Different approaches of diallel analysis in wheat revealed that both additive and non-additive type of gene actions were involved in the inheritance of ear emergence. The GCA : SCA ratio and degree of dominance indicated partial dominance and preponderance of additive genetic variance. Combining ability variances further revealed that Sonalika, Sonora 64, and Hira, all early maturing varieties, were good general combiners for earliness. Array means could be used in place of GCA effects. The use of *per se* performance of the hybrids instead of their SCA effects has been advocated. Hira × Sonora 64 under high fertility and Hira × Sonalika in low fertility were identified to be the best crosses. Exclusion of parents from the combining ability analysis (Method 4) gave better estimates. Ear emergence was positively associated with plant height, grain yield and tillers per plant, whereas negative correlations were obtained with 100-grain weight and synchrony of height. A single major gene appeared to be governing the inheritance of ear emergence. Earliness was partially dominant over lateness. Different approaches gave similar results. In the light of these findings, populattion breeding approach in the form of biparental mating should be practiced.

Realization of the importance of ear emergence has been increasing both among cultivators and breeders. Now the breeders, inspired by the greater awareness of increasing the cropping intensity among the farmers, have been concentrating their attention on breeding short-duration, well adapted and high yielding genotypes which may very well fit into the multiple cropping pattern. Detailed studies of genetic analysis through different approaches elucidate the genetic architecture of a character and consequently helps to formulate a pragmatic breeding programme. Most of the genetical studies on ear emergence in wheat (Crumpacker and Allard, 1962; Johnson *et al.*, 1966; Bhatt, 1971, 1972; Bitzer *et al.* 1971; Amaya *et al.*, 1972., Novoa, 1973) made so far have been attempted either using a single approach or only one aspect of the complex genetic architecture has been investigated. Therefore, genetic control of ear emergence has been investigated using various approaches of genetic analysis.

MATERIAL AND METHODS

The material consisted of eight diverse wheat varieties and their all possible hy-

*part of the Ph. D. thesis submitted by the senior author to the Haryana Agricultural University, Hissar

brids excluding reciprocals. The varieties selected were of Mexican and Indian origin representing different height and maturity groups. Both parents and F_1's were sown in 3 m rows under two fertility levels (high and low) at the Haryana Agricultural University Farm, Hissar. The spacing between rows and plants was 30 and 15 cm, respectively. The data on number of days taken to ear emergence were recorded on five random competitive plants. Combining ability analysis was carried out according to method 2, model 1 and method 4, model 1, as proposed by Griffing (1956). Diallel analysis was done following Hayman (1954). Correlation coefficients of plant height with ten quantitative traits were also computed. Narrow-sense heritability was computed as $\frac{1}{4}D/(\frac{1}{4}D+\frac{1}{4}H_1-\frac{1}{2}F_1+E)$ following Crumpacker and Allard (1962).

RESULTS AND DISCUSSION

The mean squares due to GCA and SCA were statistically significant under high as well as low fertility levels indicating involvement of both additive and non-additive types of gene action (Table 1). Greater than one value of GCA : SCA ratio suggested predominance of additive genetic variance. Earlier reports in wheat corroborate these conclusions (Crumpacker and Allard, 1962; Bitzer *et al.*, 1971; Amaya *et al.*, 1971; Paroda *et al.*, 1972; Bhatt, 1972). For breeding short duration varieties, negative GCA effects are desirable. Sonalika, followed by Sonora 64 and Hira, had the maximum negative GCA effect (Table 2) and thus, were good general combiners for earliness. For late maturity, UP 301 was the best general combiner as this strain had the maximum positive GCA effect in both the environments. It is interesting to note that all the three good general combiners were also early in earing. These genotypes, therefore, could be used for breeding short-duration varieties.

Comparison of two methods of combining ability analyses (Table 1) revealed that GCA and SCA variances computed by method 2 (parents included) were higher than those computed by method 4 (parents excluded). Thus, inclusion of parents caused considerable upward bias in the estimates of combining ability variances. However, the information on GCA effects obtained from the tow methods was almost similar.

The first three good general combiners selected on the basis of array means were the same as those were selected on the basis of GCA effects (Table 3). Thus, the array means could effectively be used in place of GCA effects. Jatasra and Paroda (1978b) have also suggested the use of array means in place of GCA effects. Further, crosses selected on the basis of *per se* performance and SCA effects were not the same (Table 3). This was because SCA effects were merely a measure of the deviation of F_1 performance from the mean performance of parents; for a given hybrid, the SCA effects might or might not be high depending upon the performance of parental lines. Thus, high SCA and high heterosis over better parent need not necessarily mean a high performance by the hybrid as well. Therefore, the estimates of SCA effects seem rather of limited value. On the other hand, the best crosses selected on the basis of *per se* performance and heterosis over check were identical. The choice of the best cross combinations, therefore, could be based on either of these parameters. Hira × Sonora 64 under high fertility conditions and Hira × Sonalika under low

TABLE 1

Mean squares for general combining ability (GCA) and specific combining ability (SCA) for ear emergence in wheat

Source	d. f.	Method	Mean squares		F	
			High fertility	Low fertility	High fertility	Low fertility
General combining ability	7	2	71.950**	63.764**	40.24	21.92
	7	4	35.840**	46.087**	22.10	15.38
Specific combining ability	28	2	6.741**	4.664*	3.77	1.60
	20	4	7.066**	5.108*	4.36	1.70
Error	70	2	1.787	2.908		
	54	4	1.622	2.997		
GCA : SCA ratio		2	10.670	9.460		
		4	5.070	9.020		

*Significant at 5% level

**Significant at 1% level

TABLE 2

Estimates of GCA effects for ear emergence in wheat

Variety	Method	High fertility	Low fertility
Hira	2	—0.85	—3.46
	4	—1.33	—3.47
Sonora 64	2	—3.59	—2.68
	4	—3.36	—2.69
Sonalika	2	—3.48	—3.61
	4	—3.17	—3.62
Kalyansona	2	1.98	1.64
	4	1.31	1.64
PV 18	2	2.83	2.78
	4	1.79	2.78
Lerma Rojo	2	—0.17	0.31
	4	—0.03	0.93
UP 301	2	2.77	2.69
	4	3.48	2.70
Agra Local	2	1.60	1.71
	4	1.31	1.71
C. D. 5%	2	0.701	0.895
(gi-gs)	4	0.874	1.189

TABLE 3

Three best parents and cross combinations for earliness selected on the basis of different criteria

Criterion	High fertility			Low fertility		
	First	Second	Third	First	Second	Third
Parents						
Per se performance	1*	2	3	3	1	2
Array mean	3	2	1	3	1	2
GCA effect	3	2	1	3	1	2
Cross combinations						
Per se performance	1×2	2×6	3×6	1×3	1×6	3×7
Heterosis over better parent	4×8	—	—	1×3	5×8	1×6
Heterosis over check	1×2	2×6	3×4	1×3	1×6	3×7
SCA effect	4×8	5×8	3×5	2×4	3×7	5×8

*1. Hira 2. Sonora 64 3. Sonalika
4. Kalyansona 5. PV 18 6. Lerma Rojo
7. UP 301 8. Agra Local

fertility environment were identified to be the best crosses for earliness. Interestingly, these crosses involved all the three varieties which were also good general combiners for this trait. Hence, these hybrids could be exploited more profitably in breeding programmes aimed at evolving short duration varieties.

In order to investigate the inter-relationship of ear emergence with other metric traits of economic worth, genotypic and phenotypic correlations were worked out (Table 4). The correlation estimates varied not only from generation to generation but also from environment to environment, suggesting the need of such studies in a range of environments. Jatasra and Paroda (1978) investigated association patterns in six environments for parental, F_1 and F_2 generations and made similar observations. Ear emergence was found to be negatively correlated with 100-grain weight and synchrony of ear emergence in both the generations under high as well as low fertility environments. This trait showed positive correlations, though weak, with grain yield, tillering, plant height and non-synchrony of height.

Estimates of the components of genetic variation (D, H_1, H_2, F) are given in Table 5. The estimates of t^2, b and $H_2/4H_1$ fulfilled the assumptions of the diallel. The D and H_1 components were found to be statistically significant in both the environments revealing thereby that both additive and non-additive types of gene action were involved in the inheritance of ear emergence in wheat.

The estimate of degree of dominance was less than one under both the fertility levels, suggesting partial dominance and thus, preponderance of additive gene action Bhatt, 1971; Bitzer *et al.*, 1971; Paroda *et al.*, 1972 and Nanda *et al*, 1974 have also reported partial dominance for earliness. The combining abi-

TABLE 4

Genotypic (G) and phenotypic (P) correlations of ear emergence with ten quantitative traits in wheat

Character	Generation	High fertility		Low fertility	
		G	P	G	P
Synchrony of emergence	Parental	—0.822*	—0.561	—0.418	—0.252
	F_1	—1.000**	—0.382*	—0.828**	—0.606**
Plant height	Parental	—0.174	0.138	0.413	0 302
	F_1	0.022	0.014	0.787**	0.736
Synchrony of height	Parental	0.479	0.413	0.787*	0.563
	F_1	0.230	0.088	0.462	0.378*
Grains per ear	Parental	0.480	0.446	0.302	0.226
	F_1	0.438*	0.362	—0.784**	—0.744**
Synchrony of grains per ear	Parental	0.885**	0.494	0.237	0.144
	F_1	0.120	0.064	0.290	0.250
Grain weight per ear	Parental	—0.271	—0.144	0.121	—0.027
	F_1	—0.349	—0.154	—0.943**	—0.911**
Synchrony of weight per ear	Parental	0.310	0.248	0.373	—0.084
	F_1	0.113	0.066	—0.976**	—0.843**
Tillers per plant	Parental	0.656	0.389	0.444	0.362
	F_1	0.559**	0.353	0.302	0.252
Grain yield	Parental	—0.159	—0.090	0.587	0.412
	F_1	0.427*	0.275	0.447*	0.291
100-grain weight	Parental	—0.793*	—0.671	—0.451	—0.361
	F_1	0.632**	—0.499	—0.422*	—0.066

*Significant at 5%
**Significant at 1%

TABLE 5

Estimates of the genetic components of variation for ear emergence in wheat

Genetic components of variation and their proportions	High fertility	Low fertility
D	39.65±1.83	18.80±0.64
H_1	24.47±4.21	12.94±1.47
H_2	20.77±3.66	11.32±1.28
F	17.19±4.32	—6.06±1.51
E	1.71±0.61	2.91±0.21
Heritability (%)	73.74	38.04
$(H_1/D)^{\frac{1}{2}}$	0.79	0.83
$H_2/4H_1$	0.21	0.22
$(4DH_1)^{1/2}+F/(4DH_1)^{1/2}-F$	1.76	0.68
h^2/H_2	0.20	—0.11
r	0.95	0.53
b±Sb	0.76±0.212	0.81±0.136
t^2	1.42	1.07

lity analysis also indicated partial dominance (Table 2). The value of $H_2/4H_1$ was close to 0.25 in both the environments, suggesting symmetry in proportions of the positive and negative genes. The ratio $(4DH_1)^{1/2} + F/(4DH_1)^{1/2} - F$, which gives the relative estimate of dominant and recessive alleles, did not give consistent results in the two environments. The positive correlation coefficients between parental order of dominance and the parental measurements indicated that the positive genes, i.e., those for lateness were mostly recessive. The ratio h^2/H_2 indicated that one gene or gene group exhibited dominance out of all the genes controlling ear emergence. However, this ratio appeared to have been under-estimated under low fertility conditions Ear emergence has been reported to be controlled by single major gene by Johnson *et al.* (1966), Bhatt (1972), Paroda *et al.*, (1972), and Ahmed & Aksel (1972). High values of narrow sense heritability revealed that the character was highly heritable.

In the present study, both additive and non-additive genetic variances were found to be important. For exploitation of both components of genetic variation, population breeding approach in the form of biparental mating should be practised.

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REFERENCES

Ahmed, U. S. and Aksel, R. 1972. Evidence of absence of earliness genes in chromosomes 1B and 4A in two early wheat varieties. *J. Hered.* 63 : 287-92.

Amaya, A. A, Busch, R. H. and Lebsock, K. L. 1972. Estimates of genetic effects of heading date, plant height and grain yield in *durum* wheat. *Crop Sci.* 14 : 478-81.

Bhatt, G. M. 1971. Heterotic performance and combining ability in a diallel cross among spring wheats *(T. aestivum L.). Aust. J. Agric. Res.* 22 : 359-68.

Bhatt, G. M. 1972. Inheritance of heading date, plant height and kernel weight in two spring wheat crosses. *Crop Sci.* 12 : 95-98.

Bitzer, M. J., Patternson, F. L. and Nyquist, W. E. 1971. Hybrid vigour and gene action in a six parent diallel cross of soft winter wheat. *Can. J. Genet. Cytol.* 13 : 131-37.

Crumpacker, D. W. and Allard, R. W. 1962. A diallel cross analysis of heading date in wheat. *Hilgardia.* 32 : 275-318.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.* 9 : 463-93.

Hayman, B. I. 1954. The theory and analysis of diallel crosses. *Genetics.* 39 : 789-809.

Jatasra, D. S. and Paroda, R. S. 1978a. Character association in three generations of wheat under different environmental conditions. *Cereal Res. Comn.* 6 : 85-91.

Jatasra, D. S. and Paroda, R. S. 1978b. Heterosis and combining ability analysis for synchrony traits in wheat. *Indian J. Genet.* (In press).

Johnson, J. A., Biever, K. J., Haunold, A. and Schmidt, J. W. 1966. Inheritance of plant height, yield of grain and other plant and seed characteristics in a cross of hard red winter wheat, (*T. aestivum* L.). *Crop. Sci.* 6 : 336-38.

Nanda, G. S., Gill, K. S. and Sharma, S. K. 1974. Combining ability in wheat. *Genet. Agrar.* 28 : 307-16.

Navoa, R. V. 1973. Inheritance of height and other characters under conditions of the coast of Peru. *Proc. 4th Int. Wheat Genet. Symp. Mussourl.* 611-15.

Paroda, R. S., Singh, V. P. and Joshi, A. B. 1972. Genetics of ear emergence in wheat (*T. aestivum* L.). *Indian J. Agric. Sci.* 42 : 653-56.

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INFLUENCE OF DIFFERENT DATES OF SOWING OF ALDRIN-TREATED AND UNTREATED WHEAT SEED ON GERMINATION, TERMITE DAMAGE AND YIELD OF WHEAT CROP

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ABSTRACT

Aldrin-treated and untreated wheat seed was sown at 3-week interval between mid-October to mid-January during 1975-76 and 1976-77.

There were no differences in the germination counts of the two types of seeds sown on five different dates. Termite damage was more in the crop sown during the first week of November than during the mid-October or end-November. The crop sown during the first three dates (mid-October, the first and last week of November) yielded higher than the one sown on subsequent dates (third week of December and mid-January).

As compared to untreated seed, use of aldrin-treated seed resulted in lesser termite damage and higher grain yield. Irrespective of the sowing dates, these values were calculated to be 93.7 and 13.9 per cent, respectively.

The effectiveness of aldrin-treated wheat seed in checking termite damage in wheat crop has been clearly demonstrated (Verma *et al.*, 1978). The present studies were aimed at determining the losses caused by termites when wheat crop was sown on different dates and also to find out the extent to which such losses could be checked by the use of aldrin-treated seed.

MATERIAL AND METHODS

The experiments were conducted in the research area of the Department of Entomology, Haryana Agricultural University, Hissar, during the years 1975-76 and 1976-77. The dates of sowing were: 16th October, 7th November, 1st December, 23rd December and 17th January during 1975-76 and 19th October, 9th November, 27th November, 21st December and 15th January during 1976-77. On these dates aldrin-treated (4 ml aldrin 30 EC per kg seed) and untreated wheat seed (variety C-306) was sown each in four plots. The plot size was 10×5 m and the sowings were done by *kera* method. The seed rate for both types of the seed was 90 kg/ha. Fertilizers applied were 30 kg N and 15 kg P_2O_5 per ha. Between any two plots 50 cm wide buffer area was provided. Crop was irrigated only once, i.e., about

3 weeks after the sowing. Germination counts were taken only during 1975-76. This was done 21 days after sowing by counting all the germinated plants in 5 out of the total of 20 rows in each plot. Termite attacked tillers were collected and counted at 20 day interval during 1975-76 and at 15 day interval during 1976-77. Crop in each plot was harvested separately and thus grain yield was recorded on plot basis.

RESULTS AND DISCUSSION

Germination. The data on germination counts were recorded only during 1975-76 (Table 1). The differences among all the treatments were, however, non-significant. These observations were, therefore, not recorded during the subsequent year.

Termite damage. On the basis of the data pooled for the two years, termite damage was observed to be the maximum when crop was sown around 7th of November (D2) and the minimum when it was sown around middle of October (D1) or end of November (D3). All other differences among the different sowing dates were non-significant (Table 2).

Considering overall as also the five sowing dates separately, termite damage was lesser in plots sown with aldrin-treated than with untreated seed. During both years, aldrin-treated seed proved superior to untreated seed though such differences in case of the 5th date of sowing during 1975-76 and the third date of sowing during 1976-77, were non-significant (Table 2).

Grain yield. Grain yield was higher when the crop was sown on any of the first three dates (D1, D2 and D3) than on any other subsequent date. Though the differences among the first three dates were non-significont, the yield obtained with D4 was, however, higher than in case of D5 (Table 2). Relative lower grain yield of the crop sown around mid-January could partly be explained due to the unexpectedly heavy incidence of shootfly, *Atherigona naqvii* Steyskal, recorded about one and a half months after sowing the crop. As compared to untreated seed, use of aldrin-treated seed gave higher grain yield.

The use of aldrin treated, in place of untreated seed, resulted in 93.7% reduction in termite damaged tillers and 13.9%

TABLE 1

Mean number of germinated plants per 5 rows of 10m each (1975-76)

Date of sowing	Seed used		Mean
	Aldrin-treated*	Untreated	
16.10.1975	1558.7(39 48)**	1583.7(39.76)	1571.2(39.62)
7.11.1975	1546.7(39.31)	1553.2(39.40)	1549.9(39.35)
1.12.1975	1656.2(39.92)	1613.0(40.14)	1634.6(40.03)
23.12.1975	1512 5(38.89)	1663.0(40.77)	1587.7(39.83)
17.1.1976	1514.5(38.89)	1440.0(37.90)	1477.2(38.40)
Mean	1557.7(39.30)	1570.6(39.59)	1564.1(39.45)

*Seed treated with aldrin 30 EC @ 4 ml per kg

**$\sqrt{n}$ transformation

All the differences were non-significant

TABLE 2

Termite damaged tillers and grain yield of wheat crop when aldrin-treated and untreated seed was sown on different dates

Date of sowing*	Aldrin-treated seed**		Untreated seed		Aldrin treated seed**	Untreated seed	Mean
	1975-76	1976-77	1975-76	1976-77			
(a) Termite damaged tillers per plot* **							
D_1	0.5(1.18)****	1.8(1.56)	46.5(6.62)	119.5(9.82)	1.1(1.37)	78.5(8.22)	39 8(4.80)
D_2	15.0(3.72)	8.8(3.06)	189.8(13.77)	495.3(22.08)	11.9(3.39)	342.5(17.92)	177.2(10.66)
D_3	2.5(1.71)	1.8(1.55)	79.5(8.84)	6.0(2.57)	2.1(1.63)	42.8(5.70)	22.5(3.67)
D_4	1.3(1.41)	20.0(3.63)	74.0(8.27)	200.5(13.16)	10.6(2.52)	137.3(10.71)	74.0(6.62)
D_5	1.3(1.47)	38.3(5 01)	9.8(2.98)	237.3(14.56)	19.8(3.24)	123.5(8.77)	71.7(6.01)
CD at 5%		(1.98)			(1.98)		(1.98)
Mean	4.1(1.90)	14.1(2.96)	79.9(8.10)	209.9(12.44)	9.1(2.43)	144.9(10.26)	77.0(6.35)
CD at 5%		(1.25)			(1.25)		
(b) Grain yield (kg) per plot* **							
D_1	10.78	9.45	9.80	9.03	10.12	9.42	9.77
D_2	10.18	10.41	9.20	8.20	10.30	8.70	9.50
D_3	9.50	9.63	9.23	8.08	9.57	8.66	9.12
D_4	7.30	6.06	6.56	5.35	6.68	5.96	6.32
D_5	1.98	1,74	0.94	1.25	1.86	1.10	1.48
CD at 5%							1.87
Mean	7.95	7.46	7.15	6.38	7.71	6.77	7.24
CD at 5%					1.19		

*D_1=Oct. 16, 1975, Oct. 17, 1976; D_2=Nov. 7, 1975; Nov. 9, 1976. D_3=Dec. 1, 1975; Nov. 27, 1976. D_4=Dec. 23, 1975; Dec. 21, 1976. D_5=Jan. 17, 1976; Jan. 15, 1977.

**Treated with aldrin 30 EC @ 4 ml/kg

***50 Sq. M.

****$\sqrt{n+1}$ transformation

TABLE 3

Comparison of the performance of aldrin-treated* and untreated wheat seed (1975-76 and 1976-77)

Dates**	Use of aldrin-treated in place of untreated seed	
	Percentage reduction in termite damage tillers	Percentage increase in grain yield
D_1	98.6***	7.4
D_2	96.5	18.4
D_3	95.1	10.6
D_4	92.3	12.1
D_5	84.0	69.1
Mean	93.7	13.9

*Treated with aldrin 30 EC @ 4 ml/kg

**See foot-note under Table 2

***Calculated from the data given in Table 2

increase in grain yield. In relation to different sowing dates the values for these two parameters varied from 84.0 to 98.6 and 7.4 to 69.1%, respectively (Table 3).

REFERENCE

Verma, A. N., Khurana, A. D. and Bhanot, J. P. 1978. *A new method to check termite damage in wheat crop.* International Symposium on Arid-Zone Research and Development, held at Central Arid-Zone Research Institute, Jodhpur (India), from 14 to 18 February, 1978. Abstracts of papers. p. 153.

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STUDIES ON THE EFFECT OF CUTTING INTERVALS AND STUBBLE HEIGHT ON FORAGE YIELD OF SWEET SUDAN GRASS *(SORGHUM SUDANENSIS)*

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ABSTRACT

The results of the studies conducted on different cutting intervals and stubble heights on sweet sudan grass have been reported. First cutting taken 60 days after sowing produced significantly higher green fodder yield. Contrary to this, the crop harvested 80 days after sowing gave maximum dry matter yield. Subsequent cuttings taken at an interval of 50 days produced significantly higher dry matter yield. A stubble height of 5 cm was significantly better in case of 30 days cutting intervals, whereas in case of 40 days cutting intervals 5 cm and 7.5 cm stubble heights were at par but significantly superior to 10 cm height. In case of 50 days intervals, different stubble heights had got no affect.

Shortage of green forage, particularly in the summer months (April-June) is well known. The present supplies are met mostly from poor quality roughages of the grain crops. Malik (1957) and Gill *et al.* (1975) have suggested growing of sweet sudan grass under multicut programme, as it is capable of giving 3 to 4 successful cuttings. As such, not only the higher tonnage of the forage is received but the supply of green fodder is also regularised over a longer period. However, the forage yield can further be boosted by adopting suitable agronomic practices. Since, very little scientific information is available regarding the proper stubble height and cutting intervals, a field experiment was laid out to study the effects of these factors on regeneration and production of sweet sudan grass.

MATERIAL AND METHODS

A field experiment was conducted at the Haryana Agricultural University Farm, Hissar during the *Kharif* seasons of 1975 and 1976. The treatments comprised of four cutting treatments (first cutting 50, 60, 70 and 80 days after sowing); three subsequent cutting treatments (30, 40 and 50 days after first cut) and three stubble cutting heights (5, 7.5 and 10 cm above ground surface). Split plot design with first cutting × subsequent cuttings in main plots and stubble heights in sub plots was adopted. The treatment combinations were replicated three times. Sowings were done in rows 25 cm apart on 9th May during 1975 and 18th May during 1976, respectively after giving the pre-sowing irrigation. Two post sowing irrigations were given before the onset

of monsoon during both the years. The crop was fertilized with 80 kg. N/ha and 40 kg. P_2O_5 as uniform dose. Whole of the phosphatic fertilizer was applied before sowing, whereas 80 kg. N/ha in the form of urea was applied in two split doses, i. e., half at sowing and the remaining half 60 days after sowing. The data on green and dry fodder yield obtained in different treatments were recorded.

RESULTS AND DISCUSSION

First cutting taken 60 days after sowing gave significantly higher green forage yield over those harvested after 50, 70 or 80 days of sowing, except in 1975 when it was at par with 50 days harvesting treatment (Table 1). On the other hand, harvesting the crop 80 days after sowing produced significantly higher dry matter yield over 70 days harvesting treatment in 1975 and over 50 and 60 days harvesting treatments in 1976. Gill *et al.* 1975 have also reported that harvesting the multicut varieties 55 days after sowing gave maximum green forage yield. However, for dry matter production 70 days harvesting was found to be better. These results do not tally with Malik (1957), who has reported that sudan grass is ready for first cutting 15 days after sowing.

Subsequent cuttings taken at 30, 40 or 50 days interval after first cutting did not differ significantly during both the years for green forage yield. However, for dry matter yield 50 days interval was found significantly superior to 30 and 40 days intervals. The differences in yield among 40 days and 30 days intervals were also significant, maximum dry matter being obtained at 40 days intervals. Maraschin (1971) has also mentioned that cutting at 8 weeks interval, produced 87% more herbage than cutting at 2 weeks interval. Similarly, Binnie and Harrington (1972) had reported that increasing the interval between cuts increased the dry matter yield in Italian rye grass.

Harvesting sudan grass 5 cm above ground surface produced significantly higher green as well as dry matter yield over the higher stubble height of 10 cm during both the years. During 1976, 7.5 cm stubble height also gave significantly higher green and dry fodder yield over 10 cm stubble height. Tomer and Moolani (1970), however, recommended 30 or 45 cm stubble height for napier grass. Maraschin (1971) reported that a cutting height of 8 cm increased the dry matter yield of *Phalaris tuberosa* L. Binnie and Harrington (1972) reported that lowering the cutting height from 12.7 cm to 2.5 cm increased the dry matter yield in Italian rye grass, whereas Huss et al. (1973) has recommended a cutting height of 5 cm in buffel grass.

The interaction of first cutting × subsequent cutting intervals were found to be significant both for green and dry fodder yield during both the years. The data given in Table 2 revealed that when first cutting was taken early, i.e., 50 days after sowing, subsequent cuttings taken at an interval of 50 days produced significantly higher green as well as dry matter yield over short intervals of 30 and 40 days. When the first cuttings was delayed upto 60, 70 or 80 days after sowing, subsequent cutting intervals had got no effect either on the green or on dry matter yield, except in 1976, where first cutting taken after 60 days of sowing and subsequent cuttings taken at an interval of 50 days produced significantly

TABLE 1

Effect of cutting intervals and stubble height on the green and dry fodder yield of sudan grass

Treatments	Green fodder yield (q/ha)			Dry matter production (q/ha)		
	1975	1976	Pooled	1975	1976	Pooled
1st cut						
C_1 (50 days after sowing)	659.4	571.6	615.5	146.6	129.4	138.0
C_2 (60 days after sowing)	686.1	621.6	653.8	145.3	138.9	142.1
C_3 (70 days after sowing)	598.1	580.3	589.2	142.8	144.4	143.6
C_4 (80 days after sowing)	621.1	558.6	589.8	156.8	153 2	155.0
SEm±	21.2	15.9	13.1	4.45	3.67	2.88
C. D. at 5%	62.1	46.5	38.0	13 02	10.70	8.52
Subsequent cuttings:						
Sc_1 (30 days after 1 cut)	617.5	566.5	592.0	136.6	127.95	132.0
Sc_2 (40 days after 1 cut)	651.1	585.3	618.2	149.1	143.0	146.0
Sc_3 (50 days after 1 cut)	655.5	597.6	626.5	158.0	153.6	155.8
SEm±	18.0	13 8	13.1	3.35	3.4	2.88
C. D. at 5%	N. S.	N. S.	38.0	8.81	9.24	8.52
Stubble height						
H_1 (5 cm height)	653.5	597.8	625.6	150 2	144.8	147.5
H_2 ($7\frac{1}{2}$ cm height)	640.4	590.8	615.6	147.6	142 5	145.0
H_3 (10 cm height)	630.3	560.8	595.5	145.9	137.1	141.5
SEm±	7.6	4.6	4.4	0.75	1.29	0.81
C. D. 5%	21.6	13.2	12.9	2.23	3.65	2.35

TABLE 2

Effect of first cutting × subsequent cuttings on the green and dry fodder yield of sudan grass

Treatments	Green fodder yield (q/ha)						Dry matter yield (q/ha)					
	Sc_1		Sc_2		Sc_3		Sc_1		Sc_2		Sc_3	
	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976
C_1	573.9	534.7	651.1	565.2	753 3	614.9	118.5	106.2	143.5	129.2	178.0	152.8
C_2	662 8	580.0	704.4	625.2	691.1	660.7	132.5	120.2	150.5	135.1	153.0	161.5
C_3	593.9	564.7	615.0	595.1	585.5	581.0	137.0	134.5	145.5	149.4	146.0	149.3
C_4	639.4	586.7	639.9	555.3	592.8	533.9	158.5	150.7	157.0	158.3	155.0	150.6
SEm±	33.8	26.5					8.3	5.9				
C. D. 5%	105.60	80.60					23.4	18.3				

TABLE 3

Effect of subsequent cuttings × stubble height on the green and dry fodder yield of sudan grass

Treatments	Green fodder yield (q 'ha)						Dry matter yield (q/ha)					
	H_1		H_2		H_3		H_1		H_2		H_3	
	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976
Sc_1	646.2	625.4	609 2	548.8	596.7	525.3	141.5	140.4	133.5	118.7	135.0	124.6
Sc_2	662.1	587.5	662.9	617.0	628.3	551.3	152.0	142.3	152.0	153.2	143.5	133.5
Sc_3	651.7	580.4	649.2	606.7	665.8	605.7	157.5	151.8	157.0	155.8	159.5	153.3
C. D. 5%	37.5	42.2					1.9	7.3				

higher green as well as dry fodder yield over short intervals. These results are in confirmity with Gill *et al.*, (1975) who have recommended 40 days interval for taking subsequent cuttings. Malik (1953 and 1957) and Gill *et al*, 1967 have also reported that sudan grass can give three to four repeated cuttings.

The interaction of subsequent cuttings × stubble height was also found to be significant. The data given in Table 3 show that in case of early subsequent cutting, i.e., 30 days interval, lower stubble height of 5 cm produced significantly higher green and dry fodder yield during both the years. In case of 40 days cutting intervals 5 and 7.5 cm stubble heights were at par for green as well as for dry fodder yield during both the years, but these were significantly superior to the higher stubble height of 10 cm. However, in late cutting intervals of 50 days, different stubble heights had got no effect either on the green or on the dry fodder yield. This showed that regeneration in the early cutting intervals started early which was recouped in the latter stages.

REFERENCES

Binnie, R. C., Harrington, F. J. 1972. The effect of cutting height and cutting frequency on the productivity of an Italian Rye grass sward. *Journal of British Grassland Society*. **27**(3) : 177-182.

Gill, G. S., Batra, P. C. and Singh, M. M. 1967. Effect of high doses of nitrogen on the forage yield of sudan grass (*Sorghum vulgare* UAR Sudanensis). *J. Res. Punjab Agric.* University. **IV**(2) : 179-184.

Gill, P. S., Singh Kanwar, Paroda, R. S. and Kapoor, M. L. 1975. Studies on the comparative performance of sorghum and sudan types under varying cutting managements. *Haryana agric University. J. Res.* V(1) : 4-10.

Huss, D. L., Barbaroux, E. Aguirre, E. L. 1973. Effect of height and frequency of cutting on forage production in buffel grass (*Cenchrus ciliaris* L.). In XIII Informede Investigation, Division Da Technologico de Monterray. Nuevo Leon Mexico 110-111 (ES).

Maraschin, G. E. 1971. Effect of nitrogen fertilization and cutting frequency on the initial management of *Phalaris tuberosa* L. *Revista da Faculdade de Agronomia Veterinaria da Universade Federal do Rio Grande do Sul*. 10 : 55-6(Pt) Porto Alegra Brazil.

Malik, H. C. 1953. Improved varieties of fodder crops for the Panjab. *Indian Farming* **II**(3) : 10.

Malik, H. C. 1957. Sudan grass for green forage in *kharif*. *Indian Farming* **VI**(10) : 33.

Tomer, P. S. and Moolani, M. K. 1970. Effect of cutting intervals and stubble height on yield and quality of Pusa Giant Napier. Paper presented at First All India Forage Workshop held at *Haryana Agricultural University*, Hissar September, 1970.

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EFFICACY OF SOME INSECTICIDES AS TRUNK AND FOLIAR SPRAY AGAINST MANGO MEALY BUG, *DROSICHA MANGIFERAE* GREEN (MARGARODIDAE : HOMOPTERA) IN HARYANA

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ABSTRACT

The mango mealy bug, *Drosicha mangiferae* Green is a serious pest of mango in Haryana. To achieve its economic and effective control, relative efficacy of eleven modern and commonly available insecticides, viz., carbaryl, chlorfenvinphos, chlorpyriphos, diazinon, fenitrothion, malathion, methyl parathion, monocrotophos, phosalone, quinalphos and trichlorphon was evaluated at different concentrations, both as trunk and foliar sprays, under field conditions for two consecutive years. The effectiveness of the insecticides was determined on basis of percentage mortality of the nymphs 3 days after the application of insecticides on the tree trunks and 2 and 6 days after foliar application and both were compared with that of control.

From the experimental results, it is concluded that all the treatments proved superior to control against both the first and second instar nymphs. However, below the bands on tree trunks, quinalphos, diazinon and methyl parathion at two concentrations i.e., 0.15, 0.1 and 0.075, 0.05 and 0.05 per cent, respectively, proved highly and equally effective in controlling the congregating first instar nymphs. Keeping in view the hatching of eggs over an extended period and sturdy nature of the newly hatched nymphs and their severity of damage, it may be advantageous and worthwhile to recommend higher concentrations of anyone of these insecticides against the ascending first instar nymphs of the mango mealy bugs on tree trunks to ensure high mortality and consequent safety of the trees. Similarly, the results of foliar sprays reveal that quinalphos, diazinon and methyl parathion at 0.075, 0.05 and 0.05% concentration excelled all other treatments and secured 97.04, 93.50 and 93.08% mortality of the clustering second instar nymphs, respectively.

The mango mealy bug, *Drosicha mangiferae* Green is a major insect pest of mango in Haryana. It is polyphagous. In addition to mango it also causes immense damage to fig, citrus, *ber (Zizyphus mauritiana,* pipal *(Ficus religiosa)* and guava trees, especially in the neglected orchards. The hardy chestnut brown nymphs of both sexes and the oval, soft plump-bodied females

suck vital plant juice from the tender parts and lower the plant vigour and vitality. They also secrete copious honey dew on which black fungus grows. This blocks normal photosynthetic activity of the plant and reduces the yield considerably.

The sturdy mango mealy bugs are rather difficult to control. Cultural practices primarily directed towards destruction of egg masses are not very effective. Tree banding, though effective, is cumbersome and some bands need repeated application. Moreover, all trees irrespective of the fact whether insects appear on them or not, are required to be banded prior to hatching. Considering that nymphs remain on the trees for a long time, there seems to be ample scope to control this pest by use of insecticides.

A number of workers have recommended the use of dusts of DDT and BHC (Sen, 1955 and Atwal, 1963), parathion (Sen and Prasad, 1956), chlordane and toxaphene (Sen, 1955) for the control of mango mealy bug. Application of synthetic organic insecticides, like parathion (Sen and Prasad, 1956), BHC (Trehan, 1957), diazinon (Singh, 1957), malathion (Bindra, 1967), endrin (Atwal, 1963) and dieldrin (Bhatia and Gauba, 1964) in form of spray, have been recommended in different strengths both for killing the pest below the tree bands and on the shoots, with varying degrees of success. Pradhan *et al* (1956) reported superiority of organo-phosphorous insecticides over chlorinated hydrocarbons against the nymphs of this pest under laboratory conditions. Recently, spraying of systemic insecticides, namely, monocrotophos and phosphamidon (Srivastava *et al*, 1973), formothion and Zectran (Atwal *et al.*, 1969) and dimethoate and thiometon (Prasad and Singh, 1976) have been favoured for effective control of the mango mealy bug.

Since a large number of insecticides have been suggested for control of mango bug from different regions and in different concentrations, it was considered worthwhile to evaluate some promising and newer insecticides for the effective control of this pest under the agroclimatic conditions of Hissar.

MATERIAL AND METHODS

Two field experiments were conducted to compare the efficacy of 11 different insecticides. In the first experiment, the insecticides were applied against first instar nymphs on tree trunks below the bands, and in the second against second instar nymphs on shoots. A randomized block design was used. Each treatment had four replications, one tree forming one replication. The experiments were conducted for two consecutive years in a neglected private orchard in Hissar. The insecticides were diluted with water to make the desired strength and were sprayed with a mannually operated rocking sprayer, upto run-off stage, in the morning hours of the day. On control trees, only water was sprayed.

For the first set, all 50 mango trees, about 100 year old, grown on the periphery of a guava orchard, were carefully wrapped with 25-30 cm wide slippery bands of alkathene sheet (400 guaze), about 1 m above the ground in mid-December, before hatching of nymphs. This facilitated a huge population of nymphs to congregate below the band

In the beginning of February, two concentrations of each insecticides required to be tested were sprayed on tree trunks. About 1L spray material per trunk was used. Two hours after spraying when the insecticidal film had dried, around 200-300 and 300-400 nymphs during 1977 and 1978, respectively, from each trunk from all sides and different heights, were collected randomly, and were kept in battery jars covered with muslin cloth. Untreated fresh mango leaves and twigs of thickness of a lead pencil were provided as food. Mortality counts were recorded after 72 hours of spraying. Moribund nymphs were considered as dead. The battery jars were kept in the orchard under natural conditions.

The experiments on foliar spraying of insecticides were conducted on 12 year old guava trees which were kept free from tree bands. Fifty heavily infested trees of equal spread and vigour were chosen for experimentation. From each tree, 5 terminal twigs, each about a metre long, and having thick clusters of nymphs were selected and tagged. Sticky bands of coal tar+grease (2:1 ratio) were applied at their base so as to check the movement of the nymphs. Care was also taken that the twigs did not touch other branches. About 5L spray material per tree was used. Pre-treatment and post-treatment counts of nymphs on each twig were recorded 1 day before and, 2 and 6 days after spraying. Mortality data obtained were transformed into angular transformations and subjected to analysis and were pooled together for the two years.

RESULTS AND DISCUSSION

Insecticide application on tree trunk

The data on trunk sprays (Table 1) reveal that the insecticides at both concentrations, proved significantly better than control after 72 hours of treatment, and were very effective in killing the first instar nymphs of the mango mealy bug. Even the lower concentrations proved quite effective.

Among the higher doses, quinalphos (0.15%), diazinon (0.1%) and methyl parathion (0.1%) were the most effective insecticides killing more than 99% first instar nymphs, and were significantly superior to malathion, carbaryl, trichlorphon, phosalone, chlorfenvinphos and monocrotophos. Fenitrothion was statistically at par with the most effective group, on one hand, and with chlorpyriphos, monocrotophos and chlorfenvinphos on the other. All the insecticides brought about more than 95.54% mortality of the pest after 72 hrs of spray.

The results obtained with the lower concentrations of the insecticides (Table 1) indicated that diazinon (0.05%) and quinalphos (0.075%) proved the most effective and were the only treatments to register more than 91% mortality of the pest. Methyl parathion (0.05%), malathion and carbaryl (each 0.15%) though at par with the most effective group, stood next in order of merit, and killed more than 90% of the first instar nymphs. All these insecticides proved significantly more effective than chlorpyriphos, monocrotophos, fenitrothion and phosalone. Chlorfenvinphos and trichlorohon remained statistically at par with the most effective group on one hand and with chlorpyriphos, monocrotophos and fenitrothion on the other and were superior only to phosalone. The least effective treatment was phosalone which registered only 78.24% mortality of the nymphs.

TABLE 1

Efficacy of some newer insecticides as trunk applicants against 1st instar nymphs of the mango mealy bug

Insecticides		1977			1978		
		Concentration	Mean nymphal population observed	Mean %age mortality of nymphs 3 days after spraying	Concentration	Mean nymphal population observed	Mean %age mortality of nymphs 3 days after spraying
1. Chlorfenvinphos	Birlane-24	0.1	202.2(14.18)*	97.81(81 94)**	0.05	379.0(19.46)*	87.39(69.32)**
2. Diazinon	Diazinon-20	0.1	217.5(14.72)	99.48(87.07)	0.05	327 7(18.02)	91.35(72.99)
3. Methyl parathion	Metacid-50	0.1	211.2(14.43)	99.43(87.06)	0.05	359.7(18.82)	90.31(72.30)
4. Chlorpyriphos	Dursban-200	0.1	191.5(13.79)	98.44(82.97)	0.05	423.3(20.54)	85.47(67.82)
5. Monocrotophos	Nuvacron-40	0.1	315.5(17.75)	98.13(82.34)	0.05	311.7(17.58)	82.76(65 52)
6. Fenitrothion	Folithion-50	0.1	191.5(13.78)	99.14(86.28)	0.05	368.0(19.21)	85.09(67.29)
7. Phosalone	Zolone-35	0.15	214.0(14.51)	96.04(76.67)	0.075	431.3(21.16)	78.24(62.23)
8. Trichlorphon	Diptrex-50	0.3	194.0(13.90)	95.54(77.94)	0.15	346.7(18.60)	89.08(70.75)
9. Quinalphos	Ekalux-25	0.15	249.2(15.70)	99.63(87.55)	0.075	423.0(20 59)	91.31(72.94)
10. Carbaryl	Sevin-50 WP	0.3	274.0(16.49)	97.46(80.97)	0.15	447.0(20.34)	90.40(72.04)
11. Malathion	Cythion-50	0.3	212.0(14.48)	95.91(78.33)	0.15	407.0(20.19)	90.55(72.12)
12. Control	Water spray	—	231.0(15.11)	10.78(18.96)	–	380.0(19.52)	15.12(22.88)
Analysis of variance 'F' test							
C. D. at 5% level			N. S.	Sig. (4.46)		N. S.	Sig. (4.20)

*Figures in parenthesis are $\sqrt{n+1}$

**Figures in parenthesis are angular transformations

Considering longer duration of hatching, from beginning of December to mid-February (Lakra *et al*, 1978) and to ensure high mortality, it will be safe to recommend higher concentration of the insecticides on tree trunk, where there is no fear of phytotoxicity. On the other hand, the lower doses of some insecticides which gave a good kill of the pest could also be used. It is recommended that quinalphos, diazinon or methyl parathion either at 0.15, 0.1, and 0.1% or 0.075, 0.05 and 0.05%, respectively, may be used for controlling the first instar nymphs of mango mealy bug below the tree bands. It is interesting to mention that all insecticides, except trichlorphon and malathion, caused a slightly higher mortality of second instar nymphs in comparison to the first instar, at the same concentration when sprayed on the tree trunks and foliage (Table 1 and 2). This might be possibly because of differences in observational interval and initial pest population.

The present findings indicating that diazinon and methyl parathion are very effective in controlling the mango mealy bug on the trunks, are in conformity with the laboratory and field studies made earlier by Sen and Prasad (1956), Pradhan *et al.* (1956), Singh (1957), Atwal (1963), Bhatia and Gauba (1964) Atwal *et al.* (1969) and Prasad and Singh (1976). Quinalphos which has not been evaluated against this pest earlier also gave good results and is recommended against the nymphs of *D. mangiferae* alongwith the above insecticides.

TABLE 2

Efficacy of some newer insecticides as foliar applicants against 2nd instar nymphs of mango mealy bug (Pooled data for the two years)

Insecticides	Concentration	Mean nymphal population/ twig 24 hrs before spray	Mean percentage mortality of nymphs days after spray	
			2	6
1. Chlorfenvinphos	0.05 per cent	102.1 (10.08)*	81.49(64.74)**	93.17(75.28)**
2. Diazinon	0.05	89.3(9.31)	79.21(65.30)	93.50(77.47)
3. Methyl parathion	0.05	105.7(10.28)	79.85(64.30)	93.08(75.57)
4. Chlorpyriphos	0.05	73.5(8.43)	66.31(55 62)	90.27(72.90)
5. Monocrotophos	0.05	78.8(8.76)	85.12(67.91)	92.66(74.73)
6. Fenitrothion	0.05	94.4(9.57)	82.88(66.47)	91.55(74.51)
7. Phosalone	0.075	122.8(10.97)	78.11(63.23)	90.08(71.94)
8. Trichlorphon	0.15	67.3(8.21)	67.48(56.26)	85 83(68.15)
9. Quinalphos	.075	79.6(8.85)	79.75(64.31)	97.04(80.33)
10. Carbaryl	0.15	109.8(10.39)	72.99(61.24)	92.76(76.06)
11. Malathion	0.15	75.6(8.63)	62.74(52.88)	87.45(70.88)
12. Control	Water spray	96.2(9.71)	10.52(18.27)	8.69(14.68)
Analysis of variance 'F' test				
C. D. at 5% level		N. S.	Sig. (5.14)	Sig. (5.54)

*Figures in parenthesis are $\sqrt{n+1}$

**Figures in parenthesis are angular transformations

Insecticide application on foliage

The results with respect to foliar sprays against second instar nymphs are presented in Table 2. It is evident from the data that on 1/2 to 1 m long observational twigs, an average of 67.3 to 122.8 nymphs were recorded abhering in clusters and that their population was homogeneously distributed. All the insecticides proved significantly superior to control and showed a progressive increase in pest mortality on subsequent intervals, and were fairly effective in controlling the nymphal population.

The mortality data revealed that most of the treatments failed to giva a satisfactory control of the pest 48 hr after spray and only monocrotophos, fenitrothion and chlorfenvinphos registered more than 80% reduction of the pest. Malathion being the least effective treatment caused only 62.74% mortality of the nymphs. However, all the insecticides improved upon their efficacy on sixth day of application when more than 85% reduction in the nymphal population was obtained. Quinalphos proved to be the most effective and reduced a maximum of 97.04% nymphal population and was significantly better than the least effective group of trichlorphon, Malathion, phosalone, chlorpyriphos, fenitrothion and monocrotophos. Diazinon, chlorfenvinphos, methyl parathion and carbaryl constituted the next effective group and gave around 93% reduction in the nymphal population and were statistically at per with quinalphos. Chlorfenvinphos and carbaryl, which shared the most effective group, could not be recommended because the former was not available and latter had short residual action. Accordingly, use of either 0.075% quinalphos or 0.05% diazinon or 0.05% methyl parathion emulsions are recommended for controlling the congregating second instar nymphs of *D. mangiferae* on foliage of the fruit trees. Sen and Prasad (1956), Pruthi and Batra (1960), Atwal (1963), Saxena and Rawat (1968) and Atwal *et al.* (1969) found methyl parathion to be effective, whereas Singh (1957), Birat (1963), Bhatia and Gauba (1964) and Prasad and Singh (1976) reported diazinon to be effective against nymphs of the mango mealy bug. In agreement with the findings of above workers, the current studies establish the superiority of methyl parathion and diazinon over other insecticides, except quinalphos, which has been found most effective in these studies and not yet been recommended by earlier workers, can be considered as a potent insecticide for control of the mango mealy bug nymphs.

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REFERENCES

Atwal, A. S. 1963. Insect pests of mango and their control. *Punjab Hortic. J.* 3 (2-4) : 235-58.

Atwal, A. S , Bhatti, D. S. and Sandhu, G. S. 1969. Some observations on the ecology and control of mango mealy bug, *Drosicha mangiferae* Green (Hemiptera : Coccidae). *J. Res. Punjab Agric. Univ.* 6 : 107-14.

Bhatia, L. J. and Gauba, H. R. 1964. Efficacy of different insecticides for the control of *Drosicha mangiferae*. *Pl. Prot. Bull.* 16 (1-6) : 13-15.

Bindra, O. S. 1967. Fighting pests of commercial fruits. *Indian Hortic.* 11 (4) : 71-79.

Birat, R. B. S. 1963. Comparative efficacy of organophosphorus insecticides for the control of *Drosicha mangiferae* Green (Homoptera : Coccidae). *Indian J. Entomol.* 25 (4) : 377-79.

Lakra, R. K., Kharub, W. S. and Zile Singh. 1978. Comparative efficacy of some banding materials against mango mealy bug, *Drosicha mangiferae* Green, (Margarodidae : Homoptera) in Haryana. *Ann. Rep. Dep. Ent., Haryana agric. Univ., Hissar.* 1977-78.

Pradhan, S., Jotwani, M. G. and Rai, B. K. 1956. Bioassay of insecticides to *Drosicha mangiferae* Green (Coccidae : Hemiptera). *Indian J. Entomol.* 18 : 315-17.

Prasad, V. G. and Singh, R. K. 1976. Prevalence and control of mango mealy bug, *Drosicha stebbingi* (Green) in Bihar. *Indian J. Entomol.* 38 (3) : 214-24.

Pruthi, H. S. and Batra, H. N. 1960. Important fruit pest of North-West India. *I. C. A. R. Bull* No. 80 : 61-64.

Saxena, D. K. and Rawat, R. R. 1968. Chemical control of *Drosicha mangiferae* Green, a serious pest of citrus spp. in M. P. *Indian J. Entomol.* 30 (1) : 66-68.

Sen, A. C. 1955. Control of mealy bug pest in Bihar. *Indian J. Entomol.* 17 (1) : 129-32.

Sen, A. C. and Prasad, D. 1956. Biology and control of the mango mealy bug *(Drosicha mangiferae). Indian J. Entomol.* 18 (2) : 127-40.

Singh, S. M. 1957. Control of mango mealy bug *(Drosicha mangiferae).* Green *Hortic. Adv.* 1 : 38-47.

Srivastava, A. S., Singh, Y. P., Pandey, P. C. and Awasthi, B. K. 1973. Bionomics and control of the mango mealy bug. *World Crop,* 25 (2) : 87-88.

Trehan, K. N. 1957. Crop pests and their control in the Punjab. *J. Bombay Nat. Hist. Soc.* 54 (3) : 619.

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PATTERN OF FRUIT DROP IN BER (*ZIZYPHUS MAURITIANA* LAMK) UNDER ARID CONDITION OF HARYANA

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ABSTRACT

Pattern of fruit drop in three cultivars, viz., Kakrol Gola, Umran and Kaithli was studied under arid conditions of Haryana. The entire period of fruit drop observed only one wave with maximum intensity during initial period of fruit development. Kakrol Gola differed significantly than the two cultivars which recorded maximum drop as high as 80.65 per cent. Kaithli and Umran did not differ significantly and recorded 7.21% and 12.13% drop, respectively. More than 50% loss was recorded in Grade 1 alone. Gradual decrease in intensity of fruit drop was observed as the fruit size enlarged with no significant difference in three later grades. Cultivars like Kaithli and Umran showed promise under arid conditions of Haryana.

Ber is most promising fruit of arid and semi-arid zones. It has wide adaptibility with limited cultural requirements. That is why it is becoming popular in Arid Zones of Haryana. Heavy fruit drop was noticed in some of the cultivars under arid conditions. Shrivelled fruits were dropped due to abortive embryos in early stages of fruit development. Fruit drop pattern in two waves with maximum intensity during the first three weeks of fruit development in plum was recorded by Mishra and Sud (1977) under sub temperate conditions and by Panwar and Kaul (1973) under Tarai conditions. Teaotia and Chauhan (1964) observed highest initial fruit drop in Banarasi Pewandi and lowest in Banarsi Karaka. Similar varietal behaviour of fruit drop in sub tropical peach was observed by Panwar and Kaul (1973) and in mandarin by Singh and Randhawa (1961).

MATERIAL AND METHODS

Investigation on pattern of fruit drop in ber cultivars, viz., Kakrol Gola, Kaithli and Umran was done at Dry Farming Research Centre, Haryana Agricultural University, Bawal. There were four replications and three trees in each replication were tagged soon after the fruit set. In all, twelve trees of each cultivar with uniform growth and fruiting were used for the study.

All the fruits which dropped from the tagged trees were collected right from the beginning of fruit development at 15 days interval. The dropped fruits were sorted out and graded into following categories of the size taken as diameter of the fruit, Grade 1 (0.5 to 1.0 cm), Grade 2(1.0 to 1.5 cm), Grade 3(1.5 to 2.0 cm) and Grade 4(2.0 to 2.5 cm). The

actual number of fruits in each grade was counted to work out the per cent fruit drop.

RESULTS AND DISCUSSION

The entire period of fruit drop observed only one wave. As the season of fruit development advanced, the intensity of fruit drop was reduced and ultimately ceased after 45 days (Table 1). Of the three cultivars, Kakrol Gola recorded maximum drop (80.65%) which differed significantly from the other two cultivars. The drop in Kaithli was only 7.21% and figure for Umran was very near to Kaithli (12.13%). The two cultivars did not differ significantly.

Of the three cultivars, maximum drop was observed in Grade 1 (0.5 to 1.0 cm). The intensity of fruit drop was very high in this grade alone which recorded 54.55% drop and was significantly higher than other grades. The intensity was gradually decreased as the season advanced and size of the fruit increased. It was 21.86% in Grade 2, 15.12% in Grade 3 and only 8.45% in Grade 4 with no significant difference. However, a significant difference was observed between 2 and 4 grades.

The interaction between grades and cultivars was observed with no significant difference between Kaithli and Umran cultivars, while Kakrol Gola differed significantly (Table 2).

C. D. at 5% level 2.07 (Cultivar)

C. D. at 5% level 2 39 (Grade)

C. D. at 5% level 4.45 (Cultivar × Grade)

TABLE 1

Per cent fruit drop in ber cultivars

Cultivar	Number of fruits dropped					
	Grade 1	Grade 2	Grade 3	Grade 4	Total drop in each cultivar	Per cent total drop
Kakrol Gola	120.3	42.0	28.8	16.9	208.0	80.65
Umran	14.3	8.4	5.0	3.6	31.3	12.13
Kaithli	6.1	6.0	5.2	1.3	18.6	7.21
Total drop in each grade	140.7	56.4	39.0	21.8	257.9	—
Per cent total drop	54.55	21.86	15.12	8.45	—	—

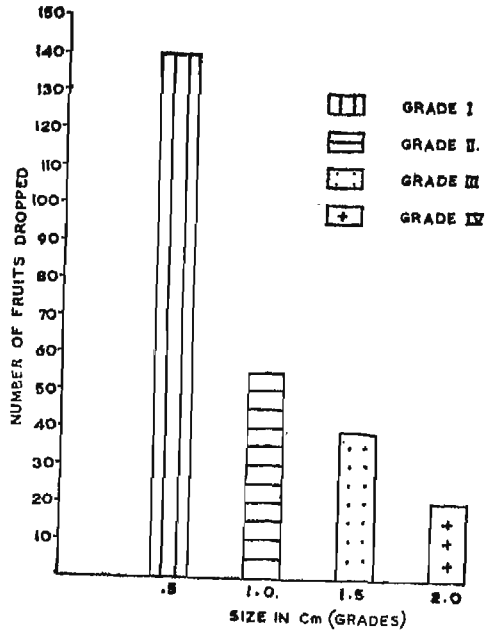
TABLE 2

Average fruit drop in ber cultivars

Cultivar	Grade 1	Grade 2	Grade 3	Grade 4	Average fruit drop
Kakrol Gola	40.08	14.05	9.60	5.63	17.34
Umran	4.93	2.93	1.85	1.28	2.74
Kaithli	2.05	2.00	1.80	0.45	1.58
Total	15.68	6.33	4.42	2.45	

Fruit drop pattern in ber differed from other fruits. There was only one wave of fruit drop which started soon after fruit set. However, no preharvest drop was observed as a second wave like in plum under sub temperate conditions as reported by Mishra and Sud (1977) and by Panwar and Kaul (1973) in Subtropical peach under Tarai conditions. This might be due to the severe initial competition for nutrients and no further moisture fluctuation due to unirrigated conditions. (Bar diagram).

FRUIT DROP IN DIFFERENT GRADES



Maximum initial fruit drop in three cultivars followed by gradual decrease is in conformity of the findings of Mishra and Sud (1977), Singh and Randhawa (1961) and Singh and Singh (1976). A very heavy drop in Kakrol Gola was due to the early fruit set and unfavourable temperature for fruit development. Further, varietal differences in the severity of fruit drop confirms the study of Panwar and Kaul (1973) and Teaotia and Chauhan (1964). Here it can be concluded that early Gola types of ber may be avoided under arid conditions and a cultivar like Kaithli be recommended.

REFERENCES

Mishra, K. A. and Sud, G. 1977. Studies on fruit development and drop in plum cultivars grown under sub-temperate conditions of H. P.; *Haryana J. Hortic. Sci.* (3-4) : 109.

Panwar, J. S. and Kaul, G. L. 1973. Studies on fruit development and drop of Peach *(Prunus persica* Batsch) cultivars under Tarai conditions of U. P.; *Haryana J. Hortic. Sci.* 2(1&2) : 38

Singh, J. P. and Randhawa, S. S. 1961. Effect of plant regulators on fruit drop size and quality in Mandarin *(citrus reticulata* Blanco) var. Nagpuri and Lahore Local; *Indian J. Hortic.* 17 : 156.

Singh, U. R. and Singh, N. 1976. Effect of plant regulators on fruit drop, size and quality of ber *(Zizyphus mauritiana* Lamk.) var. Banarsi; *Haryana J. Hortic. Sci.* 5(1&2) : 1.

Teaotia, S.S. and Chauhan, R.S. 1964. Flowering, pollination, fruit set and fruit drop studies in ber *(Zizyphus mauritiana* Lamk.) *Indian J. Hortic.* 21 (i) : 40.

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STUDIES ON CHROMOSOME NUMBER AND IN VITRO POLLEN VIABILITY AND GERMINATION IN BER (*ZIZYPHUS MAURITIANA* LAMK)

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ABSTRACT

The chromosome number in *Z. mauritiana* was observed as 2n = 48. Out of the four stains used, viz., acetocarmine, propionocarmine, haematoxylin and methyl green the first one proved a comparatively better stain for pollen size and pollen viability studies. The pollen viability was very high in all the varieties as it ranged from 86.30% in Gola to 99.23% in Kaithli.

Various concentrations of sucrose and boric acid alone did not help much in enhancing pollen tube growth. However, all varieties except Seo gave maximum response to 0.5% boric acid in 20% sucrose. In case of Seo, 0.5% boric acid in 10% sucrose was most suitable. It is concluded that boric acid in combination with sucrose helps in enhancing pollen tube growth and consequently, the fruit/seed set.

The Ber *(Zizyphus mauritiana* Lamk) is an important sub-tropical fruit crop of India. In this species, however, fruit/seed setting is a serious problem in intervarietal crosses. Consequently, it is a major hurdle in evolving improved varieties through hybridization. Ackerman (1961) has emphasised the importance of cross pollination in proper development of seed and fruit in chinese jujube. Keeping in view the above facts, work was undertaken to determine the number of chromosomes, pollen size and pollen viability in different varieties of *Zizyphus mauritiana*. A study was also made on the rate of growth of pollen tube *in vitro* using different media for selecting a suitable medium which could be used for enhancing the growth of pollen tube in various crosses.

MATERIAL AND METHODS

Four commercially cultivated varieties of *Z. mauritiana, viz.*, Umran, Kaithli, Seo and Gola were studied for different cytological aspects like chromosome number, pollen tube growth, pollen size and pollen viability. Fresh unopened buds were collected in Carnoy's fluid I (3 parts Alcohol : 1 part Acetic acid) between 2 P. M. to 3 P. M. for various studies except for pollen tube growth where fresh pollen was used. Staining for chromosome counts was done in 1% acetocarmine For pollen viability studies, 1% acetocarmine, 1% propionocarmine, Delafield's haematoxylin and 1% methyl green (pH 7.4) were used. The stainability of pollen grains was taken as an index of viability. The pollen size was

measured with the help of micrometers and expressed in microns.

Pollen tube growth study was done *in vitro* in different media by taking different concentrations of sucrose (10, 20 and 30%) and boric acid (0.25, 0.5 and 1%) separately or a combination of both by adding boric acid to sucrose solution (W/V). Distilled water was used as control.

RESULTS AND DISCUSSION

Chromosome Number

Meiosis in *Z. mauritiana* was studied to determined the exact chromosome number and chromosomal abnormalities, if any. The chronosome number in *Z. mauritiana* was found as 2n = 48. At Metaphase I, 24 II with no chromosomal abnormality were observed in all the four varieties (Fig. 1). Dodds (1958) has reported 2n = 48, 72 and 96 in case of *Z. jujuba*, whereas Darlington and Ammal (1942) reported 2n = 24 in the same species. It is hypothesised that n = 12 can be considered as basic number of the species *Z. mauritiana* from which *Z. jujuba* might have originated by polyploidy.

Pollen size

The data in Table 1 reveal that pollen size of all varieties was more or less the same in different stains. The average pollen diameter ranged from 16.1 to 22.9 μ. All varieties behaved in more or less in a similar fashion in respect of pollen size except Kaithli in which the pollen size was found to be considerably less in methyl green, propionocarmine and haematoxylin. The large size in case of acetocarmine staining might be due to the hydrolysing property of acetic acid. Most of the pollen grains were found but some showed an elliptical shape thus giving different length and breadth. However acetocarmine proved as a very efficient stain for such type of studies. Staining by methyl green, haemotoxylin and propionocarmine gave an elliptical shape to some of the pollen grains. Such effect have also been reported by Teotia and Chauhan (1963) in *Z. mauritiana*. In their studies both acetocarmine and methyl green glycerine produced a triangular shape in the pollen grains. In the present study, however, acetocarmine did not effect the pollen shape. Thus, acetocarmine is recommended for such



Fig. 1. Showing chromosome number 24 bivalents, i.e., 2n = 48

studies in ber over other stains which do not give satisfactory results.

Pollen viability

The data on pollen viability in Table 2 reveal that 1% each of acetocarmine, mythyl green and haemotoxylin stains proved equally efficient, whereas propionocarmine gave very poor staining and thus, did not prove good for such studies. Various stains behaved differently in respect of different varieties, e. g., methyl green gave a low viability in case of Seo (93.73%) and Gola (86.30%) as compared with that given by acetocarmine (96.15 and 89 56%, respectively). The pollen viability in different varieties ranged from 89.56% in Gola to 96.20% in Kaithli when stained with acetocarmine. However, maximum pollen viability was observed in Kaithli (99.23%) when stained with Haemotoxylin. Thus, none of the varieties had poor pollen viability. A high pollen viability has also been reported in this species by Teotia and Chauhan (1963) and Singh *et al.* (1970) in some other varieties.

Pollen tube growth

The data on pollen tube growth of different varieties are given in Table 3. In individual treatments of sucrose and boric acid, pollen tube growth appeared to be better in the latter. Maximum pollen tube growth of 58 μ after 24 hours was recorded in the variety Gola in 30% sucrose, whereas 0.5% boric acid gave 119 μ length at the same time interval in variety Seo. It was interesting to note that higher concentration of boric acid (1%) decreased the pollen tube growth considerably in all cultivars except Gola where it was marginal. Hence, it can be concluded that boric acid helps pollen tube growth but only at lower concentrations. Thus, in the case of boric acid alone, 0.5% concentration was found to be the most appropriate.

A perusal of Table 3 reveals that the combinations of various concentrations of sucrose and boric acid responded more favourably than either sucrose or boric acid alone. Three varieties, i. e., Umran. Kaithli and Gola responded maximum to the combination doses of 0.5% boric acid in 20% sucrose. In Umran, both 10% and 30% sucrose with the three concentrations of boric acid each, did not prove effective. In general, all concentrations of boric acid enhanced the pollen tube growth in 20% sucrose in this variety. When a lower concentration of boric acid (0.25%) in 20% sucrose was used, the growth rate of pollen tube was slow in the beginning (34 μ after 6 hours), which increased suddenly after 18 hours to 92 μ but later on the growth was very slow (96 μ after 24 hours). On the other hand, when higher concentration of boric acid (1%) was used, it gave higher rate of pollen tube growth in the beginning (51 μ) but at later stages it was as good as 0.5% boric acid in 20% sucrose. More or less similar trend was recorded in variety Kaithli and Gola. The possible explanation of this phenomenon could be that the boric acid at lower concentrations might help pollen tube growth by helping in better utilization of metabolites at the proper time while the higher concentration might give an initial boost to pollen tube growth but later caused imbalance was available micronutrients, thus, slowing down pollen tube growth.

In contrast to Umran, Kaithli and Gola, variety Seo responded maximum to the combination of 0.5% boric acid in 10% sucrose giving highest pollen tube

TABLE 1

Size (Length × Breadth) of the pollen grain as measured in different stains (μ)

Stains	Varieties			
	Umran	Kaithli	Seo	Gola
Acetocarmnie	20×20	20×20	22.9×21.4	20×20
Methyl green	20×18.3	17.1×17.8	20×20	20×20
Haematoxylin	20×18.8	19.3×17.8	20×20	20×19.6
Propionocarmine	20×20	18.6×16.1	20×20	20×20

TABLE 2

Percent pollen viability of different Ber varieties in different stains

Stains	Varieties			
	Umran	Kaithli	Seo	Gola
Acetocarmine	94.36	96.20	96.15	89.56
Methyl green	94.41	97.32	93.73	86.30
Haematoxylin	94.27	99.23	95.26	94.84
Propionocarmine	1*	*	*	*

*Studied but data not recorded due to poor staining.

TABLE 3

Pollen tube growth of different cultivars of Ber in various media at 6, 18 and 24 hours interval (μ)

Treatment	Varieties											
	Umran			Kaithli			Seo			Gola		
	hrs			hrs			hrs			hrs		
	6	18	24	6	18	24	6	18	24	6	18	24
Sucrose												
10%	0	20	25	0	18	18	0	24	24	0	18	22
20%	10	10	16	8	11	18	0	17	18	0	27	34
30%	10	11	12	8	24	28	0	17	27	8	31	58
Boric Acid												
.25%	10	22	35	12	47	47	21	47	48	16	49	49
.50%	18	37	38	14	38	38	42	107	119	27	61	63
1.00%	19	23	23	18	37	37	37	39	39	35	60	60
Sucrose+Boric Acid												
10%+25%	20	23	37	22	58	112	47	117	148	27	48	103
10%+.5%	24	38	38	27	72	117	62	142	167	43	107	135
10%+1%	26	39	39	26	42	71	62	133	147	41	87	105
20%+ 25%	34	92	96	41	92	148	31	103	103	48	102	167
20%+.5%	47	107	107	52	142	148	42	57	58	48	142	189
20%+1%	51	106	106	57	139	141	58	66	69	53	107	107
30%+25%	24	48	48	42	91	103	72	102	102	52	117	117
30%+.5%	27	39	39	41	102	104	36	46	48	41	83	83
30%+1%	32	48	48	47	91	91	48	48	48	27	81	81
Control	0	14	14	0	7	11	0	18	19	0	17	18

growth of 167 μ in 24 hours. In this variety, the combination of 0.25% boric acid in 30% sucrose gave highest pollen tube growth in early stages (72 μ in 6 hours) but at later stages the growth rate decreased reaching a maximum 102 μ in 18 hours. Prasad and Mehrotra (1963) have reported that 30% sucrose alone or 25% sucrose with 10 ppm GA improves pollen germination to a considerable extent. Teotia and Chauhan (1963) reported 15% sucrose as suitable medium for pollen germination in some varieties of the same species while Singh *et al.* (1970) found 35% sucrose as most suitable. But in the present studies, neither sucrose nor boric acid alone were effective. However, their combinations enhanced pollen tube growth considerably. Sinha and Singh (1967) also reported improved pollen germination when boric acid was added to sucrose solution. It may be suggested from the present studies that boric acid in combination with sucrose helps in increasing the pollen tube growth and consequently improves the fruit/seed set. The varieties of the same species may respond differently with different combination doses as all varieties except Seo gave maximum response to 0.5% boric acid in 20% sucrose. In case of Seo, 0.5% boric acid in 10% sucrose was most suitable for pollen tube growth.

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REFERENCES

Ackerman, W. L. 1961. Flowering, pollination, self sterility and seed development in chinese jujube. *Proc. Am. Soc. Hortic. Sci.* **77** : 265–269.

Darlington, C.D. and Ammal, E.K. Janaki. 1942. *Chromosome Atlas of Cultivated plants.* George Allen and Unwin London.

Doods, K. S. 1958. Incompatibility systems in relation to fruit breeding. *Indian J. Hortic.* **15** : 248-255.

Prasad, A. and Mehrotra, N. K. 1963. Effect of Gibberellic acid and sucrose on germination and pollen tube growth in Indian Jujube. *(Z. mauritiana). Sci. and Cult.* **29** : 245-46.

Singh, Darbara, Bakshi, J. C. and Singh, Kirti. 1970. Flowering and fruiting behaviour of Ber, variety Banarsi Karaka. *(Z. mauritiana* Lamk.) *Punjab Hortic. J.* 10 : 21–28.

Sinha, M. M. and Singh, S. N, 1967. Testing viability of pollen grains of ber *(Z. mauritiana* Lamk) in artificial media with the aid of growth, substances. *Madras Agric. J.* 54 : 258–260.

Teotia, S. S. and Chauhan, R. S. 1963. Flowering, pollination, fruit set and fruit drop studies in Ber. *(Z. mauritiana* Lamk). *Indian J. Hortic.* **21** : 40–45.

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EFFECT OF DIFFERENT WINE YEAST STRAINS ON QUALITY OF WHITE TABLE WINE FROM PERLETTE GRAPES

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ABSTRACT

Thirteen wine yeast strains were tested for selecting a yeast which could produce a good quality white table wine from perlette grapes. These strains were found to differ in their ability to produce ethanol, aldehydes and volatile acids. Some of the yeast strains left high amount of residual sugars in the finished wines. However, yeast strain 10, obtained from France was found to give better quality fruity wine from perlette grapes among all the strains tested.

The yeast strains used for the fermentation of grape juice plays an important role in determining the character and quality of table wines (Amerine *et al.*, 1972). They have been found to differ in their ability to produce ethanol, volatile acids, glycerol and aldehydes from the same grape variety (Rankine, 1955, 1968). Wine yeast also differs remarkably in their ability to produce hydrogen sulphide which is most undesirable metabolite of alcoholic fermentations (Rankine, 1963; Eschenbruch, 1974). The subtle differences in these components result in the wines of different flavour and bouquet. Apart from this, a yeast strain suitable for one grape variety may altogether be unsuitable for the fermentation of another grape cultivar. Therefore, attempts were made to select a suitable yeast strain for the production of white table wine from perlette grapes, a major variety grown in Haryana.

MATERIAL AND METHODS

Perlette grapes (50 Kg) were procured from the Experimental Vineyard of the Department of Horticulture, Haryana Agricultural University, Hissar. The source and other details of the yeast strains used in this study are given in Table 1. The chemicals used were of BDH/Merck.

The grapes were destemmed and crushed gently with hand immediately after harvesting. The juice was extracted by soft pressing of the must through cheese cloth. It was then treated with 100 ppm of SO_2 (as potassium metabisulphite). The juice was ameliorated with cane sugar to raise the initial Balling reading from 16.0 to 24.0 °Brix and total acidity with tartaric acid from 0.60 to 0.75 per cent. The suspended fine particles were removed from the juice by cold settling for 12 hours at 6°C and clear

TABLE 1

Yeast strains used for the preparation of white table wines from perlette grapes

Strain No.	Species of yeast		Source
1.	*Saccharomyces cerevisiae*	*Rein Hefe*	Wadenswil Switzerland
2.	*S. cerevisiae*	522	Department of
3.	*S. cerevisiae*	523	Enology &
4.	*S. beticus*	519	Viticulture California University, USA
5.	*S. cerevisiae*	BY	Department of Microbiology, HAU, Hissar
6.	*S. cerevisiae*	H-10-37	Wurzburg,
7.	*S. cerevisiae*	H-10-35	West Germany
8.	*S. cerevisiae*	138	Australian Wine
9.	*S cerevisiae*	729	Research Institute Glen Osmond, Australia.
10.	*S. ellipsoideus*	wine yeast	Institut D'oenologie Universite
11.	*S. ellipsoideus*	wine yeast	Bordeaux Telence
12.	*S. ellipsoideus*	champagne yeast	France
13.	*S. bayanus*	wine yeast	

juice was racked. Two litre of juice was then transferred to Winchester glass bottle of 3 l capacity for fermentation. The inocula of different yeast strains were prepared in pasteurized grape juice and the fermentation of the bulk juice was initiated by the addition of 5 per cent inoculum of the respective yeast strain ($\simeq 3 \times 10^7$ cells/ml). The juice was allowed to ferment to dryness at $18 \pm 2°C$ and fall in degree Brix was recorded after an interval of 24 hours. The SO_2 content of the fresh wines was again raised to 100 ppm and kept for cold stabilization at $5 \pm 1°C$. After racking, the wines were further clarified with 200 ppm of agar-bentonite mixture (2 : 1). The finished wines were stored in amber glass bottles at $18 \pm 2°C$ for six months for ageing.

The fresh and aged wines were analysed for their various chemical characteristics by the procedures described by Amerine (1973). Total aldehydes and ethanol contents were determined by the method suggested by A.O.A.C. (1970) and Caputi *et al.* (1968), respectively. Total phenols were estimated by using Folin-Ciocalteu reagent (Singleton and Rossi, 1965). The aged wines were also evaluated organoleptically according to the method described by Amerine *et al* (1972).

RESULTS AND DISCUSSION

Table 1 lists the yeast strains obtained from five different wine producing countries. The rate of fermentation of juice as measured by fall in degree Brix

was found to be slower in case of strain 5, 8, 11. This was probably due to difference in genetic and physiological make up resulting in slow fermentation (Table 2).

The fresh wines prepared by using these yeast strains were analysed for their chemical constituents (Table 3). The alcohol and aldehydes contents were found to vary widely between 11.8 to 13.2 per cent and 39.6 to 70.4 ppm, respectively, however, the volatile acidity was having narrow range of variation (0.024 to 0.039%). The observed differences in the production of these components by various yeast strains confirm the findings of Rankine (1955, 1968). The wines

TABLE 2

Effect of yeast strains on the rate of fermentation of juice (fall in degree Brix)

Strains	Time (hours)							
	0	24	48	72	96	120	144	168
1.	24.0	21.5	17.0	11.0	4.0	0.0	—	—
2.	24.0	19.0	12.0	7.0	4.0	1.0	0.0	—
3.	24.0	23.5	22.0	17.0	12.5	4.5	0.5	0.0
4.	24.0	19.5	12.0	8.0	4.5	1.5	0.0	—
5.	24.0	23.5	21.5	19.0	13.0	7.0	3.0	0.0
6.	24.0	22.0	16.5	8.0	5.0	2.0	0.0	—
7.	24.0	19.0	10.5	7.0	3.5	0.5	0.0	—
8.	24.0	23.0	19.0	13.5	9.5	5.5	2.5	0.0
9.	24.0	21.0	11.0	6.0	2.5	0.0	—	—
10.	24.0	22.5	18.0	12.0	7.5	2.0	0.0	—
11.	24.0	23.0	22.0	20.0	14.5	7.5	3.5	0.0
12.	24.0	21.0	13.5	8.0	4.0	0.5	0.0	—
13.	24.0	19.0	9.0	4.0	0.0	—	—	—

TABLE 3

Chemical composition of fresh white table wines

Strains	Chemical characteristics					
	Ethanol (%) (V/V)	Total acidity (%)	Volatile acidity (%)	Residual sugars (%)	Aldehydes (ppm)	Total phenols (%)
1.	12.6	0.76	0.026	0.14	50.6	0.021
2.	11.8	0.80	0.032	0.05	48.4	0.020
3.	12.3	0.82	0.032	0.09	50.6	0.020
4.	11.8	0.78	0.024	0.15	52.8	0.020
5.	11.8	0.79	0.033	0.53	55.0	0.020
6.	12.3	0.83	0.027	0.10	57.2	0.019
7.	12.8	0.78	0.029	0.06	39.6	0.020
8.	12.0	0.80	0.026	0.73	52.8	0.021
9.	13.0	0.78	0.029	0.11	68.2	0.019
10.	13.2	0.74	0.035	0.11	44.0	0.021
11.	12.3	0.77	0.030	0.52	70.4	0.021
12.	12.8	0.77	0.039	0.06	68.2	0.022
13.	12.8	0.75	0.027	0.06	57.2	0.021

TABLE 4

Chemical composition of aged white table wines

Strains	Chemical characteristics						
	Ethanol (%) (V/V)	Total acidity (%)	Volatile acidity (%)	Total aldehydes (ppm)	Total SO_2 (ppm)	Total phenols (%)	Average sensory scores (20)
1.	11.2	0.72	0.021	46.2	31.2	0.021	13.5
2.	10.8	0.72	0.023	45 8	30.2	0.021	14.9
3.	11.0	0.73	0.023	51.8	37.4	0.020	14.5
4.	10.8	0.73	0.036	55.1	43.5	0.020	13.6
5.	10.6	0.74	0.029	52.8	40.9	0.019	13.2
6.	10.8	0.73	0.027	55.6	33.3	0.020	13.8
7.	11.4	0.69	0.027	44.0	31.7	0.020	14.1
8.	11.2	0.75	00.20	55.8	26.9	0.020	13.0
9.	11.2	0.72	0.012	66.4	57.6	0.019	13.8
10.	11.2	0.68	0.026	44.4	35.8	0.019	16.3
11.	10.4	0.74	0.032	62.4	40.2	0.021	13.4
12.	11.0	0.71	0.032	62.4	58.9	0.021	14.6
13.	11.4	0.72	0.022	58.8	40.7	0.022	14.2

prepared by using strains, 5·8 and 11 were found to contain high amount of residual sugars and weer more than the maximum permissible limits of 0 3 per cent for white table wines. All other chemical constituents were within the limits of ISI specifications for white table wines (Annonymous, 1974).

During ageing, there was slight decrease in the total and volatile acidity in the wines because of the precipitation of tartrate and formation of esters, respectively (Table 4). Though, the SO_2 content of the fresh wines was raised to 100 ppm at the time of processing, this was also found to decrease during storage due to volatilization.

All the aged wines were also analysed organoleptically by a panel of five experienced tasters using a 20 point score card. Among the various strains tested for wine preparation strain 10 from France was found to be the best for white table wine from perlette grapes. This wine had a good flowery and fruity bouquet.

REFERENCES

Amerine, M. A. 1973. *Laboratory procedures for Enologists.* Associated Students Stores, Davis, Callifornia, USA.

Amerine, M. A., Berg, H. W. and Cruess, M. V. 1972. *The technology of wine making.* Westport, Connecticut; The AVI Publishing Company. Inc USA.

Annonymous, 1974. *Indian Standard Specification for Table Wines.* IS : 7058-1973.

A.O.A.C. 1970. *Official Methods of Analysis of the Association of Analytical Chemists.* 11th Ed. Washington, D. C., USA.

Caputi, A. Jr., Ueda, M. and Brown, T. 1968. Spectrophotometric determination of the ethanol in wine *Am. J. Enol. Vitic.* 19 : 160-165.

Eschenbruch, R. 1974. Sulphite and Sulphide formation during wine making. *Am. J. Enol. Vitic.* 25 : 157-161.

Rankine, B. C. 1955. *Quantitative differences* in the products of fermentation by different strains of wine yeasts. *Am. J. Enol. Vitic.* 6 : 1-10.

Rankine, B. C. 1963. Nature, origin and prevention of hydrogen sulphide aroma in wine. *J. Sci. Food Agric.* 14 : 79-81.

Rankine, B. C. 1968. The importance of yeasts in determining the composition and quality of wines. *Vitis.* 7 : 22-49.

Singleton, V. L. and Rossi, J. A. Jr. 1965. Colorimetry of total phenols with phosphomolybdic phosphopungstic acid reagents. *Am. J. Enol. Vitic.* 16 : 144-158.

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THERMODYNAMICS OF ZINC ADSORPTION IN SIEROZEM SOILS

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ABSTRACT

Thermodynamic parameters ($\triangle$ F, $\triangle$ H and $\triangle$ S) of zinc adsorption were determined in soils that differed in physical and chemical properties. The adsorption conformed to both Freundlich and Langmuir adsorption equations. Thermodynamic functions were interpreted in relation with adsorption in different soils.

An adsorption isotherm describes the equilibrium relationship between the amounts of adsorbed and dissolved species at a given temperature. The adsorption isotherm also explains the various adsorption phenomena. The adsorption equations developed by Freundlich (1926) and Langmuir (1918) have provided useful models to explain physical adsorption and in some cases these equations have been successfully applied to chemisorption. These equations are easy to apply to adsorption of ions by the soil (Boyd *et al.* 1947) and enable to calculate parameters such as intensity and capacity factors.

Jurinak and Bauer (1956) and Warncke and Barber (1973) have studied zinc adsorption isotherms. The investigations of Udo *et al.* (1970), and Bingham *er al.* (1964) had revealed that the adsorption of Zn was influenced by clay content, organic carbon and cation exchange capacity.

The present investigation was undertaken to determine the thermodynamic parameters; to check the validity of the different isotherms and to determine the Zn adsorption maxima on sierozem soils differing in physical and chemical properties.

MATERIAL AND METHODS

Three representative sierozem soils, varying in physico-chemical properties (Table 1) were air-dried and ground to pass through 1 mm mesh sieve. The various characteristics were determined by conventional methods. To study the adsorption isotherms, a 5 gm of sample of each soil was equilibrated with 15 ml of 0.01 M $CaCl_2$ solution containing graded concentration of Zn varying between 5 and 50 ppm at 22, 28 and 38°C constant temperatures. After two hours, the solution was centrifuged. The Zn content in equilibrium solution was determined by atomic absorption spec-

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TABLE 1

Physico-chemical characteristics of the soils

Characteristics	Soil 1	Soil 2	Soil 3
Textural class	Sand	Loamy sand	Sandy loam
Per cent sand	94.00	88.0	82.6
Per cent silt	1.00	2.0	1.9
Per cent clay	5 00	10.0	15.5
pH	8.00	8.2	8.2
EC (mmhos/cm)	0.11	0.08	0.18
Organic carbon (%)	0.15	0.18	0.28
$CaCO_3$	Nil	Nil	Nil

trophotometry. The individual ionic strengths were calculated by using the equation $\mu = \frac{1}{2} \sum_i ci\, zi^2$. The individual activity co-efficients of Zn^{++} at various temperatures were calculated from the known μ's applying modified form of Debye-Hiickel equation.

The adsorption data was plotted according to the following Freundlich and Langmuir adsorption equations :

$$C_e = K\, x^n \qquad (1)$$

$$Ce \Big/ \frac{x}{m} = \frac{Ce}{K_2} + \frac{1}{K_1 K_2} \qquad (2)$$

where

x/m = amount of Zn adsorbed per unit wt. of soil.

K_1 = a constant related to binding energy.

K_2 = adsorption maxima.

Ce = equilibrium concentration of Zn ion.

From Langmuir plots, the adsorption maxima and a constant related to the binding energy were calculated. The thermodynamic parameters were determined according to the method described by Jurinak and Bauer (1956).

RESULTS AND DISCUSSION

The validity of the adsorption isotherms was tested and discussed below :

The adsorption of Zn on three soils, and the effect of temperature on this reaction by different equations are shown in Figs. 1a, 1b, and 2 . The adsorption in these soils conformed to Freundlich and Langmuir adsorption isotherms. There was higher adsorption of Zn in sandy loam than in loamy sand and sand. This increase in adsorption could be attributed to higher clay content. These results are in agreement with the findings of Warncke and Barber (1973). The Langmuir adsorption parameters, such as, adsorption maxima and binding energy constants were calculated, and are given in Table 2. The adsorption maxima in the soils varied as follows: Sandy loam > loamy sand > sand. There was increase in adsorption maxima of Zn as the clay content of the soils increased.

The binding energy constant describes how strongly Zn is held in soils It is evident from Table 2 that Zn is held more strongly in sandy loam than in other soils. Sandy soils have the lowest binding energy constant. In loamy sand

FIG.1(a) LANGMUIR ADSORPTION CURVES AT DIFFERENT TEMPERATURE (SOIL-1)

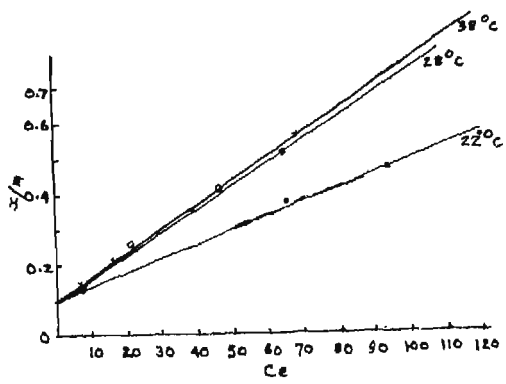
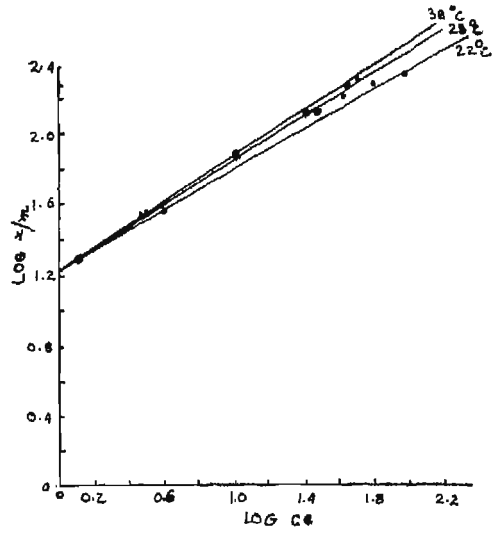


FIG.1(b) FREUNDLICH ADSORPTION CURVE AT DIFFERENT TEMPERATURE (SOIL-1)

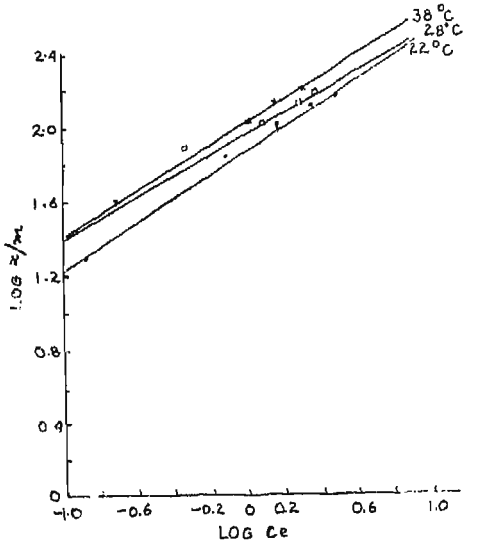


and sandy loam soils, the binding energy constant decreased as the temperature was increased.

The thermodynamic values calculated from the adsorption data are given in Table 3. The standard free energy change of adsorption is used as a measure of the decrease of concentration of Zn in solution, i.e., the free energy change can be used as a measure of the extent or the driving force of the reactions. Thus, the greater the adsorption of zinc in a given system for a given equilibrium Zn^{++} concentration, the more negative is the value of the standard free energy. It is clear that the degree of Zn bonding to the soil surface varied in the order: Sandy loam>loamy sand>sand.

The magnitude of free energy change ($\triangle F$) increased with increasing fineness of these soils.

FIG. 2 FREUNDLICH ADSORPTION CURVE AT DIFFERENT TEMPERATURE (SOIL-2)



Enthalpy may be defined as the heat content or total energy stored in a system. It is indicative of the strength or tightness with which an ion is held

TABLE 2

Adsorption maxima and bonding energy constant in different soils at varying temperature

Soil	Temperature °C	Adsorption maxima µg/g	Bonding energy constant g/ml
Sand	22	8.33	0 075
	28	11.11	0.073
	38	12.00	0.026
Loamy sand	22	10.41	0.69
	28	14.28	0.51
	38	22.72	0.39
Sandy loam	22	52.63	3.99
	28	56.66	3.42

TABLE 3

Thermodynamic functions of zinc adsorption on soils

Soils	Temperature °C	△ F° Kcals.	△ H° Kcals.	△ S° eu
Sand	22	−7.75	−21.58	−46.87
	28	−8.00	−23.05	−50.00
Loamy sand	22	−7.90	−20.80	−43.75
	28	−8.12	−22.56	−48.00
Sandy loam	22	−8.30	−19 36	−37.50
	28	−8.40	−23.45	−50.00

on a surface and whether a reaction is exothermic or endothermic. Thus, the enthalpy change is a measure of the heat of adsorption of a standard adsorption process. The adsorption of zinc in all soils was an exothermic process as in all the processes the enthalpy changes were negetive. Zinc was more adsorbed in sandy loam which clearly indicated that in adsorption there might be complete or partial removal of the hydration shell of Zn ions (Jurinak and Bauer, 1956).

The *entropy change in a system* indicates order or disorder. There will be a entropy loss and a greater disorder if there is entropy gain. The entropy gained may be described as removal of water molecules from hydrated ions. The value of entropy changes clearly indicated that there might be greater incorporation of zinc in the crystal lattice of clays as compared to that in other soils.

REFERENCES

Bingham, F. T., Page, A. L. and Sims, J. R. 1964. Retention of cu and Zn by H-montmorrilonite. *Soil Sci. Soc. Am. Proc.* 28 : 351-354.

Boyd, G. E., Shubert, J. and Adamson, A. W. 1947. The exchange adsorption of ions from aqueous solutions by organic zeolites. 1. Ion exchange equilibra. *J. Am. Chem. Soc.* 69 : 2818-2819.

Freundlich, H. 1926. *Colloid and Capillary chemistry*. Translated from third German edition by H. Stafford Hatfield Methuen and Co. Ltd. London.

Jurinak, J. J. and Bauer, N. 1956. Thermodynamics of Zinc adsorption on Calcite, dolomite and magnesite. *Soil Sci. Soc. Am. Proc.* 20 : 466-476.

Langmuir, I. 1918. The adsorption of gases on plain surfaces of glass, mica and platinum. *J. Am. Chem. Soc.* 40 : 1361-1403.

Udo, E. J., Bohn, H. L. and Tucker, T. C. 1970. Zinc adsorption by calcareous soils. *Soil Sci. Soc. Am. Proc.* 34 : 405-407.

Warncke, P. O. and Barber, S. M. 1973. Diffusion of Zinc in soils III. Relation of zinc adsorption isotherms. *Soil Sci. Soc. Am. Proc.* 37 : 355-357.

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VARIETAL RESISTANCE AGAINST LEAF SPOT OF BER

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Ber (*Ziziphus mauritiana* Lamk) is an important fruit for arid and semi-arid regions in the country and is cultivated in large area in Haryana. Among the several diseases on Ber (Gupta and Madaan 1975 A, B; 1977 A, B; 1978; Madaan and Gupta 1976), Alternaria leaf spot is one of the most serious disease caused by *Alternaria* state of *Pleospora infectoria* Fuckel (Gupta and Madaan 1977 C.) In the present investigation, screening of different varieties was done by scoring the disease (disease intensity) under natural conditions of disease development at experimental orchard Haryana Agricultural University, Hissar. Four branches, one from each side of tree from all the 57 varieties were randomly selected. The number of healthy and diseased leaves was also taken into consideration to work out the disease incidence. The varieties were classified as R (D. I. 1-5%), MS(D.I. 6-20%), S(D.I. 21-50%) and HS (D. I. 51-100%).

Of 57 varieties screened, 20 were resistant (R), 27 moderately susceptible (MS), 7 susceptible (S) and 3 varieties were highly susceptible. Among the 20

TABLE 1

Varietie reaction of Ber (Ziziphus mauritiana Lamk) against Alternaria leaf spot disease under natural condition of disease development

Reaction	Varieties
Resistant	Bahadurgarhia, Govindgarh-special, Gola-Gurgaon, Golar, Popular-Gola, Seo-Bahadurgarhia, Zg-3, Safeda-Rohtak, Kala-Gora, Tasbtaso, Thornless, Villaity, Safeda-Selected, Hziang-Tsao, Golar, Jhajjar-selection, Mirchia, Illaichi-Jhajjar, Jhajjar-special, Narma.
Moderately susceptible	Sandhura-Narnaul, Banarasi-Karaka, Gola, Deshi-Alwar, Rashmi, Kaithali, Muddia Murhera, Sua, Katha-Gurgaon, Sonari No. 5, Laddu, Chhuara, Illaichi, Katha-Bombay, Banarasi-piondi, Katha-Phal, Sonari No, 1 Triloki No. 1, Gola Gurgaon No. 2, Rewa-selection, Sonari No. 3, Pathani, Kishmish, Gora, Sonari No. 6, Nari-Kali, Noki.
Susceptible	Akrota, Umran, Katha-Rajasthan, Gola-Gurgaon No. 3, Khatti, Jullandhari, Dandan.
Highly Susceptible	Chonchal, Banarasi, Sua.

resistant varieties, Bahadurgarhia, Gola-Gurgaon, popular-Gola, Seo-Bahadurgarhia, Zg-3 and Illaichi-Jhajjar were important varieties and grown widely. Among the 27 moderately susceptible varieties, Sandhura-Narnaul, Banarsi Karaka, Gola, Rashmi, Kaithali, Chhuara, Illaichi, Katha-Phal and Noki were important varieties. The susceptible varieties were Akrota, Umran, Katha-Rajasthan, Gold-Gurgaon No. 3, Khatti, Jullandhari and Dandan. The highly susceptible varieties were chonchal, Banarasi and Sua (Table 1).

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REFERENCES

Gupta, P. C. and Madaan, R. L. 1975 A. Two leaf spot diseases of *Zizyphus* from Haryana. *Curr. Sci.* 44 : 248.

Gupta, P. C. and Madaan, R. L. 1975 B. Diseases of fruits from Haryana I. A new fruit rot of *Zizyphus mauritiana* Lamk. *Curr. Sci.* 44 : 908.

Gupta, P. C. and Madaan, R L. 1977 A. Diseases of fruits from Haryana. A new leaf spot diseases of *Zizyphus mauritiana* Lamk. *Curr. Sci.* 46 : 237-238.

Gupta, P. C. and Madaan, R. L. 1977 B. Fruit rot diseases of Ber (*Zizyphus mauritiana* Lamk.) from Haryana. *Indian Phytopath.* 30 : 554-555.

Gupta, P. C. and Madaan, R. L. 1977 C. A new leaf spot disease of *Zizyphus mauritiana*. *Indian Phytopath.* 30 : 271-272.

Gupta, P. C. and Madaan, R. L. 1978. Occurrence of Powery mildew of Ber (*Zizyphus mauritiana* Lamk.) in Haryana and its control. *Indian Phytopath.* (Accepted for publication).

Madaan, R. L. and Gupta, P. C. 1976 Diseases of fruits from Haryana II. Two new leaf spot diseases of *Zizyphus mauritiana*. *Indian Phytopath.* 29 : 328.

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STUDIES IN STABILITY PARAMETERS IN CLUSTER BEAN *(CYAMOPSIS TETRAGONOLOBA* (L) TAUB*)* FOR SEED YIELD IN RAINFED CONDITIONS

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The cultivation of cluster bean *(Cyamopsis tetragonoloba* (L) Taub*)* for seed yield is gaining importance in rainfed areas of northern India because of its industrially important gum, protein rich poultry feed and husk as nutritious cattle feed. It is also used as green fooder. Paroda and Mehrotra (1976) studied phenotypic stability in cluster bean fodder.

Considering the importance of cluster bean seed production in erratically distributed rainfall in rainfed regions, the phenotypically stable varieties with high seed yield are desirable (Boyd and Konzak, 1977). Since this aspect has not been worked out in cluster bean, therefore, this attempt was made to fill up the gap.

Of 14 genotypes, the seeds of 12 were obtained from the Forage Breeder of Haryana Agricultural University, Hissar and the rest two were received from the Indian Agricultural Research Institute, New Delhi. These genotypes were raised in four enviornments during Kharif seasons of 1975 (sowing on July 27 and August 13, 1975 with 20 kg N+40 kg P_2O_5/ha) and 1976 (sowing on August 28 with no fertilizer and 20kg

TABLE 1
Pooled analysis of variance for cluster bean yield

Sources	DF	SS	MS	F (Pooled error)	F MS 3
Total	55	3459312			
Genotype (g) MS_1	13	393316	30255.08	2.65**	2.93**
Environment (env.)	3	2050175	683391.66	59.77**	
g x env.	39	1015821	26046.69	2.28**	
env. + (g x env.)	42	3065996	72999.90	6.39**	
env. linear	1	2050164	2050164.00	179.33**	
g x env. linear MS_2	13	726431	55879.31	4.89**	5.41**
Pooled deviation MS_3	28	289401	10335.77	0.90	
Pooled error	104		11432.67		

TABLE 2

Phenotypic stability parameters for seed yield in clusterbean

Sr. No.	Genotypes	Environments (yield kg/ha) I	II	III	IV	$\mu+a_i$	$\underline{b}$	s^2_{di}	SE_b
1.	HFG 189	1511	942	913	985	1088	1.1095**	−2815.13	0.2175
2.	FS 277 (S)	1042	781	654	644	780	0.7041**	−5080.67	0.1867
3.	HFG 254	1302	1068	615	682	917	1.1499**	26867.37	0.4585
4.	Durgarpur Safed − 25	1224	968	675	871	935	0.8958**	−6366.71	0.1668
5.	HFG 227	1417	937	734	1060	1037	1.1388**	−6174.75	0.1699
6.	HFG 128	1302	938	615	757	903	1.1667**	−3060.98	0.2144
7.	HFG 116	1380	833	595	776	896	1.3677**+	−10198.44	0.0823
8.	HFG 210	1458	912	655	985	1003	1.3497**+	−8991.14	0.1158
9.	HFG 249	1276	990	794	837	974	0.8457**	−5254.79	0.1842
10.	No. 2 (S)	1302	938	754	1023	1004	0.9048**	−7986.29	0.1375
11.	R 39	1354	964	932	985	1056	0.7788**	−7843.16	0.1404
12	HFG 320	1042	677	853	1098	918	0.3386	33165.55	0.4948
13.	HFG 197	1306	964	833	1136	1060	0.7675**	−1564.51	0.2327
14.	R 26	1588	938	734	1004	1066	1.4822**+	−10051.57	0.0871
	Average	1329	917	701	917	974	1.0000	$r(\mu+a_i, \underline{b}_i)$ =	0.9607**
	SE ± m	189	108	117	136	59	0.2382	$r(s^2_{di}, \underline{b}_i)$ =	−0.2143
	CD 5%	—	—	241	280	121		$r(SE_b, \underline{b})$ =	0.7549**
	CV %	17.4	14.4	20.5	18.2	10.4			

**Significant at 1% level

+Significantly different from unity at 1% level.

(S)=Standard

N+40 kg P_2O_5/ha). The seed yield was recorded in 15 sq. m. plot. The parameters of phenotypic stability were determined following Eberhart and Russell (1966).

The highly significant affects due to genotypes, enviornment (also linear) and genotypes X environment (linear) were recorded (Table 1). These affects alongwith enviornmental indexes 347.55, —56.31, —234.45 and —56.80 not only suggested the utility of creating enviornments by manipulating sowing time and fertilizer application schedules, but also the fact that delayed sowing and no fertilizer formed poor enviornments.

The genotypes having high yield ($\mu+d_i$) with linear regression (bi) around unity and low deviation from regression (s^2_{di}) and SE(bi) was considered desirable for non - responsive enviornments. Thus, bi value suggested responsiveness and s^2_{di} indicated stability (Paroda and Mehrotra 1976). The b_i estimate was highly significant from zero for all genotypes except HFG 320, whereas, it was significantly different from unity for the genotypes HFG 116, HFG 210 and R 26 (Table 2). The s^2_{di} and SE(b_i) estimates were high for HFG 254 and HFG 320. Therefore, above mentioned genotypes, on one or the other pretext, were unsuitable for rainfed conditions.

With regard to $\mu+d_i$ and b_i values, this population could be classified as follows :

Group 1 : Low yield and non-responsive : FS 277, HFG 254, HFG 128, HFG 249 and HFG 320.

Group 2 : Low yield and responsive : HFG 116.

Group 3 : High yield and non-responsive : HFG 189, HFG 227, No. 2, R 19, HFG 197 and Durgapur Safed—25.

Group 4 : High yield and responsive : HFG 210 and R 26.

The groups 1 and 2 were considered undesirable because of low yield (Boyd and Konzak, 1977). Therefore, one of the cause for the low *guar* (cluster bean) yield could be due to the below average performance of FS 277 (recommended variety) over environments. The possibilities of improving *guar* seed production in rainfed areas existed because of the genotypes included in the Group 3. Another recommended variety No 2 and the promising genotype Durgapur Safed 25 could be used for the seed production in rainfed areas. The added advantage with the later genotype is its buff white seed colour giving untinted gum.

Further, the correlation coefficient (r) estimate between $\mu+d_i$, b_i and b_i, SE(b_i) were positive and highly significant (Table 2). This suggested that with the isolation of high yielding genotypes, responsiveness might also increase. Another trend was that increasing reponsiveness might also increase unpredictability. These trends suggested the need of balancing during the selection of phenotypically stable high yielding cluster bean strains suitable for rainfed region.

REFERENCES

Boyd, W. J. and Konzak, C. F. 1977. Discriminating between adapted genotypes of high mean yield over environments. Plant Breeding Papers 1:3 (d) 12-16. *Proc 3rd. Intern. Cong.* SABRAO, Canberra, Australia.

Eberhart, S. A. and Russell, W. A. 1966. Stability parameters for comparing varieties. *Crop Sci.* **6** : 36-40.

Paroda, R. S. and Mehrotra, Naresh. 1976. An investigation on genotype environment interactions for green fodder yield in cluster bean *(Cyamopsis tetragonoloba* (L) Taub.*). Genetica agrar.* **30** (2) : 191-200,

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REACTION OF PEARLMILLET GERMPLASM TO PYRICULARIA PENNISETI

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With the introduction of high yielding hybrid bajra, dwarf parents have been preferred in the hybrid production of the crop. Most of the dwarf parents and varieties of this crop are having thick vegetative canopy, which provides congenial microclimatic conditions for rapid development of various diseases. Among these, Pyricularia leaf spot is very important as it caused 7-19% leaf blight incidence in recently introduced hybrid bajra in Haryana (Duhan and Thakur, 1977).

However, since most of the parental materials used for hybrid breeding or for evolution of synthetics or composites have been found to be susceptible to this disease, hence, there is an urgent need to locate the source of stable and genetical resistance against *P. penniseti* of this crop. With the objective to find source of resistance against *P. penniseti*, 131 inbred lines including world collections (I. P. series) were screened for testing their reaction to pathogen in field screening trials at Haryana Agricultural University, Hissar. Along with these inbreds, few standard bajra hybrids, viz., HB 1, HB 3 HB 4, HB 5 and two improved varieties, i e., A 1/3 and T 55 were also included in the screening schedule

Each germplasm was sown in double rows, two meters each having two replications. Plant population in each row varied between 28-34. The incidence of the disease under natural conditions of infection was recorded after 30 days of germination on the upper most five leaves only.

Pyricularia blight reaction of these germplasms is as follows :

0=No infection	:	None
Very slight=1 (1-5%)	:	H 244, H 247, H 418, H 440, I. P. 347 I. P. 350, I. P. 358, I. P. 359, I. P. 378, I. P. 1672.
Slight=2 (6-15%)	:	H 19, H 203, H 205, H 218, H 224. H 242, H 246, H 255, H 256, H 259, H 282, H 299, H 319, H 323, H 357, H 361, H 367 P 1, H 367 P 3, H 369, H 373, H 405, H 407, H 410, H 414 P 2, H 414 P 3, H 414,

		P 5, H 414 P 8, H 417, I. P. 343, I. P. 349, I. P. 353, I. P. 355, I. P. 356, I. P. 360, I. P. 363, I. P. 367 I. P. 370, I. P. 925, I. P. 941, I. P. 955, I. P. 971, I. P. 972, I. P. 975, I. P. 976, I. P. 994, I. P. 996, I. P. 1114, I. P. 1116, I. P. 1117, I. P. 1118, I.P. 1120 I. P. 1122, I. P 1124, I. P. 1171, I. P. 1182, I.P. 1187, I. P. 1189, I. P. 1194, I. P. 1198, I. P. 1199, I. P. 1200, I. P. 1236, I. P. 1239, I. P. 1241, I. P. 1251, I. P. 1254, I. P 1259, I. P. 1260 I. P. 1261, I. P. 1262, I. P. 1263, I. P. 1264, I. P. 1646, I. P. 1652, I. P. 1655, I. P. 1658, I. P. 1659, I. P. 1662, I. P. 1664, I. P. 1668, I. P. 1669. I. P. 1671, I. P. 1673, I. P. 1677, HB 1, HB 3, HB 5, A 1/3, T 55.
Light=3 (16–30%)	:	H 219, H 367 P 6, I. P. 368, I. P. 375, I. P. 382, I. P. 938, I. P. 973, I. P. 1125, I. P. 1170, I. P. 1172, I. P. 1176, I. P. 1178, I. P. 1185, I. P. 1188, I. P. 1193, I. P. 1197, I. P. 1250, I. P. 1253, I. P. 1255, I. P. 1266, I. P. 1644, I. P. 1651, I. P. 1660, I. P. 1661, I. P. 1663, I. P. 1666, I. P. 1667, I. P. 1676, HB 4.
Moderate=4 (31-45%)	:	I. P. 1168, I. P. 1244, I. P. 1650.
Heavy=5 (46–60%)	:	None
Very Heavy=6 (61–100%)	:	None

Disease reaction was categorized from infection grade 0 to 6, depending on no infection (0) to very heavy infection (6), according to Chester (1950).

Of 131 inbred lines tested against Pyricularia leaf spot, none was found to be completely free from infection. Ten inbreds contracted infection to the least extent (disease rating=1) while 89 were placed in second disease rating. Twenty nine inbreds contracted light infection, while 3 inbreds scored moderate disease rating. However, none of the inbreds was placed in Heavy or very heavy disease incidence rating.

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REFERENCES

Chester, K. S. 1950. Technique for determining plant disease intensity. *Pl. Dis. Reptr. Suppl.* 193 : 238-246.

Duhan, J. C, & D. P. Thakur 1977. Incidence of leaf spot diseases of Bajra in Haryana. *Haryana agric. Univ. J. Res.* 7(3) : 126-127.

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EFFECT OF PLANTING PATTERN ON THE QUALITY OF AMERICAN COTTON H 14

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Cotton, which accounts for over 85% of the raw material requirements of the textile industry and provides employment to several lakhs of persons, is one of the major cash crops and plays a major role in the economy of our country. Cotton workers are never tired of, in providing high yielding varieties which can fetch more returns to the cultivators, simultaneously having good spinning quality so that the textile industry may easily accept the produce. Variations in row width and inter-row zones is one of the methods which contributes to this aim. There is much scope for the cotton mechanisation and suitable inter-cropping in the inter-row zones, which might produce maximum yield and get more returns.

Traditionally, row-width to be adopted depends on the variety and ranges from 60 to 90 cm, with plant population of 24,700 55,000 per hectare. Evaluation of new planting pattern with narrowed row-width and varying inter-row spacings for the cotton mechanisation and intercropping in the inter-row space, is being tried successfully in many countries.

In United States of America, rows were narrowed down to 13–25 cm and it was claimed to be one of the methods of achieving maximum yield in cotton (Anon. 1972). It was hoped that by reducing the normal spacing, the seed cotton yield might be increased. Also, that in the incresed space between the inter-rows, inter-cropping might be successfully cultivated and, hence, be able to get increased returns. Due to increase in the inter-row spacing, it is possible to mechanise the inter-culture methods of weeding, hoeing etc.

Hence, this field experiment was conducted to determine the effect of variations of row-width on the yield and quality of cotton.

American cotton H 14 was grown for 1975 to 1977 seasons with four replications in randomized block design. The net plot size was 12m × 7.2m. There were 10 different treatments of row-width and inter-row width combinations, including the normal 60 × 30 cm spacing (control).

Treatments

T_1	R_{60} I_{30} (control)
T_2	R_{50} I_{70}
T_3	R_{50} I_{80}
T_4	R_{50} I_{90}
T_5	R_{40} I_{80}
T_6	R_{40} I_{100}
T_7	R_{40} I_{120}
T_8	R_{30} I_{90}
T_9	R_{30} I_{120}
T_{10}	R_{30} I_{150}

A total of 80 lint samples were collected for the quality evaluation. The data regarding the yield, number of plants/plot, number of bolls/plant, average boll weight and average plant height were recorded. Standard laboratory methods were used in evaluating the fibre qualities, viz., mean fibre length was determined by Baer sorter, fibre fineness by Micronaire, fibre maturity by Spacer technique and fibre bundle tenacity by Stelometer (Sundaram and Iyengar, 1968).

There was no significant difference in yield of H 14 due to reduction in row-width (Table 1), as plant population was kept almost the same for all the plots, by simultaneously increasing the inter-row spacings. The effect of variations in row-width was non-significant on any of the main fibre characteristics, viz., mean fibre length, fibre fineness, maturity and bundle tenacity (Table 2). This is in accordance with Ghandnani (1956), Hawkins and Peacock (1973) and Nagwekar and Kairon (1978), who found no significant variation in quality of cotton fibres, due to variations in spacings and population.

TABLE 1

Effect of various row-zones on H 14 Cotton

(Averages for two seasons of four replications each)

Treatments	Seed Cotton yield q/ha	No. of Plants per plot	No. of bolls per plant	Average boll wt. (g)	Average plant height (cm)
T_1	14.06	398	11	2.56	159.0
T_2	15.50	398	13	2.58	168.0
T_3	13.74	403	13	2.73	161.5
T_4	13.96	389	12	2.55	160.5
T_5	14.87	391	13	2.74	158.0
T_6	15.30	405	12	2.64	158.0
T_7	11.61	383	11	2.50	159.0
T_8	14.88	389	12	2.82	163.0
T_9	13.95	390	13	2.80	156.5
T_{10}	13.17	386	11	2.49	161.0
Mean	14.10	393	12	2.64	158.5
SEm±	0.71	15.3	0.43	0.09	7.61
C.D. (5%)	N.S	N.S.	N.S.	N.S.	N.S.
C. V. %	10.1	7.8	6.9	7.5	9.6

N. S.=Not significant

TABLE 2

Effect of various row-zones on quality of H 14 Cotton
(Averages for two seasons of four replications each)

Treatments	Mean fibre length (mm)	Fibre fineness (millitex)	Maturity Coeff. (MC)	Fibre tenacity (g/t)
T_1	24.2	142	0.72	44.3
T_2	24.2	133	0.71	45.2
T_3	24.2	135	0.70	44.8
T_4	24.8	135	0.72	44.8
T_5	24.3	137	0.71	44.0
T_6	25.4	136	0.70	43.2
T_7	24.1	137	0.74	44.8
T_8	24.8	132	0.72	44.0
T_9	24.6	136	0.72	45.5
T_{10}	24.6.	136	0.72	43.8
Mean	24.6	136	0.72	44.4
SEm±	0.4	5.7	0.02	0.70
C. D. (5%)	N.S.	N.S.	N.S.	N.S.
C. V. %	3.23	8.35	4.35	3.55

N. S.=Not significant.

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REFERENCES

Anon. 1972. Population explosion in India, *Cotton Dev.* 1 (3) : 18.

Ghandnani, J. J. 1956. Studies on the cultivation of G. hirsutum in delta tract. *Indian Cotton Grow Rev.*, 10 (1) : 29.

Hawkins, B. S. and Peacock, H. A. 1973. Influence of row-width and population density on yield and fibre characters of cotton. *Agron. J.* 65 : 47-57.

Nagwekar, S. N. and Kairon, M. S. 1978. Note on effect of fertilizers, sowing dates and spacings on yield and fibre properties of H 14 and J 34 varieties of *(G. hirsutum* L.). *Haryana Agric. Univ. J. Res.*, 8 : 95-96.

Sunderam, V. and Iyengar, R. L. N. 1968. *Hand Book of Methods of Tests for Cotton Fibres, Yarns and Fibrics.* CTRL publication, Bombay pp 4-39.

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THE EFFECT OF METHALLIBURE (I. C. I., 33828) ON OVULATION AND SPAWNING IN CARP, *CYPRINUS CARPIO*

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The surgical hypophysectomy and replacement therapy are very reliable procedures for several endocrinological studies, especially those which tend to demonstrate hypophyseal regulation of reproduction. The hypophysectomy in teleosts is a difficult procedure especially in fishes, where skulls are dorsoventrally very deep (Hoar *et al.*, 1967). Moreover, it may disrupt the whole endocrine system. In order to achieve gonadotrophic supression, some steroids have been used which may affect several feedback pathways and, therefore, lack high degree of specificity required for endocrinological studies (Donaldson, 1973). Recently, several workers have recommended the use of a nonsteroidal antigonadotrophic compound, methallibure (I. C. I., 33838) as an alternative to the surgical hypophysectomy technique in a variety of teleost species (Breton *et al.*, 1973 ; Mackay, 1973 a, b; Van Ree, 1976; Singh *et al.*, 1977). In earlier studies conducted in this laboratory, it was observed that mathallibure treatment might cause a marked time-dependent reduction in the activities of various hydroxy steroid dehydrogenases (Kapur and Toor, 1978 a,), which parameters were stimulated by gonadotrophin treatments (Kapur and Toor, 1978 b,). The present studies are aimed at establishing the antigonadotrophic nature of this compound in carp, *Cyprinus carpio* by demonstrating its inhibitory influence on ovulation and spawning in this species.

For these studies, 36 mature specimens (12 females and 24 males) of *Cyprinus carpio* measuring 15-20 cm and weighing 100–120 g were selected in February-March, 1978, during the breeding season of the fish. The females were divided into two equal groups and housed in 300 L aquaria, which were kept aerated periodically. A 1% methallibure suspension was prepared in distilled water and stabilized by tween-80 (2 drops/10ml). Group 1 females were treated 5 times with 3.0 ml suspension dissolved in equarium water on alternate days. The group 2 females received the equivalent amount of vehicle (tween-80) during this period. On 10th day (7 A. M.), the fishes were divided into 12 sets, each set containing one female and two males. Sets 1-6(females-only) had been pretreated

with methallibure, whereas sets 7-12 served as control. Each set was released into a separate inverted mosquito netting type structure (9'×3 1/2'×3') called "hapa", a series of which were suspended in a large fish tank by means of ropes and bamboo sticks. Branched weeds were put in each hapa, which act as a substratum for attachment of the spawned eggs in this species. The weeds could be removed for examination. On each day up to 20th day (8 A. M.), the fishes were examined for ovulation by a gentle abdominal message, and spawning, by study of the weeds. In cases where spawning had occured, fresh weeds were added to the hapa.

The present studies demonstrate that a short (10 day) methallibure treatment blocked ovulation and spawning in *Cyprinus carpio*, with none of the treated specimen exhibiting ovulation or spawning up to 20th day. These studies, therefore, indicate a prolonged inhibitory influence of this chemical on reproduction in this species. On the other hand, all the control sets spawned next morning.

The present studies establish a complete blockade to ovulation even after short methallibure treatment. Some other reports also indicate the inhibitory effect of methallibure on ovulation in teleosts and amphibians (Kanakaraj and Gangadhara, 1967; Singh *et al.*, 1977). Methallibure treatment in several species of teleosts may cause supression of gametogenesis and the development of secondary sexual characteristics, decline in plasma gondotrophin level, steroidogenesis and p 32 uptake by the gonads (Devlaming, 1974, Singh *et al.*, 1977; Kapur, 1978). At the same time, hypophysectomy may inhibit ovulation, cause suppression of vitellogenesis and atresia of vitellogenic follicles, and inhibition of the transformation of spermatogonia into spermatocytes (Devlaming, 1974). Hypophysectomy may also cause suppression of the activity of steroid dehydrogenases in vertebrate gonads (Samuels and Helmreich, 1956; Shikita and Hall, 1967). The results obtained during the present studies, therefore, strongly support a close similarity between the effects of "Surgical" hypophysectomy and the "physiological" hypophysectomy achieved as a result of methallibure treatment. However, the exact site and mode of action of methallibure still remains controversial. It is so far not definitely known whether methallibure acts directly at the level of pituitary or indirectly *via* the hypothalamus. The treatment of methallibure pretreated *C. carpio* with gonadotrophins may stimulate steroidogenesis and ovulation in this species (Kapur, 1978; Kapur and Toor, 1978 b,). Similar treatments in hypophysectomized goldfish may cause resumption of spermiogenesis and spermiation (Billard *et al.*, 1970). All these studies, therefore, indicate that though methallibure might block the production and release of gonadotrophins, yet it did not interfere with the exogenous gonadotrophic preparations. On the other hand, Singh and Coworkers (1977) observed that methallibure blocked the action of both endogenous as well as exogenous gonadotrophins. Since the gonadotrophins are known to stimulate the production of cyclic-AMP (Schulster *et al.*, 1976; Selstam *et al.*, 1976 ; Kapur, 1978), and protein synthesis under the influence of RNA in target tissue (Davies and Lawrence, 1976; Lawrence and

Davies, 1977 ; Kapur, 1978), the anti-gonadotrophic action of methallibure in *C. carpio* may, therefore, be either by blocking the release and/or synthesis of pituitary gonadotrophin (s), by interferance with adenyl cyclase-AMP-protein kinase system or by the inhibition of RNA/ protein synthesis. Further studies are at present in progress to better understand the mode and site of action of methallibure in this species.

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REFERENCES

Billard, R., Burzawa-Gerard, E. and Breton, B. 1970. Regeneration de la spermatogenese du Cyprin hypophysectomise *Carassius auratus* L. de Carpe. *C. R. Acad. Sci.* 271 : 1896-1899.

Breton, B., Jalabert, B. and Billard, R. 1973. Pituitary and plasma gonadotrophin levels and spermatogenesis in goldfish *Carassius auratus* after methallibure treatment. *J. Endocrinol* 59 : 415-420.

Davies, A. G. and Lawrence, N. R. 1976. Stimulation of nuclear protein synthesis in testicular germinal and sertoli cells by follicle-stimulating hormone. *J. Physiol. (Lond).* 257 : 18.

Devlaming, V. L. 1974. *Environmental and Endocrine control of teleost reproduction.* 13-83. In : Control of sex in fishes. C.B. Schreck Ed., Ext. Div. Virginia Polytech. Institute & State University Blacksburg, Virginia.

Donaldson, E. M. 1973. Reproductive Endocrinology of fishes. *Am. Zool.* 13 : 909-927.

Hoar, W. S., Wiebe, J. P. and Wai, E. H. 1967. Inhibition of pituitary gonadotropic activity of fishes by a dithiocarbamoyl hydrazine derivative. (I. C. I., 33828). *Gen. Comp. Endocrinol.* 8 : 101-109.

Kanakaraj, S. R. and Gangadhara, N. S. 1967. Effect of a dithiocarbamoyl hydrazine derivative (I. C. I. 33828) on spawning in the Skipper frog, *Rana cyanophlyetis* Schneider. *Gen. Comp. Endocrino.* 8 : 72-74.

Kapur, K. 1978. Studies on the reproductive performance of major carps under natural and confined waters. Ph. D. Dissertation, Department of Zoology, Punjab Agricultural University, Ludhiana pp. 210.

Kapur, K. and Toor, H. S. 1978 a. The effect of methallibure (I. C. I. 33828) on the steroidogenesis in the ovary and testis of a fesh water teleost, *Cyprinus carpio. Experientia, Switzerland.* 34 : 811-812.

Kapur, K and Toor, H. S. 1978b. The effect of clomiphene citrate, sexovid, mammalian gonadotraphins and carp pituitary extracts on the steroidogenesis in the ovary and testes of agonadotrophin deprived exotic fish, *Cyprinus carpio.* Vth Int. Cong. Horm. Steroids.

Lawrence, N. R. and Davies, A. G. 1977. Stimulation of testicular protein synthesis *in vivo* by gonadotrophins and growth hormone in hypophysectomized adult mice. *J. Reprod. Fertil.* 49 : 41-55.

Mackay, N. J. 1973a. The effects of methallibure (I. C. I., 33828) and thiourea on the gametogenesis in the firetail gudgeon, *Hypseleotris galli. Gen. Comp. Endocrinol.* 20 : 221-235.

Mackay, N. J. 1973b. The effect of gonadotrophin preparations and steroid hormones on the ovary of intact and gonadotrophin-deprived Gudgeons, *Hypseleotris galli. Gen. Comp. Endocrinol.* 21 : 278-286.

Samules, L. T. and Helmreich, M. L. 1956. Influence of chorionic gonadotrophin on the 3β-ol dehydrogenase activity of testes and adrenals. *Endocrinology* 58 : 434-437.

Schulster, D., Burstein, S. and Cooke, B. A. 1976. *Molecular endocrinology of steroid hormones.* 321. John Wiley and Sons, London, Sydney, Toronto.

Selstam, G., Janson, P. O. and Eden, S. 1976. Effect of LH on release of Cyclic AMP by the rabbit ovary perfused *in vivo* and *in vitro*. *J. Reprod. Fertil.* 46 : 355-358.

Singh, T. P., Raizada, R. B. and Singh, A. J. 1977. Effect of methallibure on gonadotrophic content, ovarian p32 uptake and gonadosomatic index in the fresh water catfish, *Hetropneustes fossilis* (Bloch). *J. Endocrinol* 72 : 321–327.

Shikita, M. and Hall, P. F. 1967. Action of human chorionic gonadotrophin *in vivo* upon microsomal enzymes in testes of hypophysectomized rats. *Biochim. Biophys. Acta* 141 : 433-436.

Van Ree, G. E. 1976. Effects of methallibure (I. C. I., 33828) and ovine luteinizing hormone on the ovary and the pituitary of the female zebrafish, *Brachydanio rerio Konink. Nederl. Acad. Vanwet.*, Ameterdam. Ser. C. 79 : 150-170.

VETERINARY AND ANIMAL SCIENCES

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EFFICACY OF VARIOUS LABORATORY METHODS INCLUDING FLOURESCENT ANTIBODY IN THE DIAGNOSIS OF EXPERIMENTAL RABIES IN MICE

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ARSTRACT

Fluor escent antibody technique (FAT) using horse and guineapig conjugates and four histological stains were employed to demonstrate rabies antigens/Negri bodies in the brain tissues of mice experimentally infected with street rabies virus. Out of 58 infected mouse brain smears tested, rabies antigen was detected in 52 by FAT using horse antibody conjugate. Only 26 of these 58 smears were tested with guineapig conjugate and 22 were found positive. The remaining four smears found negative by guineapig conjugate were negative by horse conjugate also. Of the remaining 30 FAT positive brain tissue samples stained with histological stains. Negri bodies could be demonstrated in paraffin sections/smears of 26, 22, 22 and 22 cases by Schleifstein, acid fuchsin methylene blue, modified van Gieson and Sellar's stain, respectively. Negri bodies were found more frequent in cerebrum than in any other part of the brain.

Goldwasser and Kissling (1958) employing therapeutic antirabic horse serum demonstrated rabies antigen in imprint smears of rabid brains by Fluorescent Antibody Technique (FAT); this provided a new tool for rapid diagnosis of rabies. Lennette *et al.* (1965) compared the efficacy and specificity of tagged antirabic globulins of horse and hamster origin and found that the later gave less non-specific reactions. According to WHO (1966), sera raised in hamsters and guineapigs gave brighter fluorescence than those raised in horses, but there was no difference in percentage efficacy.

Earlier to development of FAT as a quick and accurate diagnostic tool, histological stains were used for quick diagnosis, whereas biological tests were used as confirmatory tests. In the present study, efficacy of (i) tagged antirabic globulin of horse and guineapig origin and (ii) various histological stains in the detection of rabies antigen/Negri bodies has been studied.

MATERIAL AND METHODS

Therapeutic antirabic horse serum was purchased from the Central Research Institute, Kasauli. Hyperimmune anti-

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serum in guineapig was raised in the laboratory by giving four injections of 0.5% phenol inactivated CVS rabies virus followed by two challenge doses of live fixed and street rabies virus at weekly intervals. Gamma globulin fractions were separated by 45% ammonium sulphate saturation and were labelled with fluorescein isothiocyanate employing 25 mcg of dye per mg of protein. The free dye was removed from the conjugates through Sephadex G-25 column.

Normal mouse brain (NMB) and rabid mouse brain (RMB) suspensions were prepared according to the procedure recommended by WHO (1966). They were used for absorbing non-specific antibody from conjugates.

Sellar's stain (Sellars, 1951) was used for detecting Negri bodies in impression smears. Acid fuchsin methylene blue (Tustin and Smit, 1962), modified van Gieson (Rai Choudhary and Thomas, 1967) and Schleifstein stains (Schleifstein 1937) were used for detecting Negri bodies from rabid brain paraffin sections

Rabies was experimentally produced in mice by giving intracerebral injection of 0.03 ml of street rabies virus. When the mice started showing nervous symptoms, their brains were harvested. A total of 58 brain samples were examined; 26 samples were stained with horse and guineapig conjugates separately, while remaining 32 samples were stained with horse conjugates as well as with various histological strains, given above.

Conjugates of horse and guineapig origin were titrated according to the procedure recommended by WHO (1966). Impression smears were fixed in chilled acetone, layered with conjugate, incubated in moist chamber at 37°C for 30 minutes and subsequently washed in 0.05M phosphate buffer saline, pH 7.6.

Slides stained with various stains were examined under high power of light microscope and slow films (100 ASA) were used for photography. Exposure time of 10 to 15 minutes was found to be most satisfactory for photography of fluorescent antibody stained slides.

RESULTS

1. Comparison of results of horse and guineapig conjugates

Both the conjugates diluted 1:8 in NMB gave optimal (bright) fluorescence in positive brain smears. When the conjugates were similarly diluted in RMB, there was complete inhibition of fluorescence in positive brain smears. So, in future experiments 1:8 dilution of conjugates in NMB and RMB was used.

Of 26 rabies inoculated mice brain smears stained with horse and guineapig conjugates, 22 revealed specific viral fluorescence by either of the conjugates. Greenish yellow fluorescence was observed in positive smears. There was specific inhibition of fluorescence when positive slides stained with RMB diluted conjugates were examined. Though viral antigens most often appeared intracellularly, rarely they occurred extracellularly also. Number of fluorescing particles per cell varied from one to more than ten. The fluorescence was comparatively brighter in smears stained with guineapig conjugate as compared to those stained with horse conjugate.

II. Comparison of the results of histological stains with FAT using horse conjugate

This part of study was conducted in 30 FAT positive mouse brains out of 32 screened. The results of comparative studies for detection of positive cases through various staining techniques are presented in Table 1. Of the 30 FAT positive brain tissue sampless tained with histological stains, Negri bodies could be demonstrated in 26, 22, 22 and 22 cases by schleifstein, acid fuchsin methylene blue, modified van Gieson and Sellar's stain, respectively; the corresponding figures in percentages are 87, 73, 73 and 73, respectively. However, two and one cases were found doubtful by sellars and acid fuchsin methylene blue stain, respectively.

In the brain smear stained with sellars stain intracytoplasmic Negri bodies were visible. Since the impression smears were prepared by pressing brains against slide, boundary of the cell wall got disturbed and as such was not marked. Brain sections stained with schleifstein stain showed clearly demarcated cell boundary and the intracytoplasmic Negri bodies.

While examining the complete longitudinal section of mice, cells in cerebrum were found to exhibit Negri bodies more frequently.

DISCUSSION

This study was undertaken to compare the efficacy of different staining methods employed in diagnosis of rabies. There was complete inhibition of fluorescence in slides, stained with the conjugate treated with RMB, thereby, indicating specificity of the conjugate. Exposure of the conjugate to RMB before staining served as control for each unknown specimen as well.

Complete correlation existed in the results of staining 26 impression smears with the conjugates of guineapig and horse origin. These findings are corroborative with the finding as cited in WHO monograph (1966). It was possible to detect viral antigens in 22 out of 26 brain smears stained with both horse and guineapig conjugates. Low percentage of cases detected as positive, compared to cent per cent reported by McQueen *et. al* (1960), might perhaps be explained by the possibility that the mice had not developed rabies at the time of harvest-

TABLE 1

Comparative efficacy of histological staining methods employed in the diagnosis of experimental rabies infection in mice

Stain employed	Positive brains examined*	Cases found**		
		Positive	Doubtful	Negative
Sellar's	30	22(73)	2(7)	6(20)
Schleifstein	30	26(87)	—	4(13)
Acid fuchsin Methylene blue	30	22(73)	1(3)	7(24)
Modified van Gieson	30	22(73)	—	8(27)

*Of the 32 mouse brain smears examined by FAT for rabies, 30 were found positive, which were examined for comparative efficacy of histological stains.

**The figures in parenthesis represent percentage values.

ing brains since mice showing nervous symptoms were always sacrificed live. In no case FAT proved negative brain smears/section displayed Negri bodies when stained by any other histological stains. Keeping this in view, FA positive brains were considered as truely positive for rabies for comparing efficacy of other histolo gical stains. Since Negri bodies gave greenish yellow fluorescene specific for viral antigens, it was believed that these were of viral origin. Love *et al.* (1964), by means of cytochemical staining of brain sections, had also suggested that the ground substance of Negri bodies corresponded to virus.

In 30 brains which proved positive by FAT, Negri bodies could be detected in 87, 73, 73, and 73% brains by Schleifstein, acid fuchein methylene blue, modified van Gieson and Sellar's stain, respectively. Lennette *et. al.* (1965) and Salido and Romero (1967) reported the efficacy of Sellar's stain between 60 and 66 per cent. Our studies suggested that Schleifstein stain was probably the best amongst histological stains used.

Negri bodies were found more frequently in cerebrum in our studies. However, no such information for mice could be available in the literature for comparing the results. Purkenje's cells in cattle (Adutskevich, 1951) and hippicampus in dogs and cats (du Plesis, 1965) have been reported to be more frequent sites for Negri bodies in the brain.

REFERENCES

Adutskevich, V. A. 1951. (Method of post-mortem diagnosis of rabies). *Veterinariya Moscow* 28 : 32-34. (Vet. Bull. 23:417).

du Plesis, J. L. 1965. The topographical distribution of Negri bodies in brain. *J. S. Afr. vet. Med. Ass* 36 : 203-207.

Goldwasser, R. A. and Kissling, R. E. 1958. Fluorescent antibody staining of street and fixed rabies virus antigen. *Proc. Soc. Exp. Biol. Med.* 98 : 219-223.

Lennette, E. H., Woodie, J. D. Nakamura, A. and Magoffin, R. L. 1965. Diagnosis of rabies by fluorescent antibody methods employing immune hamster serum. *Hlth Lab. Sci.* 2 : 34 (Vet. Bull. 35 : 3808).

Love, R., Fernandes, M. V. and Koprowski, H. 1964. Cytochemistry of inclusion bodies in tissue culture cells infection with rabies virus. *Proc. Soc. Exp. Biol. Med.* 116 : 560-563.

McQueen, J. L., Lewis, A. L. and Schneider, H. L. 1960. Rabies diagnosis by fluorescent antibody staining (i) Its evaluation in public health laboratory. *Am. J. Pub. Hlth.* 50 : 1743-1752.

Raichoudhary, A. N. and Thomas, A. K. 1967. *Rabies : General considerations and laboratory procedures.* Special report series No. 58, ICMR, New Delhi.

Salido, R. F. and Romero, A. A. 1967. (Evaluation of fluorescent antibody test for rabies). *Revts. Invert. Solud. Publ. Mex.* 27 : 137-148 (Vet. Bull. 38 : 1366).

Schleifstein, J. 1937. A rapid method for demonstrating Negri bodies in tissue sections. *Am. J. Pub. Hlth.* 27 : 1283-1288.

Sellars, R. F. 1951. Cited by Tierkel, E S. "Rabies". *Adv. Vet. Sci.* 5 : 1959. 183, Academic Press.

Tustin, R. C. and Smit, J. D. 1962. Rabies in South Africa An analysis of histological examination. *J. S. Afr. Vet. Med. Ass.* 33 : 287-294.

WHO. *Laboratory technique in rabies* 1966. Ed. II. Geneva Monograph series.

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EFFECT OF FEED RESTRICTION ON EGG WEIGHT AND EGG QUALITY OF WHITE PEKIN DUCKS

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ABSTRACT

Effect of feed restriction on egg weight, Haugh Unit, yolk index, yolk colour, and shell thickness were studied on the eggs of 188 White Pekin ducks.

Feed restriction did not result in the production of small or extra large eggs. However, higher number of medium sized eggs were laid by the ducks with restricted feeding than those kept on full feed. Feed restriction did not have any effect on Haugh Unit, yolk index, yolk colour and shell thickness.

There are conflicting reports regarding the effect of feed restriction on egg quality of chickens. Pepper *et al* (1959), Fuller and Dunahoo (1962), Reddy *et al* (1974) and Singh *et al* (1975) suggested that the feed restriction had no effect on egg quality. The restricted feeding enhanced the percent production of settable eggs with good shell quality and desirable size (Pym and Dillon, 1974; Watson, 1975). The report that restricted feeding of birds has adverse effect on egg quality is hardly available in the literature. Most of the researches were conducted on chickens. A similar information on ducks is lacking. Hence, the present study was undertaken to find the effect of feed restriction on egg quality of ducks.

MATERIAL AND METHODS

Three levels (20, 30 and 40%) and three durations (6-20, 6-24 and 10-24 weeks) of feed restrictions were imposed on 188 White Pekin ducks. The composition of rations fed during the experimental period is given in Table 1.

All the eggs laid during the experimental period were weighed. For the egg quality characteristics, three eggs from each duck were collected at the beginning of lay and at 35th and 43rd weeks of age by trapnesting the ducks during these periods.

The albumen and yolk qualities were observed by studying the Haugh Unit, yolk index and yolk colour using the methods suggested by Brant and Shrader (1952). The shell thickness was measured by a shell thickness guage. Shell pieces were collected from three places, i.e., from both the ends and from the middle of each egg. Shell membranes were removed before measuring the thickness of the shell. The presence of

TABLE 1

Composition of Rations

Ingredients	Composition in kg	
	0-12 weeks	12 weeks onward
Yellow maize (9.5% CP)	52.5	45.0
Groundnut Cake (34% CP)	34.0	25.0
Rice Polish (10% CP)	0.0	20.0
Fish Meal (42% CP)	12.0	5.0
Mineral Mixture[1]	1.5	2.5
Shell grit	0.0	2.5
Vitamin premix[2] (g)	25	25
Total (kg)	100.025	100.025
Crude Protein%	22.25	17.37
M. E (Kcal/kg feed)	2542	2562

1. Mineral Mixture containing Ca 32%, P 6%, Mn 0.27%, I 0.01% Zn 0.26%, Cu 100 ppm, Fe 1000 ppm and F1 less than 0.30%.
2. Vitamin premix each gram contains—

Vitamin A	40,000 I. U.
Vitamin D_3	5,000 I. U.
Vitamin B_2	20 mg.

blood and meat spot was also recorded in the broken eggs. The data were statistically analysed for estimating the differences between various treatment means.

RESULTS AND DISCUSSION

It is apparent from Table 2 that the restricted ducks produced higher number of medium sized eggs than the control. In a full fed group, the percentage of smaller eggs (below 66 g) were higher than the restricted groups. The feed restriction did not favour the production of extra large eggs (above 80 g). According to Helmy (1967), the desirable size of hatching duck eggs was 65-74 g. Thus, restricted feeding was noted as desirable method of producing a higher percentage of hatching eggs. Similar results were obtained in chickens by Pym and Dillon (1974) and Watson (1975). The data on albumen quality expressed as Haugh Units are presented in Table 3. The Haugh Units were not affected by feed restriction (Table 7). Similar results were reported by Pepper *et al.* (1959) and Fuller and Dunahoo (1962) in chickens. In a similar manner, yolk index and yolk colour were also not affected by feed restriction as shown in Table 4 and 5.

TABLE 2

Per cent production of different grades* of egg as effected by different treatments

Treatments			Below	60 to	66 to	71 to	76 to	Above	Total
Code	Level of Feeding (%)	Duration	60 g	65 g	70 g	75 g	80 g	80 g	
T_1	100	Throughout	12.84	17.13	19.36	19.37	17.74	13.56	100
			(126)	(168)	(190)	(190)	(174)	(133)	(981)
T_2	80	6-20 weeks	8.85	14.34	19 44	23 10	19.25	15.02	100
			(92)	(149)	(202)	(240)	(200)	(156)	(1039)
T_3	80	6-24 weeks	9 87	13.81	20.79	26.73	19.67	9.13	100
			(133)	(186)	(280)	(360)	(265)	(123)	(1347)
T_4	80	10-24 weeks	10.83	14.83	24.02	27.57	16.38	6.37	100
			(119)	(163)	(264)	(303)	(180)	(70)	(1099)
T_5	70	6-20 weeks	8.20	15.65	22.99	22.53	16.59	14.04	100
			(87)	(166)	(244)	(239)	(176)	(149)	(1061)
T_6	70	6-24 weeks	2.00	9.46	18.58	26.53	20.92	22.51	100
			(24)	(113)	(222)	(317)	(250)	(269)	(1195)
T_7	70	10-24 weeks	8.19	12.32	19 35	25.64	21.84	12.66	100
			(99)	(149)	(234)	(310)	(264)	(163)	(1209)
T_8	60	6-20 weeks	2.12	13.05	25.81	27.85	17.78	13.38	100
			(27)	(166)	(328)	(354)	(226)	(170)	(1271)
T_9	60	6-24 weeks	3.71	11.78	21.48	28.35	18.65	16.03	100
			(34)	(108)	(197)	(260)	(171)	(147)	(917)
T_{10}	60	10-24 weeks	3.15	9 04	22.28	22.02	19.13	24.38	100
			(24)	(69)	(170)	(168)	(146)	(186)	(763)

*Grades on the basis of egg weight.
Figures in brackets are the number of egg.

TABLE 3

Average values for Haugh Unit of duck eggs as affected by restricted feeding during the growing period

Stages of Production	Full feeding T_1 control	80% Feeding T_2 6-20 (weeks)	T_3 6-24 (weeks)	T_4 10-24 (weeks)	70% Feeding T_5 6-20 (weeks)	T_6 6-24 (weeks)	T_7 10-24 (weeks)	60% Feeding T_8 6-20 (weeks)	T_9 6-24 (weeks)	T_{10} 10-24 (weeks)
Initial Stage.	88 (0.780)	87 (0.854)	89 (0.908)	88 (0.838)	87 (0.933)	86 (0.743)	88 (0.795)	88 (0 661)	86 (0 908)	88 (0.577)
At 35th week of age.	88 (0 624)	87 (0.668)	87 (0.733)	87 (0.545)	86 (0 618)	87 (0.759)	87 (0.778)	86 (0.591)	87 (0.676)	87 (0.748)
At 43rd week of age.	88 (0.581)	87 (0.698)	87 (0.627)	89 (0.747)	88 (0.640)	89 (0.803)	87 (0.590)	87 (0.587)	89 (0.657)	87 (0.657)

Figures within parenthesis are standard errors.

TABLE 4

Average values of yolk index affected by feed restriction during growing period

Stages of Production	Full feeding T_1 (control)	80% Feeding T_2 6-20 (weeks)	T_3 6-24 (weeks)	T_4 10-24 (weeks)	70% Feeding T_5 6-20 (weeks)	T_6 6-24 (weeks)	T_7 10-24 (weeks)	60% Feeding T_8 6-20 (weeks)	T_9 6-24 (weaks)	T_{10} 10-24 (weeks)
Initial stage.	0.50 (.0054)	0.50 (.0046)	0.50 (.0044)	0.50 (.0032)	0.50 (.0050)	0.49 (.0031)	0.50 (.0044)	0.50 (.0031)	0.50 (.0044)	0.50 (.0031)
At 35th week of age.	0.50 (.0031)	0.51 (.0031)	0.49 (.0031)	0.49 (.0031)	0.50 (.0045)	0.49 (.0031)	0 50 (.0031)	0.50 (.0030)	0.50 (.0038)	0.50 (.0036)
At 43rd week of age.	0.50 (.0031)	0.50 (.0031)	0.50 (.0038)	0.49 (.0038)	0.50 (.0041)	0.50 (.0033)	0.50 (.0042)	0.50 (.0042)	0.49 (.0033)	0.48 (.0036)

Figures within parenthesis are standard errors.

TABLE 5

Average values of Yolk Colour as affected by restricted feeding during growing period

Stages of Production	Full feeding T_1 (control)	80% Feeding T_2 6-20 (weeks)	T_3 6 24 (weeks)	T_4 10-24 (weeks)	70% Feeding T_5 6-20 (weeks)	T_6 6-24 (weeks)	T_7 10-24 (weeks)	60% Feeding T_8 6-20 (weeks)	T_9 6-24 (weeks)	T_{10} 10-24 (weeks)
Initial stage	12.57 (.096)	12.24 (.087)	12.42 (.099)	12.38 (.088)	12.44 (.074)	12.40 (.075)	12.30 (.101)	12.46 (.088)	12.45 (.085)	12.56 (.076)
At 35th week of age	12.38 (.089)	12.31 (.091)	12.50 (.084)	12.44 (.085)	12.38 (.089)	12.48 (.072)	12.18 (.071)	12.25 (.084)	12.44 (.085)	12.34 (.071)
At 43rd week of age	12.58 (.079)	12.47 (.074)	12.52 (.076)	12.46 (.079)	12.40 (.076)	12.55 (.081)	12.41 (.092)	12.44 (.076)	12.64 (.082)	12.35 (.087)

Figures within parenthesis are standard errors.

TABLE 6

Average values of shell thickness (mm) as affected by restricted feeding during the growing period

Stages of Production	Full feeding T_1 (control)	80% Feeding T_2 6-20 (weeks)	T_3 6-24 (weeks)	T_4 10-24 (weeks)	70% Feeding T_5 6-20 (weeks)	T_6 6-24 (weeks)	T_7 10-24 (weeks)	60% Feeding T_8 6-20 (weeks)	T_9 6 24 (weeks)	T_{10} 10-24 (weeks)
Initial stage	0.32 (.0043)	0.32 (.0053)	0.33 (.0042)	0.32 (.0036)	0.33 (.0079)	0.34 (.0050)	0.33 (.0053)	0.35 (.0050)	0.35 (.0053)	0.34 (.0043)
At 35th week of age	0.37 (.0056)	0.35 (.0046)	0.36 (.0041)	0.36 (.0044)	0.37 (.0040)	0.36 (.0046)	0.36 (.0037)	0.37 (.0030)	0.38 (.0037)	0.37 (.0036)
At 43rd week of age.	0.38 (.0044)	0.39 (.0038)	0.38 (.0056)	0.38 (.0050)	0.38 (.0042)	0.39 (.0036)	0.38 (.0036)	0.38 (.0040)	0.38 (.0051)	0.39 (.0044)

Figures in parenthesis are standard errors.

TABLE 7

Anova for Haugh Unit, yolk index, yolk colour and shell thickness

Trait	d. f.	M. S. Initial	35th week	43rd week
Haugh Unit	9	2.222	1.258	2.056
	1	33.489	0.330	0.028
	9	3.238	0.847	1.853
Yolk index	9	0.000024	0.000501	0.000085
	1	0.000285	0.000054	0.000161
	9	0.000080	0.000238	0.000088
Yolk colour	9	0.02286	0.0206	0.0120
	1	0.00070	0.0245	0.0044
	9	0.01921	0.0143	0.0059
Shell thickness	9	0.000217	0.00145	0.000044
	1	0.002405	0.00104	0.002153
	9	0.000195	0.00085	0.000171

The mean values for shell thickness as affected by different treatments have been presented in Table 6. The shell thickness increased with the advancement of age but was not affected by feed restriction (Table 7).

REFERENCES

Brant, A. W. and Shrader, H. L. 1952. *How to measure egg I. Q.* (Internal quality). Bureau of Animal Industry, Agricultural Research Administration, U. S. Dept. of Agric., U. S. A.

Fuller, H. L., Dunahoo, W. S. 1962. Restricted feeding of pullets : 2. Effect of duration and time of restriction on three year laying house performance. *Poult. Sci.* 41 : 1306-1314.

Helmy, S. A. 1967. Fertility and Hatchability of duck eggs as affected by age of layers, weight and shape of eggs. *Animal Breeding Abstracts* 37 : 4139.

Pepper, M. F., Slinger, S. J , Orr, H. L. and Snyder, E. S. 1959. Effect of high and low energy diets and range versus confinement rearing on egg production and quality of fresh and old eggs. *Poult. Sci.* 38 : 379-385.

Pym, R. A. E. and Dillon, J. F. 1974. Restricted food intake and reproductive performance of broiler breeder pullets. *Br. Poult. Sci.* 15 : 245-259.

Reddy, C. V., Reddy, P. R. and Siddiqui, S. M. 1974. Influence of feed restriction on the laying-house performance of growing pullets. *Indian J. Anim. Sci.* 44 : 262-267.

Singh, F., Rao, P. V., Sadagopan, V. R. and Panda, B. 1975. Effect of quantitative feed restriction in broiler pullets on their subsequent laying performance. *Indian J. Poult. Sci.* 10 : 131-135.

Watson, N. A. 1975. Reproductive activity of broiler hens subjected to restricted feeding during rearing period. *Br. Poult. Sci.* 16 : 259-262.

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UTILIZATION OF AGROINDUSTRIAL BYPRODUCTS BY LIVESTOCK AND POULTRY

1. EFFECT OF MALT SPROUT AND PEA WASTE ON BROILER CHICKS

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ABSTRACT

Seven diets containing different levels of malt sprout and dehydrated pea waste were fed to one hundred and ninty six broiler chicks divided into seven different groups upto the age of ten weeks. Observations were recorded on the feed consumption and live weight gain at weekly intervals. Carcass data were obtained at 8 and 10 weeks of age by sacrificing the broilers.

Chick growth and feed efficiency values indicated that malt sprout could be incorporated in the broiler diet only upto an extent of 2.5% without any deleterious effect. Higher level (5%) of malt sprout resulted in significantly (<0.05) poor growth and feed efficiencies. Diets containing dehydrated pea waste upto 5% level compared favourably with control, while 10% level showed significantly higher ($P<0.05$) body weight gain and lower feed conversion ratio. Inclusion of malt sprout and pea waste could not bring about any significant effect on the dressing percentage.

The present shift towards formulation of non-cereal rations for poultry is mainly based on the use of various agro-industrial wastes or byproducts which cannot be utilized in human dietary. Various attempts (Rao and Bose, 1966; Verma and Panda, 1972; Vaidya *et al.*, 1975; Rao and Sadagopan, 1975; Pradhan and Saxena, 1978 and Singh and Prasad, 1976) have been made to utilize one or the other byproduct. As such the present investigations were initiated to find out the effect of different levels of malt sprout, a byproduct of malt processing industry and dehydrated pea waste, which consisted of undersized, unriped, overheated and broken peas during the dehydration process, on the growth, feed efficiency and carcass traits of broilers.

MATERIAL AND METHODS

One hundred ninty six day old Arbor Acre commercial broiler chicks, vaccinated for fowl pox and Marek's disease, were reared in elcetrically heated battery brooders and were offered a standard control mash for seven days. The chicks were randomly distributed into 14 comparable groups of 14 chicks each on the

basis of body weight after wing banding. Each treatment was randomly allotted to two of these groups thus providing two replications.

The treatments consisted of seven test diets (Tables 1 and 2) by the use of different levels of dehydrated pea waste (PW) and malt sprout (MS). Thus, treatment T_1, devoid of both PW and MS, served as the control; T_2, T_5 and T_6 provided a combination of MS and PW, viz., 2.5% MS+2.5% PW (T_2), 5% MS+5% PW (T_5) and 2.5% MS+7.5% PW (T_6). Treatment T_4 provided 5% MS, while T_3 and T_7 provided 5 and 10% PW, respectively. Calorie protein ratio was approximately 130 : 1 in case of starter diets, whereas it was 150 : 1 in case of grower diets. The levels of protein, energy and crude fibre in the diets were within the limits prescribed by I. S. I. (1967) for broiler rations. Malt sprout could not be used beyond 5% level due to higher crude fibre content. These chicks were offered starter diets upto the age of 6 weeks (Table 1) after which grower mashes (Table 2) were offered upto the age of 10 weeks. Feed and water were made available *ad libitum*. The chicks and feed refusals were weighed at weekly intervals.

Twelve birds (six from each replicate) selected at random were killed at 8 weeks of age, while the remaining birds were sacrificed at 10 weeks of age. The feed was withdrawn 24 hours prior to killing, but a free supply of drinking water was available. Each bird was weighed (empty live weight), killed and subjected to semi-scalding process at a temperature of 128° F for half a minute. Dressed carcasses were weighed after picking the feathers and removing the shanks by cutting at hock joints Eviscerated weights were recorded after removal of the crop, gullet and trachea.

The statistical analysis of the data was performed according to Snedecor and

TABLE 1

Percent ingredient composition of starter diets (1–6 weeks)

Ingredients	Treatments*						
	Control	2.5% MS +2.5% PW	5% PW	5% MS	5% MS+ 5% PW	2.5% MS +7.5% PW	10% PW.
	(T_1)	(T_2)	(T_3)	(T_4)	(T_5)	(T_6)	(T_7)
Constant mash**	49.5	49.5	49.5	49.5	49.5	49.5	49.5
Fish meal	8.0	8.0	7.0	8.0	8.0	7.0	7.0
Rice polish	25.0	21.0	21.0	19.5	15.0	17.0	18.5
Maize gluten meal	17.5	16.5	17.5	18.0	17.5	16.5	15.0
Malt sprout	—	2.5	—	5.0	5.0	2.5	—
Pea-waste (dehydrated)	—	2.5	5.0	—	5.0	7.5	10.0

*Vitablend (Glaxo) was added to supplement Vit. A, B_2 and D_3 @ 25 g and Bifuran @ 40 g used as a coccidiostat per 100 kg diet.

**Constant mash contained maize 40.0, groundnut cake 3.0, guar meal 3.0, poultry mindef 2.5 and limestone 1.0 parts.

MS=Malt sprout.

PW=Pea waste (dehydrated).

TABLE 2

Percent ingredient composition of grower diets (6-10 weeks)

Ingredients	Treatments*						
	Control (T_1)	2.5% MS+ 2.5% PW (T_2)	5% PW (T_3)	5% MS (T_4)	5% MS+ 5% PW (T_5)	2.5% MS+ 7.5% PW (T_6)	10% PW (T_7)
Constant mash**	58.0	58.0	58.0	58.0	58.0	58.0	58.0
Rice polish	27.0	24.0	24.0	22.5	20.0	20.0	20.0
Maize gluten meal	15.0	13.0	13.0	14.5	12.0	12.0	12.0
Malt sprout	—	2.5	—	5.0	5.0	2.5	—
Pea-waste (dehy.)	—	2.5	5.0	—	5.0	7.5	10.0
Calculated Composition							
Crude protein %	19.58	19.30	19.40	19.88	19.56	19.61	19.70
M. E. (Kcal/kg)	2954	2913	2937	2903	2881	2906	2931

*Supplements as in starter diet (Table 1).

**Constant mash contained maize 47.5, fish meal 7.0, poultry mindef 2.5 and lime stone 1.0 parts.
MS=Malt sprout.
PW=Pea waste (dehydrated).

TABLE 3

Proximate composition and energy content of feed ingredients

Ingredients	Dry matter (%)	Proximate principles percentage on DM basis					ME (Kcal/kg)
		Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Total ash	
Maize	91.8	10.5	3.6	5.6	78.5	1.8	3420
Fish meal	94.6	51.4	4.0	2.4	13.3	28.9	2870
Rice-polish	91.5	11.8	14.1	13.1	49.6	11.4	2400
Maize gluten meal	89.4	52.2	3.6	1.5	40.9	1.8	3300
Groundnut oil cake	95.0	41.7	6.4	8.3	36.9	6.7	2500
Guar meal (toasted)	88.8	41.0	5 8	11.2	35.9	6.1	2300
Malt sprout	95.8	22.7	3.4	17.1	49.4	7.4	1410
Pea-waste (dehydrated)	94.5	25.3	2.6	12.7	56.7	2.7	2400

Cochran (1967) and the chemical composition of diet ingredients was determined by the A.O.A.C. (1970) methods.

RESULTS AND DISCUSSION

The chemical composition and energy content of different ingredients used in the formulation of various experimental rations have been presented in Table 3. All the rations were nearly isonitrogenous and isocaloric (Tables 1 and 2).

Mean live weights of chicks at start (1 week), 6, 8 and 10 weeks of age are presented in Table 4. At 6 weeks of age, the highest body weights were obtained by the chicks reared on 10% PW diet (T_7) followed by the chicks under treatment T_5 (MS 5%+PW 5%) and T_6 (MS 2.5%+PW 7.5%), while the lowest gains were recorded in treatment T_4 (5% MS). Practically the same trend was observed at 8 and 10 weeks of age. The statistical analysis of the live weight data revealed that chicks reared under treatment T_1, T_2, T_3 and T_4 did not differ significantly amongst themselves in live weight gains at 6 weeks of age. Similarly, chicks fed diets under T_5, T_6 and T_7 behaved in the same fashion. However, significantly ($P<0.05$) higher live weights were attained by the chicks under treatment T_5, T_6 and T_7 in comparison to treatment T_1, T_2, T_3 and T_4. At 8 weeks of age, the highest body weights were attained by the chicks reared under treatment T_7, while the lowest gains were observed in chicks fed with diet under treatment T_4. Treatment T_4 and T_1 did not differ significantly with regard to body weight gains, however, live weight gains under these treatments (T_1 and T_4) were significantly lower ($P<0.05$) than the live weights attained under treatment T_7. At 10 weeks of age the trend of live-weight gain remained same as at 8 weeks of age.

These observations revealed that the live weight gains were significantly reduced by inclusion of malt sprout in the diet, but this effect was not apparent till 6 weeks of age. When pea waste was incorporated with malt sprout the growth depression was checked. The malt sprout had a growth depressing effect on the broiler chicks, was also evident from the comparison of live-weight figures attained by chicks under treatment T_6 and T_7 at 10 weeks of age.

Groupwise average feed consumption, corresponding feed conversion rate and its index alongwith the cost of feed/kg live weight gain have been presented in Table 5. It was observed that the highest feed consumption was recorded in treatment T_7 at all the ages. The feed consumption did not differ significantly amongst the different treatments upto the age of 6 weeks thus indicating that alterations in the control diet by including malt sprout and/or pea waste did not amount to significant change in the consumption of feed and its utilization upto the age of 6 weeks. That the grower diets showed their influence within a period of 2 weeks time was evident from the data of feed consumption and FCR at 8 weeks of age. Feed consumption was significantly higher ($P<0.05$) in treatment T_7 in comparison to control (T_1). At 10 weeks of age also, significantly more feed was consumed ($P<0.05$) by the chicks reared under treatment T_7 which resulted in a lowest feed conversion ratio for this treatment.

To find out specifically the effect of inclusion of pea waste and malt sprout

TABLE 4

Average live weights (g) at different ages of broiler growth

Age	Treatments						
	Control (T_1)	2.5% PW+ 2.5% MS (T_2)	5% PW (T_3)	5% MS (T_4)	5% MS+ 5% PW (T_5)	2.5% MS+ 7.5% PW (T_6)	10% PW (T_7)
1 week	63.1±[a]	64.4±[a]	68.9±[a]	66.4±[a]	67.7±[a]	65.2±[a]	66.5±[a]
	1.66	1.69	1.87	1.83	1.60	1.66	1.43
6 week	647.3±[a]	655.5±[a]	661.9±[a]	642.8±[a]	735.9±[b]	735.9±[b]	795.9±[b]
	24.25	25.42	25.98	24.79	20.46	20.12	20.13
8 week	932.2±[ab]	943.9±[b]	954.1±[b]	869.6±[a]	1007.9±[b]	1004.8±[b]	1135.7±[c]
	28.27	35.27	32.70	30.63	24.91	29.48	25.03
10 week	1280.0±[ab]	1310.6±[ab]	1414.7±[b]	1184.7±[a]	1405.6±[b]	1410.0±[b]	1608.1±[c]
	62.48	84.96	57.32	60.07	55.07	59.78	47.79

MS=Malt Sprout

PW=Pea waste (dehydrated)

[a], [b], [c],=The figures having different superscripts are significantly different ($P<0.05$) with each other.

TABLE 5

Feed consumption and conversion index of broiler chicks at different ages

Particulars	Treatments						
	Control (T_1)	2.5% MS + 2.5% PW (T_2)	5% MS (T_3)	5% PW (T_4)	5% MS + 5% PW (T_5)	2.5% MS + 7.5% PW (T_6)	10% PW (T_7)
			1–6 weeks				
Av. feed consumed (g)	1518[a]	1438[a]	1474[a]	1490[a]	1598[a]	1522[a]	1677[a]
FCR	2.60	2.43	2.47	2.58	2.39	2.27	2.30
FCR Index	100	93	95	99	92	87	88
			1–8 weeks				
Av. feed consumed (g)	2589[ab]	2422[a]	2462[a]	2596[b]	2781[cd]	2688[bc]	2828[d]
FCR	1.98	2 75	2.78	3.23	2.96	2.86	2.65
FCR Index	100	92	93	108	99	96	88
Cost of feed/kg gain (Rs.)	3.27	3.00	3.02	3.55	3.30	3.09	2.85
			1–10 weeks				
Av. feed consumed (g)	3895[b]	3766[ab]	3754[a]	3732[a]	4047[c]	4062[c]	4151[c]
FCR	3.19	3.01	2.79	3.35	3.03	3.02	2.69
FCR Index	100	94	87	105	95	100	84
Cost of feed/kg gain (Rs)	3.43	3.20	2.97	3.55	3.24	3.21	2.85

MS=Malt sprout

PW=Pea waste (dehydrated)

The figures having different superscript are significantly different ($P<0.05$) from each other.

TABLE 6

Carcass yield, dressing percentage and feed cost per kg dressed carcasses at different ages

Parameters	Weeks	Treatments						
		Control (T_1)	2.5% MS+ 2.5% PW (T_2)	5% MS (T_3)	5% PW (T_4)	5% MS+ 5% PW (T_5)	2.5% MS+ 7.5% PW (T_6)	10% PW (T_7)
Empty live weight	8	929.2	999.2	920.0	843.3	1030.0	1039.2	1170.8
(g)	10	1292.7	1320.0	1385.3	1181.7	1366.3	1408.0	1550.0
Dressed weight	8	750.8	811.7	735.8	681.7	830.8	834.2	945.8
(g)	10	1025.3	1059.4	1110.7	930.0	1078.8	1124.7	1244.4
Eviscerated weight	8	624.2	680.0	619.2	555.8	694.2	705.8	807.5
(g)	10	874.7	900.6	957.3	791.3	936.9	959.3	1086.9
Dressing percentage	8	80.8	81.2	80.0	80.8	80.7	80.3	80 8
(%)	10	79.3	80.3	80.2	78.7	79.0	79.9	80.3
Feed cost/kg dressed carcass	8	4.05	3.69	3.77	4.39	4.09	3.84	3.52
(Rs.)	10	4.33	4.00	3.70	4.51	4.10	4.01	3.55

in starter and grower diets, the data on growth and feed consumption were split into starter and grower periods (1–6 and 6–10 waeks). It was evident from the data that inclusion of MS and PW in the starter diet did not bring about any significant change in feed consumption and growth of chicks. When these ingredients were included in the grower diets, a specific growth depression with MS which was alleviated with PW was observed. The FCR, calculated by taking FCR of control group as 100, was 110 in case of treatment T_4 as compared to 81 in the case of tretment T_7. These observation supported further the superiority of pea waste diets. This growth stimulating effect of pea waste diets could be explained on the basis of amino acid make up of peas which had been reported to contain high amounts of lysine and a favourable essential amino acid balance (Block and Bolling, 1951; Moran *et al.*, 1968).

The data pertaining to carcass yield, dressing percentage and cost per kg dressed carcasses have been presented in Table 6. The yield of dressed eviscerated carcass was significantly ($P<0.05$) higher under treatment T_7 as compared to treatment T_1, while it was significantly lower in case of treatment T_4. Inspite of significantly higher dressed carcass yield, the dressing percentage was practically same in case of treatment T_7 at both the slaughter ages. All other groups compared favourably with treatment T_7 in respect of dressing percentage.

Economics. Feed cost per kg gain was the highest (Rs. 3.55) in treatment T_4, while it was the lowest in case of treatment T_7, i.e., Rs. 2.85 at 8 weeks of age. When the chicks were further reared for another two weeks, i.e., upto the age of 10 weeks, the cost per kg gain remained unchanged in case of treatment T_7, decreased slightly in treatment T_3 and increased in all other treatment groups (Table 5). When the feed cost was calculated on the basis of dressed carcasses, it was found that the cheapest carcasses were obtained from treatment T_7 followed by T_2, T_3, T_6, T_1, T_5 and T_4 at 8 weeks of age, while at 10 weeks of age the cheapest carcasses were obtained from treatment T_7 followed by T_3, T_6, T_2, T_5, T_1 and T_4, respectively, thus indicating that the increment of pea waste in the diet reduced the cost of feed/kg dressed carcass produced.

REFERENCES

A. O. A. C. 1970. *Official Methods of Analysis* (11th edn.). Washington, D. C. Association of Official Agricultural Chemist.

Block, R. J. and Bolling, D. 1951. *The amino acid composition of proteins and foods.* Charles C. Thomas. Springfield. Illinois.

Moran, E. T. Jr., Summers, J. D. and Jones, G. E. 1968. Field peas as a major dietary protein source for the growing chick and laying hen with emphasis on high temperature steam pelleting as a practical means of improving nutritional value. *Can. J. Ani. Sci.* 48 : 47–56.

Pradhan, K. and Saxena, V. P. 1978. Role of nutrients in poultry feeds. *Poultry. Guide* 25 (11) : 59.

Rao, P. V. and Bose, S. 1966. Utilization of industrial and agricultural byproducts in starter rations for meeting amino acid requirements. *Indian J. Poult. Sci.* 1 (1) : 1–11.

Rao, P. V. and Sadagopan, V. R. 1975. Recent developments in alternate feeds for poultry. *Indian Poult. Rev.* **7** : 13-19.

Singh, K. S. and Prasad, C. M. 1976. Effect of replacement of groundnut cake with sunflower cake and the dietary protein levels on the performance of broilers. *Proc. V All India Poult. Sci. Symp. Mysore.* pp. 44.

Snedecor, G. W. and Cochran, W. G. 1967. *Statistical methods* (6th edn.). The Iowa State Univ. Press, U. S. A.

Vaidya, S. V., Panda, B. and Rao, P. V. 1975. Nutritional evaluation of mustard oil cake. 3. Metabolizable energy and nitrogen absorbability in poultry. *Indian J. Poult. Sci.* **10** : 187–188.

Verma, S. V. S. and Panda, B. 1972. Studies on the metabolizable energy value of salseed and salseed cake by chemical and biological evaluation in chicks. *Indian J. Poult. Sci.* **7** : 5-12.

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EFFICACY OF PANACUR(R) (HOECHST) AGAINST SWINE ASCARIASIS

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ABSTRACT

Panacur(R) (Fenbendazole) at dose rates of 5 and 10 mg/kg was found to be 100% effective in eliminating a naturally acquired *Ascaris suum* infection in pigs. The post treatment worm egg production was completely reduced to zero. No adverse side-effects were observed in treated pigs at either of the two dose rates used.

Fenbendazole (Methyl5-(phenylthio)-2 benzimidazole carbamate-$C_{15}H_{13}N_3O_2$ has been reported to have broad spectrum anthelmintic activity against gastro-intestinal nematodes in pigs (Baeder *et al.*, 1974; Enigk *et al.*, 1974; Batte *et al.*, 1975 and Kostenis, 1975). The present study was designed to investigate the efficacy of fenbendazole against a naturally acquired *Ascaris suum* infection in pigs.

MATERIAL AND METHODS

Thirty five naturally infected pigs belonging to the Department of Animal Nutrition, Haryana Agricultural University, Hissar, were included in this trial. Three groups were formed, two (treated) consisted of 15 pigs each and the third group of 5 pigs was designated as non-medicated control. The intensity of each animal's parasite burden was gauged by faecal sampling and egg counting (Stoll's technique) of all the pigs. All the pigs were weighed before treatment. Panacur(R) (Fenbendazole) granulate were administered orally with feed at the dose rate of 5 and 10 mg per kg body weight to each treated group, respectively. The faeces of all pigs were collected on 3rd, 7th, 14th and 21st day post treatment for egg counts.

RESULTS AND DISCUSSION

The infection encountered on faecal examination in naturally parasitized pigs was *A. suum* and *Balantidium coli*. The pre-treatment mean faecal egg counts of *A. suum* in all groups varied from 1200-3200. Mean faecal egg count of treated groups fell to zero on 3rd day post-treatment and remained zero on 7th, 15th and 21st day post-treatment, while in control group there was no reduction in egg counts.

A single treatment of Panacur(R) granules at the dose rate of 5 and 10 mg per kg body weight were 100% effective against *A. suum*. The result of Panacur(R)

are in conformity with the findings of Kostenis (1975), who found 100% reduction of Ascarid eggs in swines at the dosage rate of 3 and 30 mg per kg body weight of fenbendazole. The drug was quite ineffective against *B. coli*. All the pigs survived the experimental period and no toxic signs were observed at any time after treatment.

REFERENCES

Baeder, C., Bahr, H., Christ, O., Duwel, D., Kellner, H. M., Kirsch, R., Loewe, H., Schultes, E., Schutz, E. and Westen, H. 1974. Fenbendazole : A new, highly effective anthelmintic. *Experientia*. 30 : 753.

Batte, E. G., McLamb, R. D. and Vestal, T. J. 1975. Paper given at the Conference of Research Workers in Animal Disease. Chicago. 30.11.75-2.12.75.

Enigk, K., Dey-Hazra, A. and Batke, J. 1974. Zur Wirksamke it von Fenbendazole auf den nematodenbefall des magen-darm kanals beim Schwein. Dtch. Tierarztl. Wschr. 81 : 177-182

Kostenis, C. 1975. Untersuchungen uber die anthelminthische wirkung von fenbendazol (Panacur(R) Hoechst) in der schweinepraxis. Vet. Diss., Munchen.

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PHENOTYPIC CORRELATIONS OF EXTERNAL BODY MEASUREMENTS WITH BODY WEIGHT; LACTATION YIELD AND FAT AND SOLID CONTENT OF MILK; IN MURRAH BUFFALOES

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ABSTRACT

A study of 610 murrah buffaloes revealed the existence of significant correlations of body weight, lactation yield, total solids and fat percent with a few external body measurements. The chest width, chest depth and heart girth had significant correlations with all these traits. Body length had a very high correlation (0.6918) with body weight. The relationship of this trait with lactation yield and total solids was also high.

There are two reliable ways to select the buffaloes, that is, from production and reproduction records or body conformation. However, there are a vast number of animals in our country on which production records are not maintained. In determining the value of such animals for dairy purposes, the estimate has to be based on the visual appraisal. The reports available in the literature indicate that certain physical measurements are correlated with milk production and other important production characters. Such reports are mostly available in cases of cows and the data indicating the relationship of external measurements with production traits is scanty in case of Indian buffaloes. The present study was aimed to fill up this gap.

MATERIAL AND METHODS

Six hundred and ten murrah buffaloes in different stages of lactation were studied. These animals were maintained at Haryana Agricultural University (21), Government Livestock Farm (442) and Military Dairy Farm (147). The animals in most of the cases were farm bred and in some cases purchased. The data on external body measurements as well as lactation yield, fat and total solid percent of milk were recorded on various lactations and in different periods of individual animals. The means and standard errors of these observations have been reported in Table 1. The different lactation periods represented freshening to 7 weeks, 8th to 20th week and 21st week to the end of lactation

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(300 days lactation). Since the least square analysis of variance revealed significant effects of lactation number and stage of lactation on various traits, the data were adjusted for these effects and the phenotypic correlations were calculated to find the functional relationships between yield and the various external body measurements on the adjusted data. The farm effects were found non-significant. The skin thickness was measured just behind the shoulders. The detailed method of measuring the other traits have been reported by Sindhu (1974).

RESULTS AND DISCUSSION

The correlation co-efficients between external body measurements and the production traits have been presented in Table 2. The body weight was correlated with most of the body measurements. However, the correlations between teat measurements and body weight were low and positive. The udder width had a negative correlation with body weight. Heart girth, body length, chest width and chest depth had very high correlations with body weight. This indicated that these measurements

TABLE 1

Least square means & standard errors for various traits

Trait	Least square mean	SE
Body weight (kg)	508.60	5.34
Lactation yield (kg)	1895 30	32.87
Total solids (%)	15.86	0.51
Fat (%)	6.85	0.09
Skin thickness (cm)	1.32	0.02
Body length (cm)	143.00	0.62
Wither height (cm)	135.20	0.68
Chest width (cm)	66.80	0.34
Chest depth (cm)	79.30	0.37
Heart girth (cm)	197.40	0.75
Tail length (cm)	89.00	0.67
Space between foreteats (cm)	13.44	0.14
Space between fore & rear teats (cm)	8 96	0.13
Teat length (Fore) (cm)	7.50	0.72
Teat length (Hind) (cm)	8.50	0.13
Teat diameter (Fore) (cm)	2.65	0.04
Teat diameter (Hind) (cm)	2.83	0.04
Udder length (cm)	54.80	0.54
Udder width (cm)	46 30	0.47
Udder depth (cm)	23.20	0.32
Milk vein length (cm)	49.63	0 59
Milk vein diameter (cm)	2.58	0.03
Udder area $(cm)^2$	2565.00	44.5
Udder volume $(cm)^3$	62735.00	2299.00

TABLE 2

Correlation coefficients of body measurements with production traits of murrah buffaloes

Traits	Correlations coefficients with			
	Body weight	Lactation yield	Total solids%	Fat %
Skin thickness	0.2595	0.1931	0.1013	0.0640
Body Length	0.6918	0.2341	0 2135	0.1983
Withers height	0.1972	0.1659	0.1265	0.0990
Chest width	0.5233	0.2791	0.3521	0.3266
Chest depth	0.4553	0.2457	0.2881	0.2713
Heart girth	0.7975	0.2711	0.2258	0.2293
Tail length	0.1754	0.1033	0.1073	0.0869
Space beetween fore and rear teats	0.2207	0.1326	0.1417	0.1464
Teat length (Fore)	0.1562	0.0521	0.0847	0.0833
Teat length (Hind)	0.0072	0.0107	-0.0191	-0.0012
Teat diameter (Fore)	0.1749	0.0736	0.1102	0.1219
Teat diameter (Hind)	0.1447	0.1173	0.0563	0.0708
Udder length	0.2551	0.1631	-0.0643	0.0386
Udder width	0.2239	0.1100	0.0463	-0 0315
Udder depth	0.2700	0.1641	0.0301	0.0585
Milk vein length	0,2703	0 0480	0.1874	0.1999
Milk vein diameter	0.1638	0.0739	0.0116	0.0189
Udder area	0.2905	0.1448	0.0208	0.0182
Udder volume	0.2191	0.0880	0.0487	0.0710

could be used to make a reliable estimate of body weight.

The lactation yield, percent solids and percent fat content of milk had moderately high corrrelations with chest width, chest depth and heart girth. The correlations of these traits with other body measurements were mostly low but positive. A few negative correlations of a very low order were also obtained.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. C. K. Aggarwal for going through the manuscript.

REFERENCES

Sindhu, M. S. 1974. Studies on the external physical traits and their relationship to milk production and composition in Murrah buffaloes. Ph. D. thesis. Haryana Agricultural University Hissar.

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ANGIOARCHITECTURE OF SHEEP EPIDIDYMIS

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ABSTRACT

The two epididymal arteries of the ram arose from the testicular artery at or close to the apex of the vascular cone. These vessels described helical coils during their course along the pampiniform plexus of the spermatic cord and ramified in the epididymis. The first epididymal artery established anastomosis with the artery of the ductus deferens in the region of the tail of the epididymis. The organ was drained by mini pampiniform venous plexuses, which were juxtaposed with the arteries. The coiling of the arteries and their close association with the mini pampiniform venous plexus may be responsible for thermoregulatory and haemodynamic mechanism in epididymis.

Vascular adaptations in the shape of spiral course of the epididymal arteries and their juxtaposition with the mini pampiniform plexuses of veins draining different portions of the epididymis have been reported in buffalo (Dhingra, 1978b). Spiral course of the epididymal arteries has also been demonstrated in the buck (Dhingra, 1978a) and donkey stallion (Dhingra, 1978c). The coiling of the arteries and their close association with the pampiniform plexuses play an important role in haemodynamics and thermoregulatory mechanism for enhancing the fertile life of the spermatozoa in mammalian epididymis (Free, 1977).

The literature on the vascular adaptations of the sheep epididymis is incomplete, sparse and scattered. Considering the non-availability of complete information on the angioarchitecture of ram epididymis, it was thought worthwhile to investigate the vascular adaptations in the ram epididymis.

MATERIAL AND METHODS

Ten adult male sheep were used for this study. Their testes alongwith the spermatic cords were excised at the level of the internal inguinal ring under general anaesthesia. The testicular artery and the satellite vein were cannulated at the apex of the vascular cone and the pampiniform plexus of vein, respectively. The organ was flushed with normal saline solution. In five of the animals, radiopaque material (20% lead oxide suspension in 100 ml of liquid soap) was injected through the artery. The testes of four animals were given the following treatment :

1. One of the prominent capsular veins was cannulated and the radiopaque material was injected very slowly till it started coming out of the testicular vein, cannulated at the level of the apex of the vascular cone. The testicular vein was then ligated and

another 5 ml of radiopaque material was injected very slowly so that it demonstrated all the intratesticular venous passage-ways.

2. In one of the animals, both the testicular arteries and the testicular veins were injected to study this relationship.

After satisfactory injections, the cannulated vessels were ligated. The epididymal vessels were studied first along with the testis and then epididymis along with its vessels was gently separated from the testis and the spermatic cord for detailed vascular studies through radiography and gross and subgross dissections. The radiographs were taken on Indu films at 90 mm FFD with 50-60 Kvp and 6-10 MaS depending upon the thickness of the tissue.

RESULTS AND DISCUSSION

Arteries

The epididymis received its arterial supply through two epididymal arteries, which were given off the testicular artery near the apex of the vascular cone. Similar observations have been made in buck and buffalo (Dhingra, 1978a, 1978b), sheep (Dhingra, 1978d) and other scrotal eutharian (Free, 1977). However, in donkey stallion (Dhingra, 1978c), the first epididymal artery arises from the straight portion of the testicular artery proximal to the vascular cone and the second epididymal artery from the convoluted portion of the testicular artery (vascular cone), Fehlings and Pohlmeyer (1978) reported the origin of three epididymal rami from the extratesticular portion of the testicular artery. Branches to the epididymis have been described to originate from different levels of the vascular cone in man (Hundeiker, 1971) and dog (Harrison, 1949). The first epididymal artery (*R. epididymalis primus*) arose 0.5 to 1 5 cm ventral to the apex of the vascular cone and the second epididymal artery *(R. epididymalis secundus)* arose 1.5 to 2 5 cm ventral to the first epididymal artery. These vessels descended in a spiral fashion along the highly coiled testicular artery in the vascular cone and were intimately related to the pampiniform plexus of veins. Similar relationship of blood vessels has been recorded in buck, buffalo (Dhingra, 1978a, 1978b), horse (Fehlings, 1976) and donkey stallion (Fehlings and Pohlmeyer, 1978 and Dhingra, 1978c) and eutharian mammals in general (Setchell, 1970). The degree of coiling of the epididymal arteries in the sheep was comparable to that of the goat and buffalo (Dhingra, 1978a, 1978b). However, in donkey stallion, this feature is less developed specially so in the first epididymal artery (Dhingra, 1978c). The first epididymal artery, after its origin from the vascular cone, descended and described helical coils in conformity to the coiled testicular artery of the vascular cone. Slightly ventral to the level of origin of second epididymal artery it gave off a branch, *R. epididymalis corporis*, for the proximal one third of the body of epididymis. At the level of the proximal extremity of the latter, it gave off another corporal branch of the caliber similar to that of first corporal branch, which pursued a slightly spiral course along the body of the epididymis giving off branches to the latter. In some of the specimens (Fig. 2) the single corporal branch gave off a tiny twig at the level of the junction of body and head of epididymis, bifurcated at the level of junction of proximal one third

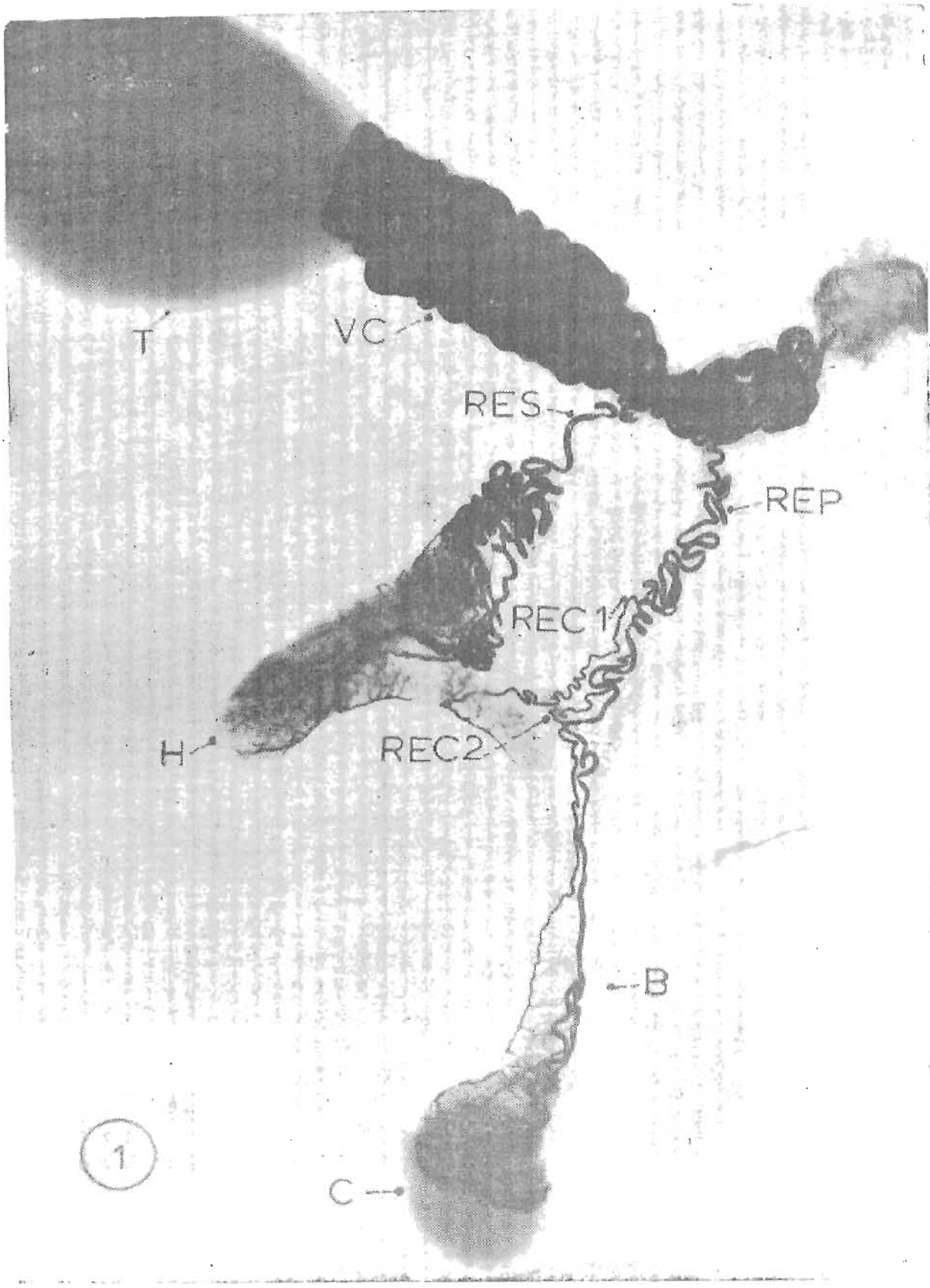
and distal two thirds of the body of epididymis into an ascending branch and a descending branch. The ascending branch ramified into the proximal one third of the body. The descending branch was comparable to the second corporal branch given off usually at the level of the head of the epididymis and its territory of ramification was also similar to the above referred corporal branch. The parent trunk, *R. epididymalis caudae* descended in a slightly coiled fashion along the posterior border of the body of the epididymis and gave off 2 to 3 slender branches proximal to the junction of the body and tail of the epididymis. These branches travelled distally and terminated in the tail of the epididymis. The main trunk also reached the tail in a spiral fashion and broke up into fine branches which established anastomosis with branches of the artery of the ductus deferens (Fig. 3), similar to that of buffalo (Borthakur and Dhingra, 1977) and buck (Dhingra, 1978a).

The second epididymal artery described 1 to 3 helical coils along its descending course on the vascular cone before dividing into a dorsal and a ventral branch (Fig. 1). Its division into three branches was also encountered frequently (Fig. 2). In the first type of branching, the dorsal branch coiled profusely on the basilar part of the vascular cone and descended on the attached surface of the head of the epididymis. It described 4 to 6 helical coils on the attached surface before traversing the anterolateral projection of the head. It ramified mostly in its dorsal segment and a part of its anteriolateral projection. The ventral branch also descended ventrally close to the dorsal branch but it described comparatively less number of coils during its course on the vascular cone. It entered through the attached surface of the head close to the entrance of the dorsal branch and ramified in the ventral segment of the head and adjacent portion of the body of the epididymis. In the case of the artery dividing into three branches, two of the branches, which were of similar caliber but thinner than the third one served similar territories of the head of epididymis as were nourished by the above referred dorsal branch, whereas the third one corresponded with the ventral branch in its distribution.

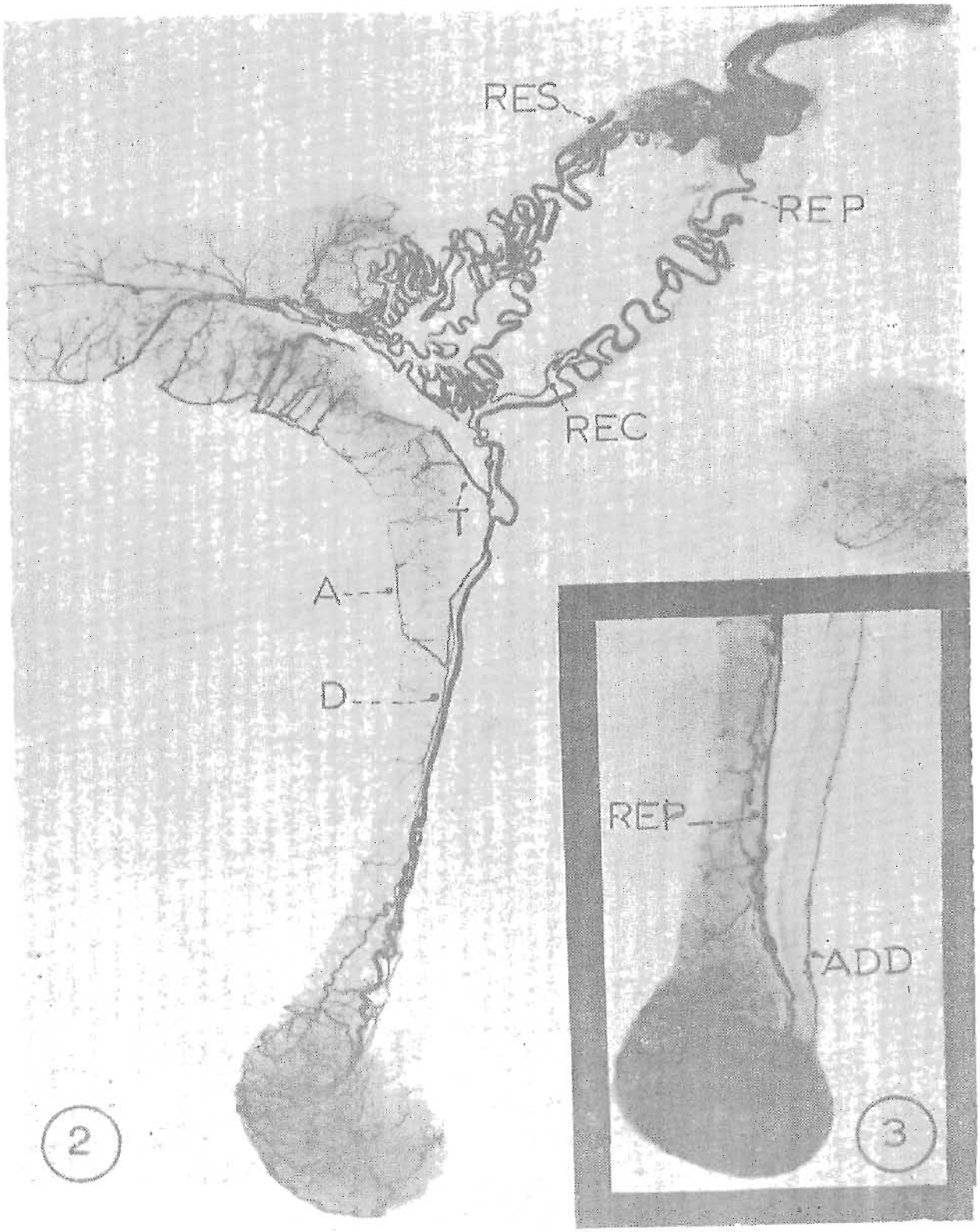
Veins

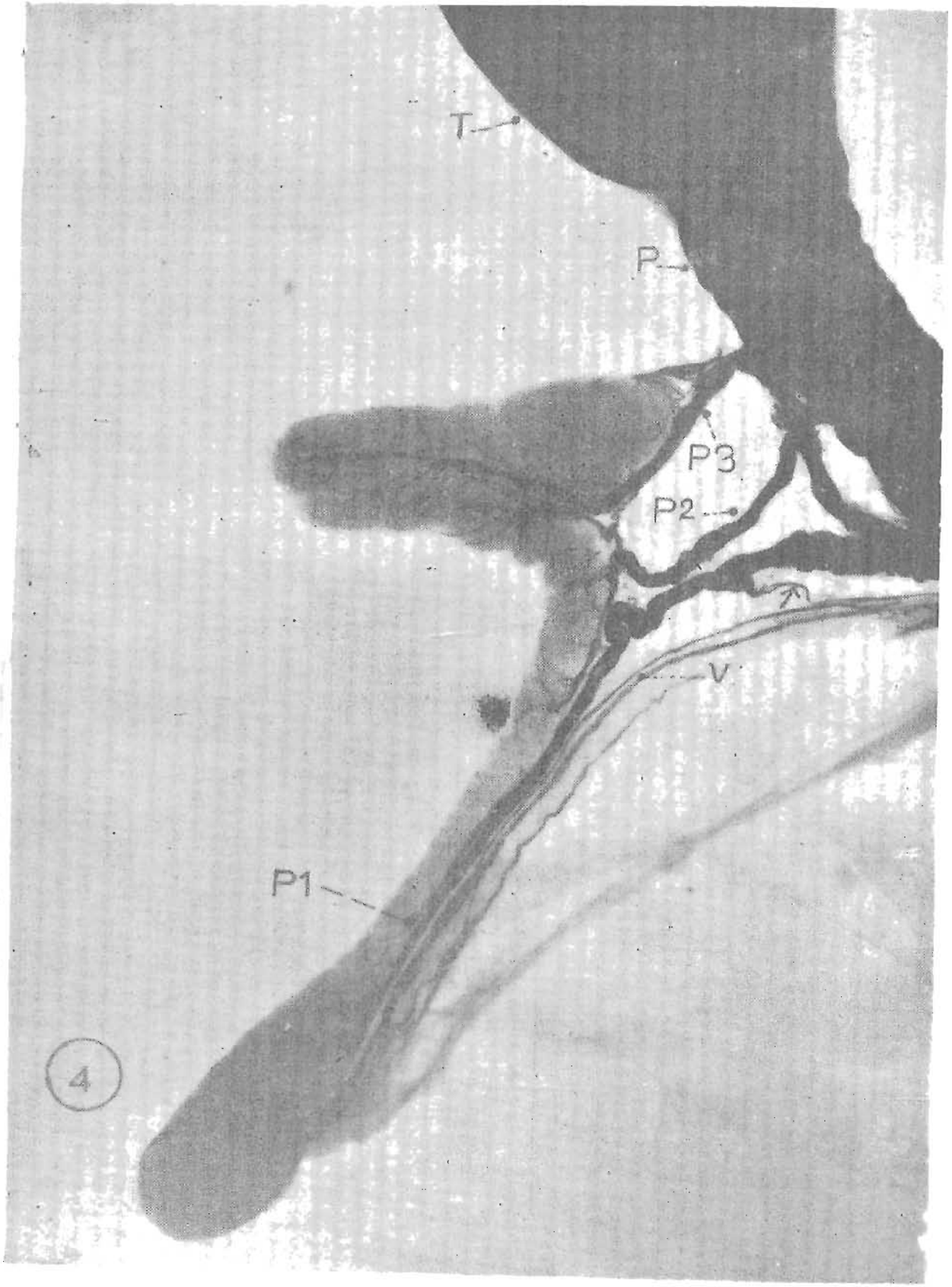
The veins draining the epididymis (Fig. 4) demonstrated vascular adaptations in the form of mini pampiniform plexuses, which drained into the main pampiniform plexus of veins as had been observed in buffalo (Dhingra, 1978b). The tail of the epididymis had a dual drainage system. It was partly drained by vessels, which after emerging from the organ, formed a thin mini pampiniform plexus-1 (P-1) and partly through the deferential vein (V). P-1 ascended in between the body of the epididymis and the ductus deferens and progressively increased in size through merging of veins draining the distal 2/3rd of the body of the epididymis. At the level of the head of the epididymis, it received an anastomotic vessel from the deferential vein and travelled proximally to receive a joint trunk of the mini pampiniform plexuses draining the head and proximal one third of the body of the epididymis.

The latter segment of the organ was drained by a mini pampiniform plexus-2 (P-2), which originated at the level of the junction of the proximal 1/3rd and distal 2/3rd of the body of the epididymis. It ascended towards the head of the



1


RES
REP
REC
A
D
REP
ADD
2
3


T
P
P3
P2
V
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4

epididymis and received veins draining the portion lying adjacent to the body of the epididymis. The parent trunk of P-2 then ascended and received another mini pampiniform plexus-3 (P-3) draining the dorsal segment of the head and also craniolateral portion of the ventral segment of the latter The P-3 established anastomosis with the P-2 through a small vein and also anastomosed with the main pampiniform plexus of vein. The common trunk of P-2 and P-3 ascended and met P-1 before merging with the main stream of the pampiniform plexus of veins in the spermatic cord. P-1 lay satellite to the first epididymal artery during its course in the spermatic cord and on the epididymis. Similarly, P-2 and P-3 were closely related with the second epididymal artery during their course in the pampiniform plexus and also on the epididymis. The mini pampiniform plexuses of veins draining the epididymis of ram, were similar to those of the buffalo except that the proximal 1/3rd of body of the epididymis and the ventral segment of the head were drained by two different plexuses of veins in buffalo (Dhingra. 1978b), whereas in ram a single plexus drained the above referred segments of the epididymis. Such plexuses draining the epididymis of donkey stallion have not been reported but instead, veins drain-

LEGENDS

Fig. 1 Mediolateral arteriogram of dissected epididymis showing the course and distribution of *Ramus epididymalis primus* (REP) and *Ramus epididymalis secundus* (RES). The first epididymal artery gives off a corporal branch (*R. epididymalis corporis.*, RECI) for upper 1/3rd portion of the body of the epididymis and another corporal branch (REC 2) for the remaining segment of the body. The parent trunk of the first epididymal artery continues ventrally as *Ramus epididymalis caudae* for distribution in the distal 1/3rd of the body and tail of the epididymis. T=testis; VC=vascular cone; H=*caput epididymalis;* B=*corpus epididymalis* and C=*cauda epididymis*. Negative image reproduction X 1.

Fig. 2 Mediolateral arteriogram of a dissected epididymis showing a different pattern of branching of the first and second epididymal arteries. The second epididymal artery (REP) is seen to trifurcate and the resulting branches describe helical coils before penetrating the dorsal and ventral segment of the caput epididymidis. The corporal branch (REC) of the first epididymal artery (REP) is given off at the level of the proximal extremity of the corpus epididymalis. A tiny twig (T) is seen to arise from it and the main trunk of the corporal artery bifurcates into an ascending (A) and a descending (D) branches. Negative image reproduction X 1.

Fig. 3 Mediolateral arteriogram of the epididymis and ductus deferens showing the distribution of the first epididymal artery (REP) in the distal half of the body and tail of the epididymis. The artery of the ductus deferens (ADD) is also seen filled up with the radiopaque injection material indicating anastomosis of the first epididymal artery and the artery of the ductus deferens in the tail of the epididymis. Negative image reproduction X 1.

Fig. 4 Mediolateral venogram of the dissected epididymis showing the formation and course of the pampiniform venous plexuses draining the epididymis. The body and tail of the epididymis is drained by a plexus of veins (P 1) which ascends along the body of the epididymis. Two mini pampiniform plexuses (P2, P3) drain the head of the epididymis and proximal 1/3rd segment of the body of the epididymis. P2 and P3 anastomose with each other and drain into P1. The latter finally merge with the main pampiniform plexus (P) of the spermatic cord. P1 and the deferential vein also anastomose through a small vein (arrow). T=testis. Negative image reproduction X 1.

ing different portions of the organ run satellite to the arteries (Dhingra, 1978c). It is, therefore, likely that the heat and metabolite transfer mechanism between the venous and arterial blood through juxtaposition of the vessels seems to be more efficient in the epididymis of sheep and buffalo as compared to that of the donkey stallion.

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REFERENCES

Borthakur, S. and Dhingra, L. D. 1977. Anatomical studies on the blood vessels of the testis in buffalo *(Bubalus bubalis). Indian J. Anim. Sci.* (in press).

Dhingra, L. D. 1978a. Angiographic and gross anatomical studies of the arterial pattern of the goat epididymis. *Haryana agric. Univ. J. Res.* 8 (2) : 120-124.

Dhingra, L. D. 1978b. Angioarchitecture of the epididymis of buffalo *(Bubalus bubalis). J. Anat. Soc. India* (in press).

Dhingra, L. D. 1978c. Angioarchitecture of the epididymis of Indian donkey stallion. (Unpublished observation).

Dhingra, L. D. 1978d. Angioarchitecture of sheep testis (Unpublished observation).

Fehlings, K. 1976. Korrosion-und-rontgenanatomische untersuchungen der arteria testicularian vonkatz und, schwein, schaf, rind and pferd. Tierarztl. Hochschule, Diss., Hannover. (Quot. Fehlings and Pohlmeyer, 1978).

Fehlings, K. and Pohlmeyer, K. 1978. Die arteria testicularis und Ihre aufzweigung im hoden und nebenhoden des esels *(Equus africanus. f. asinus). Zbl. Vet. Med. C. Anat. Histol. Embryol.* 7 : 74-78.

Free, M. J. 1977. Blood supply to the testis and its role in local exchange and transport of hormones. In "The Testis IV" (A. D. Johnson and W. R. Gomes Eds). PP. 39-84. Academic Press, New York.

Harrison, R. G. 1949. The comparative anatomy of the blood supply of the mammalian testis. Proc. Zool. Soc. *London* 119 : 326-344 (Quot-Setchell, 1970).

Hundeiker, M. 1971. Studies on vascularization of testis. *Fortschr. Med.* 89 : 35 (Quot. Free, 1977).

Setchell, B. P. 1970. Testicular blood supply, lymph drainage and secretion of fluids. In *"The Testis"* (A. D. Johnson, W. R. Gomes and N. L. Van Demark Eds). PP 101-218, Academic Press, New York.

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HISTOMORPHOLOGICAL OBSERVATIONS ON THE TONGUE OF BUFFALO WITH SPECIAL REFERENCE TO ITS PAPILLAE

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ABSTRACT

The buffalo tongue was studded with filiform, fungiform, conical, lenticular and vallate papillae. All the papillae, except the filiform, were provided with a connective tissue core. The filiform papillae consisted of only the cornified layer of epithelium. The fungiform papillae were surrounded by a narrow and shallow trench. These papillae were mostly devoid of taste buds, but those present on the ventral surface of the free portion of the tongue occasionally demonstrated them. Nerve endings and ganglion cells were observed. Maximum innervation was observed in the region of vallate papillae. Arteriovenous anastomoses were seen, especially at the root of the tongue.

In an earlier report, the gross anatomical features of the buffalo tongue were reported. The present paper incorporates the detailed histological observations on the tongue of buffalo with special emphasis on its papillae.

MATERIAL AND METHODS

Eight adult Murrah buffalo tongues were dissected out from formalin embalmed carcasses. Tissues from different regions were collected in neutral buffered formalin. The routine alcohol-benzene schedule was adopted for paraffin sectioning. Thin sections (5 μ) were stained with haematoxylin and eosin, Gridley's reticular (Thompson, 1966) and Weigert Van Giesson stains (Luna, 1968). Bielschowsky's silver and Chang's formolthionin (Cook, 1974) block impregnation techniques were used for demonstration of neuron and nerve fibers.

RESULTS AND DISCUSSION

The buffalo tongue comprised of a core of interwoven bundles of skeletal muscle fibers in dense connective tissue and was covered with mucous membrane lined with stratified squamous epithelium. The lamina propria merged with the interstitial tissue of the muscle. The mucous membrane was modified on the dorsum and ventral margins of the free portion of tongue to form various types of papillae, filiform, giant filiform, fungiform, conical, lenticular and vallate.

The skeletal muscle fibers were grouped into bundles which interlaced with one another. They were arranged in vertical, transverse, longitudinal and oblique directions. The interstitial tissue contained blood vessels, nerves and fat cells. A number of motor-end-plates were also observed. The lamina propria

was composed of closely interwoven collagen fibers, a few reticular fibers and connective tissue cells. Mast cells and plasma cells were frequently observed. The primary and secondary papillae projected into the epithelium. Serous and seromucous glands were present in the vicinity of vallate papillae in the lamina propria and also deep into the interstices of the musculature (Fig. 5). Senger and Singh (1970) found racemose type of tubuloacinar glands in buffalo. Serous and mucous glands have been reported in the tongue of horse (Trautmann and Fiebiger, 1957). Their duct system was well developed. The

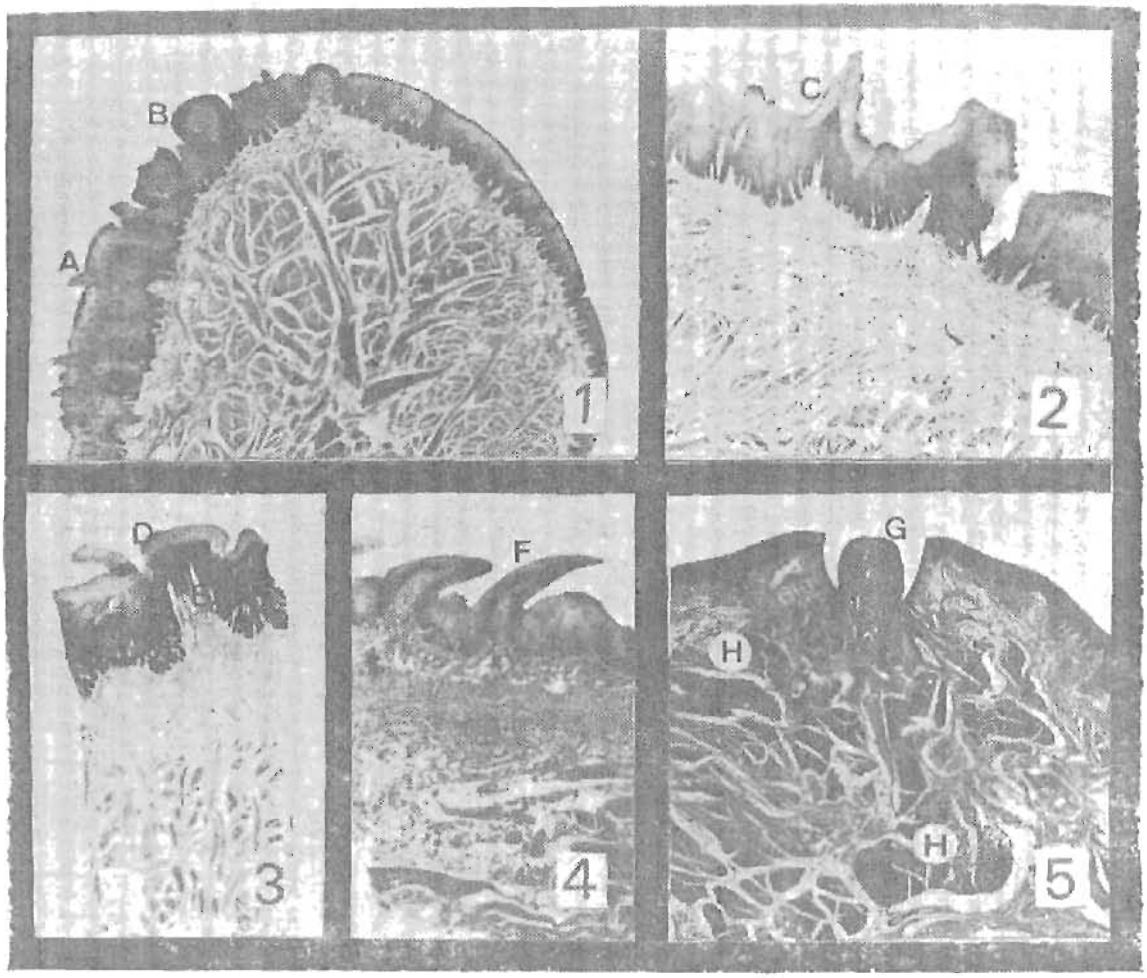


Fig. 1. Photomicrograph showing the filiform (A) and fungiform (B) papillae on the dorsum of the tongue. The filiform papillae constitute the projection of cornified layer. The fungiform papillae are surrounded by crypts. H & E×7.

Fig. 2. Photomicrograph showing the conical papillae (C) in which the dermal core does not extend beyond the surface epithelium. H & E×6.

Fig. 3. Photomicrograph showing the lenticular papilla (D). The dermal core sends long and slender secondary connective tissue projections (E) into the epithelium. H & E×6.

Fig. 4. Photomicrograph showing the giant filiform papillae (F) with a dermal core reaching upto the tip of the papillae. H & E×6.

Fig. 5. Photomicrograph showing the vallate papilla (G). The lingual glands (H) are located in the lamina propria and also deep into the musculature. H & E×7.

intralobular ducts were lined with simple low cuboidal epithelium with spherical nuclei. The excretory interlobular ducts were lined with simple columnar or stratified cuboidal epithelium. It became stratified squamous near its termination into the crypts of vallate papillae (Fig. 9). These ducts usually terminated on the lateral wall of the moat. A few lymph follicles were also noticed in the vicinity of vallate papillae.

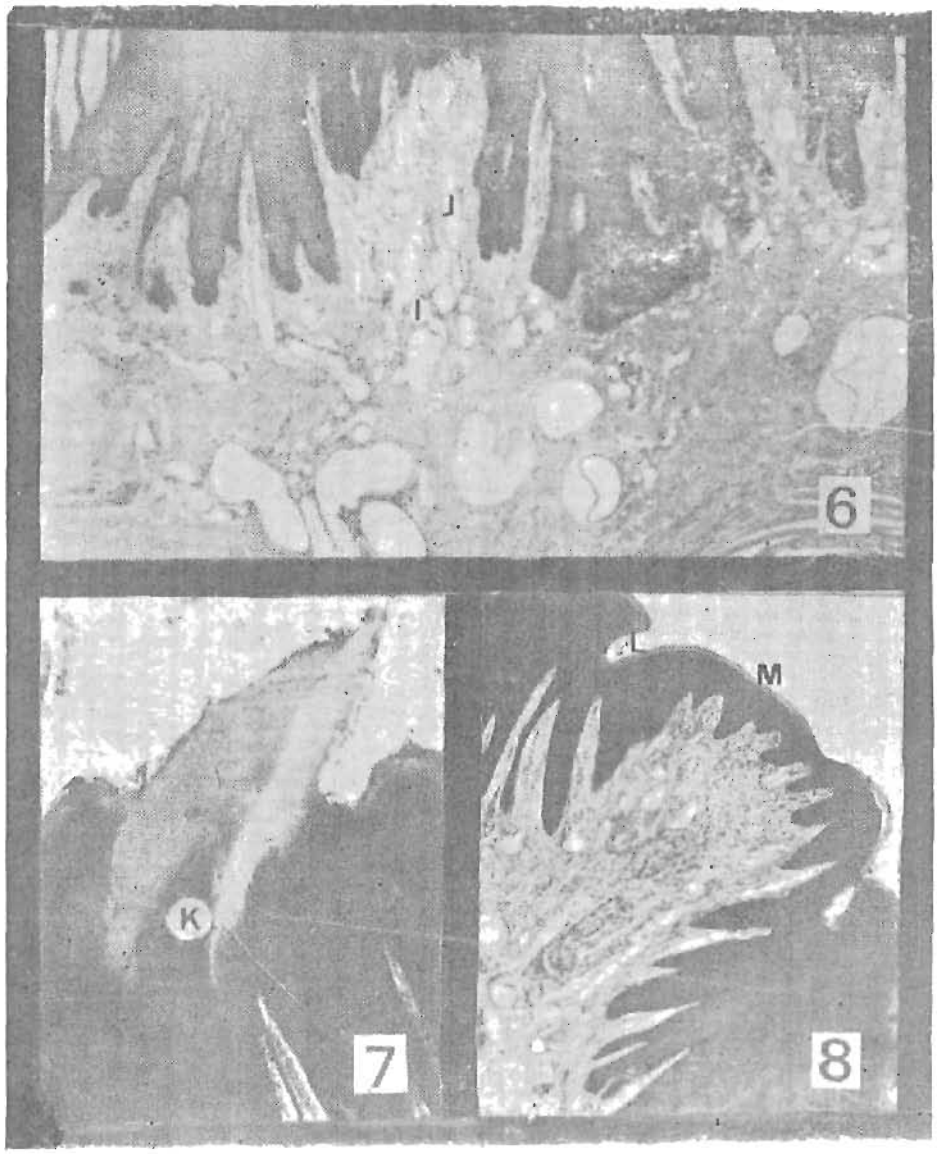


Fig. 6. Photomicrograph showing lamina vasculare under the epithelium. The blood vessels pass into the connective tissue core and secondary papillae. H & E×40.

Fig. 7. Photomicrograph showing the strong anchorage of filiform papilla into the epithelium. The stratum spinosum projects into the base of papilla forming a cellular cone (K). H & E×40.

Fig. 8. Photomicrograph showing a narrow and shallow trench (L) surrounding the fungiform papilla. The epithelium is covered with a thin stratum corneum. H & E×40.

The tongue was richly supplied with blood vessels. The root of the tongue showed comparatively larger number of blood vessels and arteriovenous anastomoses. The blood vessels formed a lamina vasculare under the epithelium (Fig. 6) and coursed into the connective tissue core of the lingual papillae, where they branched to send atleast one terminal vessel to each of the secondary papillae.



Fig. 9. Photomicrograph showing the vallate papillae with oval taste buds (N) towards the moat. The duct of lingual glands is seen opening into the trench. Thionin impregnation. x 40.

Fig. 10. Photomicrograph showing the thick nerve bundle (O), serous (P) and mucous (Q) glands in the lamina propria in the vicinity of vallate papillae. Thionin impregnation. x 100.

The dorsal mucous membrane of the tongue was richly supplied with nerves. The ventral mucous membrane was poorly innervated. Large number of thick (Fig. 10) and thin nerve fibers associated with ganglion cells and lamellated nerve endings, like end bulb of Krause in domestic animals, Herbst's corpuscle in birds (Trautmann and Fiebiger, 1957) and pacinian corpuscle in elephant (Kubota, 1967) were observed. The perivascular nerves were observed forming plexuses over them. The filiform, giant filiform, conical and lenticular papillae were poorly innervated. The vallate papillae had an abundent nerve supply.

The tongue was covered with stratified squamous epithelium which was modified to form lingual papillae. The epithelium was much thicker on the dorsal surface than on the ventral surface of the tongue (Fig. 1). The interpapillary zone was smooth and less cornified.

The filiform papillae were composed of cornified cells (Figs. 1, 7). It did not possess any connective tissue core. This is in contrast to the observation of Senger and Singh (1970) who reported the presence of connective tissue core in all types of lingual papillae of buffalo. Trautmann and Fiebiger (1957) described that in most of the species the connective tissue core of filiform papillae did not extend beyond the level of glossal epithelium. In ruminants, the keratinized cone projects above the surface and the connective tissue core has several secondary papillae (Stinson and Calhoun, 1976). Labh and Mitra (1975) reported branching connective tissue core in the filiform papillae of goat and dog. In elephant, these papillae have a slender connective tissue core (Kubota, 1967). The cornified tissue of the papilla burrowed deep into the epithelium to form a strong anchorage. The cells of stratum spinosum projected into the base of the papillae forming a cellular cone (Fig. 7) which, however, did not extend beyond the level of lingual epithelium. The intrapapillary prickle cells had a characteristic eosinophilic cytoplasm. Their rounded nuclei contained peripherally arranged specks of chromatin. The filiform papillae of the dorsum linguae were longer than the papillae on the ventral margin (Fig. 11). The average length of the dorsal papillae was 302.16 $\mu \pm 45.24$ μ (144.15 – 605.20 μ), while that of the ventral side was 203.60 $\mu \pm$ 29.91 μ (63.37 – 340.00 μ).

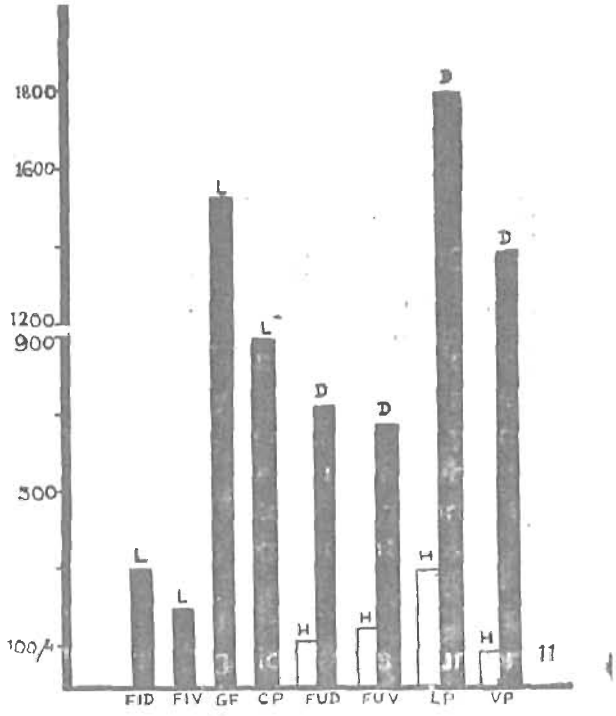


Fig. 11. Histogram showing the length (L) of filiform papillae on dorsal (FID), and ventral surface (FIV), giant filiform (GF) and conical papillae (CP); height (H) and diameter (D) of fungiform papillae on dorsal (FUD) ventral surface (FUV), lenticular (LP) and vallate papillae (VP).

The fungiform papillae were round with a distinct neck (Fig 1). They were surrounded by a narrow and shallow trench (Figs. 1, 8). No such trench has been reported encircling the fungiform papillae of other domestic animals. The papillae were provided with a connective tissue core covered with stratified squamous epithelium. Each secondary papilla was furnished with a set of naked nerve endings and blood capillaries. Intraepithelial nerves were not observed. Qayyum and Beg (1975) reported quite a rich innervation in the fungiform papillae of goat. The epithelium of these papillae in buffalo had a thin stratum corneum (Fig. 8) and a double layered stratum granulosum. The cells of stratum spinosum often contained melanin granules. The cells of stratum cylindricum were heavily pigmented. The fungiform papillae of the dorsum were free of taste buds, while the papillae on the ventral side occasionally demonstrated a few of them. In goat, the dorsal papillae are without taste buds, however, the ventral ones have many of them (Qayyum and Beg, 1975). The taste buds are very sparse in the fungiform papillae of cattle and horse (Trautmann and Fiebiger, 1957; Stinson and Calhoun, 1976). These papillae projected 117.86μ $\pm$21.26 μ (54.40—176.80 μ) from the lingual surface on the dorsal side and for 148.24 $\mu\pm$10.91 μ) (108.80—197.20 μ) on ventral side. Their average maximum diameter were 723.06 $\mu\pm$94.96 μ (544.00—1156.00 μ) and 674.56 $\mu\pm$ 12.09 μ (652.80 - 707.20 μ), respectively. It is clear that ventral papillae were smaller in size but projected higher than the dorsal papillae (Fig. 11).

The conical papillae were provided with a wide and conical primary connective tissue core which did not extend beyond the general lingual epithelium (Fig. 2) and was covered over by a highly keratinized epithelium. Their connective tissue core in goat was large with a blunt apex (Labh and Mitra, 1975). The papillae were curved and slightly blunt pointed. The basal layer demonstrated a number of mitotic cells. The stratum corneum was compact and a bit thicker on one side than on the opposite side (Fig. 2). The connective tissue core demonstrated a few thin nerve fibers and blood capillaries. The average length of these papillae was 893.76$\pm$42.35 μ (710.28—1109.88 μ).

The lenticular papillae were characterized by a primary connective tissue core having six to ten simple, long and slender secondary projections (Fig. 3). The stratum corneum was highly keratinized. These papillae demonstrated a great variation in their diameter with an average of 1796.76 $\mu\pm$240.13 μ (616.05—3463.20 μ). Their average height from the lingual surface was 294.40$\pm$20.60 μ (208.12—421.57 μ).

The giant filiform papillae were located between two arms of the vallate papillae on the root of the tongue (Dhingra and Barnwal, 1979). It was covered by a highly keratinized epithelium. The connective tissue core extended along its full length (Fig. 4) and demonstrated a few simple, narrow and long secondary projections. The average length of the papilla was 1527.43$\mu\pm$224.19μ (421.57—2575.08μ). Their length, however, was greatly variable and could vary in the different animals of same age group.

The vallate papillae were characteristically surrounded by a trench and a vallum lined with stratified squamous

noncornified epithelium (Figs. 5, 9). The epithelium was indented by a number of simple, short and wide secondary connective tissue projections. The epithelium facing the moat was studded with taste buds (Fig. 9). The papillae projected about 83.25 $\mu \pm 16.65\ \mu$ (66.60 – 133.20 μ) above the lingual epithelium. Their average diameter was 1381.95 $\mu \pm 471.23\ \mu$ (999 00 – 1731.60 μ). The connective tissue core consisted of a closely knitted and highly cellular connective tissue. The mast cells and plasma cells were frequently observed.

The taste buds were oval or chalice shaped and distributed throughout the moat area of vallate papillae. Senger and Singh (1970) reported the presence of barrel shaped taste buds in buffalo. In ox, sheep (Trautmann and Fiebiger, 1957) and goat (Qayyum and Beg, 1975) it is oval. In ruminants, horse and swine the taste buds are distributed over the entire papillary wall, while in carnivores they are restricted to the bottom of the moat (Trautmann and Fiebiger, 1957). The nonmyelinated nerve fibers extended through the dermal core into the epithelium and penetrated the taste buds. There, they ramified extensively and projected into the taste pore as taste hairlets.

REFERENCES

Cook, H. G. 1974. *Manual of histological demonstration techniques.* Butterworth & Co., London.

Dhingra, L. D. and Barnwal, A. K. 1979. Gross anatomical studies on the tongue of the Indian buffalo (Bubalus bubalis) *Haryana argic. Univ. J. Res.* 9(1) : 63-68.

Kubota, K. 1967. Comparative anatomical and neurohistological observations on the tongue of elephants *(Elphas Indicus* and *Loxodonta africana). Anat. Rec.* 157 : 505-516.

Labh, P N. and Mitra, N. L. 1975. The mastricatory papillae of the mammalian tongue. *J. Anat. Soc. India.* 24 : 13-19.

Luna, L. G. 1968. M*anual of histologic staining methods of Armed Forces Institute of Pathology.* 3rd edn. McGraw Hill Book Company, New York.

Qayyum, M. A. and Beg, M. A. 1975. Anatomical and neurohistological observations on the tongue of the Indian goat. *Capra aegagrus. Acta anat.* 93 : 554-567.

Senger, O. P. S. and Singh, S. N. 1970. Studies on the digestive system of ruminants. Part III. Structure of the foregut in buffalo, *Bos bubalis. Agra Univ. J. Res. (Sci.)* 19 : 43-64.

Stinson, Al. W. and Calhoun, M. L. 1976. *Digestive system.* In. *Textbook of Veterinary histology.* Ed. Dellmann H. D. and Brown, E. M. Lea and Febiger, Philadelphia.

Thompson, S. W. 1966. *Selected histochemical and histopathological methods.* Charles C. Thomas Publishers; Springfield. Illinois.

Trautmann, A. and Fiebiger, J. 1957. *Fundamentals of the histology of domestic animals.* Comstock Publishing Associates, Ithaca, New York.

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THERAPEUTIC AND PROPHYLACTIC ACTIVITY OF IMIDOCARB DIPROPIONATE AGAINST CLINICAL AND EXPERIMENTAL *BABESIA BIGEMINA* INFECTION IN CATTLE

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ABSTRACT

Chemotherapeutic activity of a new babescide Imidocarb, 3, 3'-bis-(2-imidazolin-2-yl)-carbanilide dipropionate (Imizol, Burroughs wellcome) against *Babesia bigemina* was evaluated in 17 clinical field cases and 5 splenectomised cross-bred calves. The drug was found very efficacious administered intramuscularly @ 1 mg/kg and all the animals except two clinical cases with severe anaemia, were completely cured without any side effects.

Chemoprophylactic trials with Imidocarb also showed its residual effects and four calves treated @ 2 mg/kg 28-40 days previously were fully protected against artificial challenge with lethal dose of *B. bigemina* infected blood, whereas only partial protection seen in two calves treated 52 days earlier.

Many drugs have been advocated over the years as therapeutic agent against infections with *Babesia* spp. The list includes arsenicals, dyes, quinine, quinuronium salts, acridine derivatives and aromatic diamidines (Joyner *et al.*, 1963). Out of these chemotherapeutic agents only few have been found effective, especially against small babesias. The favourable results were reported for most of these drugs on improvement of clinical signs but there was no indication for their efficacy in completely eliminating the parasite.

Schmidt *et al.* (1969) and Beveridge (1969) found basically substituted carbanilides to be active against *B. rodhaini* in mice. One of these compounds Imidocarb dihydrochloride was also used by Callow and McGregor (1970) to treat *B. argentina* and *B. bigemina* infections in cattle. This paper reports the results of chemotherapy and chemoprophylaxis trials undertaken with Imidocarb against clinical cases and experimental *B. bigemina* infection in splenectomised cross-bred calves.

MATERIAL AND METHODS

Experimental animals

Fifteen male cross-bred calves (Red Kandhari × Jersey and Deoni × Holstein Friesian) having a blood level of 50% each, in the age groups of 8-12 months, were used in this study. The calves were obtained from Animal Farms of Marathwada Agricultural University (MAU), Parbhani and kept under uni-

form conditions of housing and feeding. The calves and sheds were regularly sprayed with 0.5% Sumithion* to keep them free from ticks. In addition, 17 field clinical cases of babesiosis *(B. bigcmina)* in cattle presented for treatment at Veterinary Clinics, MAU were also included in the present studies.

Babesia bigemina Strain

B. bigemina was isolated from a cow showing clinical signs of the disease including haemoglobinuria, brought for treatment at Veterinary Clinics MAU, Parbhani. The strain was later maintained in cross-bred calves by syringe passage of infected blood. The calves were splenectomised as per the technique of Singh and Gautam (1972).

Haematological studies

The blood films were stained by Giemsa and per cent parasitaemia expressed as number of parasitised erythrocytes per unit of 100 erythrocytes. For haematological studies, blood was collected from jugular vein in glass vials containing double oxalate as anticoagulant. The determinations of haemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC) and total leucocyte count (TLC) were done according to the methods described by Schalm (1965).

Experimental drug

Imidocarb, 3, 3'-bis-(2-imidazolin-2-yl) carbanilide dipropionate*, related structurally to aromatic diamidines, was used in the present trials as a 12% w/v solution in distailled water.

Experimental design

Chemotherapy

The experimental design for testing the therapeutic activity of Imidocarb against *B. bigemina* in splenectomised calves is shown in Table 1. Five calves were taken to study the efficacy of drug and two kept as control. The drug was administered intramascularly (i/m) @ 1 mg/kg at the time of rising parasitaemia. Blood from treated calves was subinoculated into clean susceptible splenectomised calves to note whether they had become free of infection or not. Subsequently, the treated calves were given cortisone (Decadron, MSD) for four days and then challenged intravenously (i/v) with 50 ml of virulent blood having homologous *B. bigemina* strain to see the relapse or recrudescence of parasitaemia, if any.

Imidocarb was also tried in 17 clinical cases of *B. bigemina* infection in cattle at the same dose rate as in experimental calves. The supportive treatment like blood transfusion, haematinics, glucose saline and calcium etc. was also done in some cases.

Chemoprophylaxis

The experimental design to see the prophylactic effect of Imidocarb against *B. bigemina* is shown in Table III. Two calves each in group A, B and C were used to see the therapeutic effects of drug and remaining two in group D kept as control. The calves treated 28-52 days previously with Imidocarb @ 2 mg/kg i/m were challenged i/v with 50 ml virulent blood having homologous *B. bigemina* strain. Subsequently, the test calves were given cortisone for 4

*Sumithion, Tata Fision Ltd, Bombay
*Imizol, Burroughs Wellcome & Co.,London

TABLE I

Chemotherapeutic efficacy of Imidocarb (1 mg/kg I/M) against experimental *Babesia bigemina* infection in splenectomised cross-bred calves

Calf No.	Treatment (day after infection)	Parasitaemia (%) when treatment started	Haemoglobin (g%) (day of treat.)	Packed cell volume (%) (day of treat).	Result	Effect of Subinoculation into susceptible calf	Effect of cortisone (2 ml i/m for 4 days)
1	2	3	4	5	6	7	8
1	11	16.5	5.0	23	Survived	Negative	No relapse
2	12	21.5	5.1	22	Survived	Negative	No relapse
3	10	15.6	7.0	26	Survived	Negative	No relapse
4	11	12.4	9.0	28	Survived	Negative	No relapse
5	11	19.2	8.4	29	Survived	Negative	No relapse
6	Control	18.5	2.3	8	Died	—	—
7	Control	19.0	2.8	10	Died	—	—

TABLE II

Effect of Imidocarb (1 mg/kg I/M) on parasitaemia and Haematology (Mean values) in five splenectomised cross-bred calves experimentally infected with *Babesia bigemina*

Day after infection	Hb (gm %)	PCV (%)	TEC (million/cmm)	TLC (thousand/cmm)	Parasitaemia (%)
1	12.0	42.2	7.0	9.08	Nil
3	11.5	39.8	6.7	9.16	Nil
5	10.98	37.2	6.62	10.16	Nil
7	10.52	34.6	6.4	10.9	0.5
9*	8.56	30.0	5.98	11.42	4.32
10	8.16	26 4	5.68	11.42	7.3
11*	6.85	24.75	5.85	11.67	17.56
12*	6.86	23.6	5.62	11.1	9 1
13	7.28	25.4	6.2	10.34	2.0
14	7.65	26.25	6.34	10.27	Nil
15	8.33	31.0	6.46	9.2	Nil
16	10.7	36.0	7.2	8.85	Nil

Hb = Haemoglobin
PCV=Packed cell volume
*Treatment given
TEC=Total erythrocyte count
TLC=Total leucocyte count

days and then splenectomised to see the relapse or recrudescence of parasitaemia, if any.

RESULTS

Chemotherapy

The results of therapeutic efficacy of Imidocarb against experimental *B. bigemina* infection in splenectomised calves are summarised in Table I and II. All the five calves treated with Imidocarb cleared *B. bigemina* organisms from peripheral circulation within 24-48 hr and urine became clear. Two calves of control group (No. 6 and 7) succumbed to infection after showing a parasitaemia of 18.5-19.0 per cent. Imidocarb was administered at the time of rising parasitaemia (12.4-21.5%) when Hb ranged between 2.3-9.0 gm/100 ml and PCV between 8-29 per cent. The haematological values improved 4-7 days after therapy but stood a little below preinfection level (Fig. 1). Imidocarb was found effective in treating 15 clinical cases of babesiosis *(B. bigemina)* out of 17 cattle presented for treatment. All cases were showing clinical signs of haemoglobinuria, severe anaemia manifested by pale and white mucous membranes, dyspnoea and low Hb (3.3-5.4 gm%), PCV (11-21%) and TEC (3.14-6.27 m/cmm). Two clinical cases which died were calves showing very severe anaemia. Blood transfusion to some anaemic patients proved very useful as supportive treatment.

Chemoprophylaxis

The results of prophylactic trials are shown in Table III. All calves in group A and B treated 28 and 40 days previously with Imidocarb were protected against disease after artificial challenge with lethal dose of *B. bigemina* infected blood. However, one calf in group C treated 52 days before challenge succumbed to infection, and the other died after splenectomy. The treated calves of group A and B survived the challenge and did not show any relapse or recrudescence of parasitaemia, even after stress of cortisone treatment and splenectomy. Calves of control group died after challenge showing clinical signs of the disease including haemoglobinuria.

DISCUSSION

Chemotherapy

The compound Imidocarb, 3, 3'-bis-(2-imdazolin-2-yl)-carbanilide dipropio-

TABLE III

Chemoprophylactic effect of Imidocarb against experimental *Babesia bigemina* infection in cross-bred calves

Group No.	No. of calves	Imidocarb (mg/kg i/m)	Challenge with virulent blood 60 ml i/v after treatment (day)	Result	Effect of 4 days treatment with cortisone (after 28, 40 days)	Effect of splenectomy after 25-40 (days)
1	2	3	4	5	6	7
A	2	2	28	Survived	No relapse	Survived
B	2	2	40	Survived	No relapse	Survived
C	2	2	52	One died	—	—
D	2	(Control)	28, 40	Both died	—	—

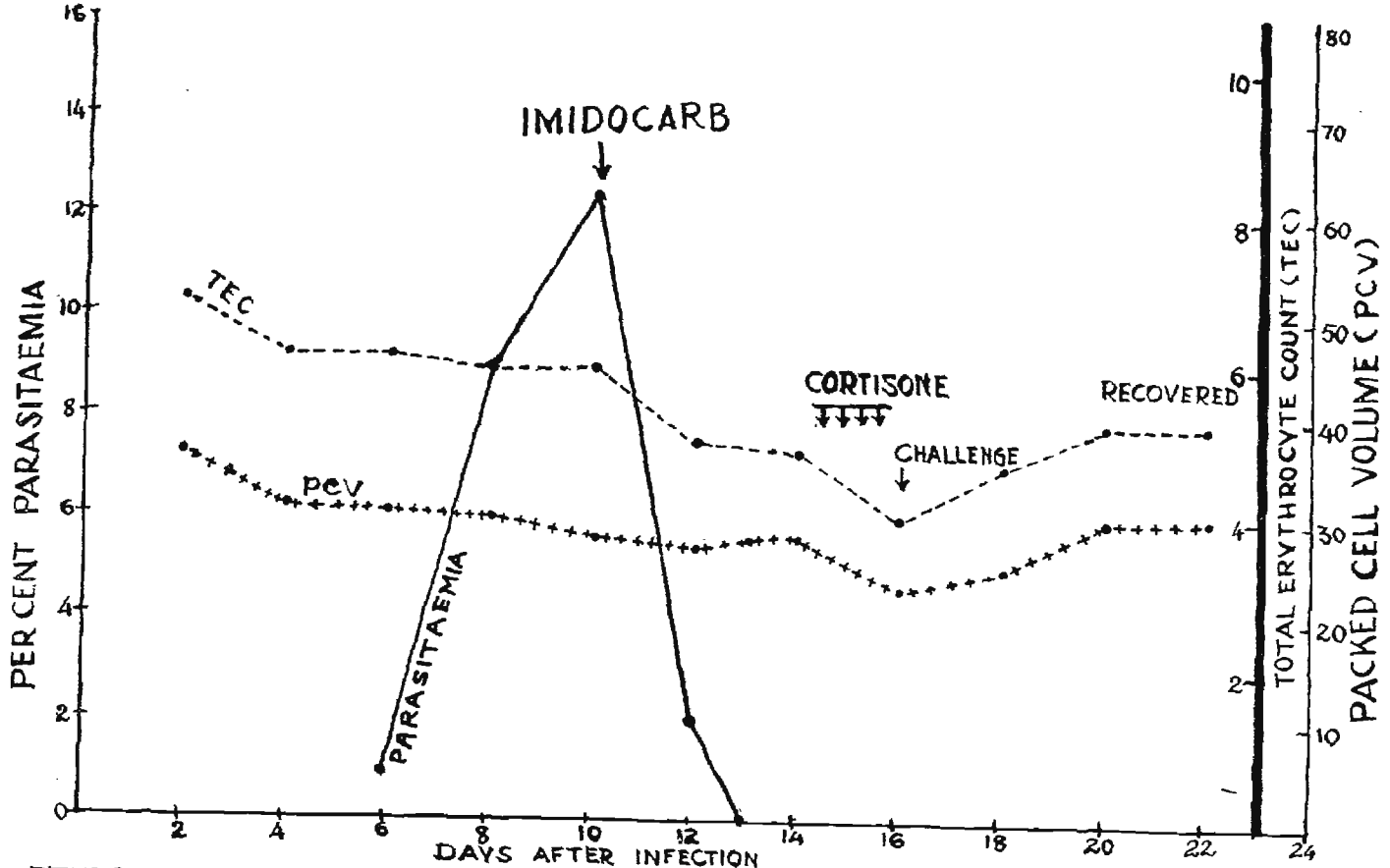


FIG) EEFECT OF IMIDOCARB TREATMENT (1mg/Kg) ON PACKED CELL VOLUME, TOTAL ERYTHROCYTE COUNT AND PARASITAEMIA IN SPLENECTOMISED CROSS-BRED CALF No 8. EXPERIMENTALLY INFECTED WITH BABESIA BIGEMINA

nate was found highly effective for the treatment of clinical cases and experimental *B. bigemina* infection in cattle. The compound is available as 12% solution in distilled water under the trade name of Imizol (Burroughs Wellcome). All the five splenectomised calves treated with Imidocarb @ 1 mg/kg were cleared of *B. bigemina* organisms from peripheral circulation within 24-48 hr and urine became clear. The drug controlled rising parasitaemia (12.4-21.5%) and low Hb, PCV and TEC values further improved.

The subinoculation of clean susceptible splenectomised calves with blood from treated group proved negative. There was no recrudescence of parasitaemia or relapse of the disease in treated calves following cortisone therapy or challenge with virulent blood (Fig.). This indicated that drug had sterilising effect and completely eliminated *B. bigemina* infection in experimental calves. The results of the present study further lend support to the findings of Callow and McGregor (1970), Roy-Smith (1971), Wood (1971), Todorovic *et al.* (1973c), Haigh and Hagan (1974), Kuttler *et al.* (1975), Hashemi-Fesharki (1976), Dwivedi *et al.* (1977), Dubouyi *et al.* (1977) and Rakhimov *et al.* (1978) who treated *B. bigemina* infection with Imidocarb in doses of 0.5-2 mg/kg body weight.

Imidocarb was also found very efficacious in treating field clinical cases of *B. bigemina* infection in cattle. Fifteen clinical cases of babesiosis out of 17 cattle were cured with single dose of drug given @ 1 mg/kg i/m. Only two calves which died of *B. bigemina* infection were showing very severe anaemia characterised by low levels of Hb, PVC and TEC and almost white conjunctivae. Blood transfusion to anaemic patients proved very beneficial as supportive treatment.

Chemoprophylaxis

Imidocarb showed a marked prophylactic activity against *B. bigemina* in experimental calves and had a residual effect for atleast 52 days after drug administration. All the calves treated 28-40 days previously with Imidocarb were completely protected against virulent challenge with homologous *B. bigemina* strain. However, one calf out of two succumbed to infection when challenged 52 days after treatment. This clearly proves that Imidocarb can also be used as prophylactic agent against *B. bigemina*.

Roy-Smith (1971) and Callow *et al.* (1974) showed that one dose of Imidocarb administered to non-infected animals would prevent the occurrence of clinical babesiosis for about a month, and Immunity might develop, if the animal was naturally infected during this period. Hashemi-Fesharki (1976) showed prophylactic activity of Imidocarb against *B. bigemina* for 100 days and Dwevedi *et al.* (1977) for 65 days after experimental *B. bigemina* infection.

No side effects were observed in cattle treated with dipropionate salt of Imidocarb in doses of 1-2 mg/kg against *B. bigemina* infection in clinical and experimental cases. Imidocarb shows a great promise in treatment and control of bovine babesiois, especially in enzootic areas like India, due to its both therapeutic and prophylactic activity against *B. bigemina*.

REFERENCES

Beveridge, Elizabeth. 1969. Babescidal effect of basically substituted carbanilides. II. Imidocarb in rats and mice. Toxicity and activity against *Babesia rodhaini* *Res. Vet. Sci.* 10 : 534-539.

Callow, L. L. and McGregor, W. 1970. The effect of Imidocarb against *Babesia argentina* and *Babesia bigemina* in cattle. *Aust. Vet. J.* 46 : 195-200.

Callow, L. L., McGregor, W., Parker, R. J. and Delgliesh, R. J. 1974. Immunity of cattle to *Babesia argentina* after drug sterilisation of infections of varying duration. *Aust. Vet. J.* 50 : 6-11.

Dubovyi, S. Z, Lazaridi, A. V., Bibikov, G. I. and Zaitsev, P. F. 1977. Chemoprophylaxis of *Babesia* infection in cattle using Dimidin (Imidocarb analogue). *Veterinariya Moscow* 3 : 71-72 (Abstr. Vet. Bull. 47, 5602).

Dwivedi, S. K., Gautam, O. P. and Banerjee, D. P. 1977. Therapeutic and prophylactic activity of Imidocarb against *Babesia bigemina* infection in splenectomised bovine calves. *Indian Vet. J.* 54 : 697-702.

Haigh, A. J. B. and Hagan, D. H. 1974. Evaluation of Imidocarb dihydrochloride against redwater disease in cattle in Eire. *Vet. Rec.* 94 : 56-59.

Hashemi-Fesharki, R. 1976. Studies on Imidocarb dihydrochloride in experimental *Babesia bigemina* infection in calves. *Br. Vet. J.* 131 : 666-672.

Joyner, L. P., Davies, S. P. M. and Kendall, S. B. 1963. Chemotherapy of babesiosis *Exptl. Chemotherapy*. Vol. I. Ed. Schnitzer, R. J. and Hawking, F., Academic Press, New York and London, pp-603-624.

Kuttler, K. L., Graham ,O. H. and Trevino, J. L. 1975. The effect of Imidocarb treatment on *Babesia* in the tick *(Boophilus microplus)*. *Res. Vet. Sci.* 18 : 198-200.

Rakhimov, T. J., Shmuni, E. K., Tursunow, M. T., Tashtemirov, N and Gafurov, A. 1978. Dimidin and Imidocarb for piroplasmosis. *Veterinariya Moscow* 10 : 75-77 (Abstr. Vet. Bull. 48, 3005).

Roy-Smith, F. 1971. The prophylactic effects of Imidocarb against *Babesia argentina* and *Babesia bigemina* in cattle. *Aust. Vet. J.* 47 : 418-420.

Schalm, O. W. 1965. *Veterinary Haematology* 2nd ed. Lea and Febiger, Philadelphia.

Schmidt, C., Hirt, C. R. and Fisher, R. 1969. Babesicidal effect of basically substituted carbanilide. I. Activity against *Babesia rodhaini* in mice. *Res. Vet. Sci.* 10: 530-533.

Singh, B. and Gautam, O. P. 1972. Splenectomy technique in cattle, sheep and goat. *Tripura Vet. Bull.* 3 : 1-4.

Todorovic, R. A., Vizcaino, O. G., Gonzales, E. F. and Adams, L. G. 1973c. Chemoprophylaxis (Imidocarb) against *Babesia bigemina* and *Babesia argentina* infections. Am. J. Vet. Res. 34 : 1153-1161.

Wood, J. C. 1971. The activity of Imidocarb against *Babesia* infections of cattle. *Irish vet. J.* 25 : 254-257.

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AN EXPERIMENTAL STUDY ON PATHOLOGICAL CHANGES FOLLOWING URETHRAL LIGATION IN BUFFALO CALVES

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ABSTRACT

Gross and histopathological studies on different tissues were conducted in experimental buffalo calves dying consequent to retention of urine as a sequel to urethral ligation. Kidney, ureter, urinary bladder, urethra, intestine and liver were studied.

Many pathological changes may be accompanied following obstruction to the flow of urine depending upon the duration. Jubb and Kennedy (1970) observed thin and almost transparent bladder wall in cases of local obstruction. The mucosa and deeper layers of the bladder were subjected to infection and various degree of inflammation (Smith and Jone, 1970), and haemorrhagic complications were common following urethral obstruction (Jubb and Kennedy, 1970). Petechial haemorrhages on the kidney, stomachs and intestines were reported by Bhargava and Lakhotia (1965). Boyd (1970) and Smith and Jones (1970) observed that the ischaemia of the kidney was largely due to pressure of the retained fluid. Various degrees of histopathological changes occuring in ureter and bladder have been reported by Smith and Jones (1970), Jubb and Kennedy (1970) and Mohanty (1973). Merrill and Hampers (1971) were of the view that the decomposition of urea by gastrointestinal flora might result in the liberation of ammonia and resultant irritation of the gastro-intestinal mucosa in the uremic cases.

This study was undertaken to know exactly the changes taking place in various organs, as certain clinical cases die even after the animal had been relieved of the obstruction.

MATERIAL AND METHODS

Animals

The experiment was performed on ten apparently healthy uncastrated buffalo calves one to two years old. Animals were kept under observation for a period of 5 to 7 days prior to the undertaking the experiment.

Urethral ligation

Urethral ligation was undertaken under local infiltration anaesthesia at the sigmoid flexure area by making a three centimeters incision in the median raphae behind the scrotum. The sigmoid flexure was exteriorized and urethra was ligated under the corpus cavernosum penis muscle using black braided silk thread No. 4.

Tissues collection

Immediately after death, *post mortem* examination was carried out. Kidney, ureter, bladder, urethra, liver and intestinal tissues were collected in 10% formalin saline for histopathological examination. The tissues were embedded in paraffin and 5 μ thick sections were cut and were stained with haemotoxylin and eosin.

RESULTS AND DISCUSSION

Gross pathology

All the animals died between 44 to 74 hours post ligation. Bladder was observed ruptured in six animals and distended in four animals. In cases of ruptured urinary bladder, it was lying contracted in the pelvic cavity and in other cases, it was lying distended in the abdominal cavity (Fig. 1). Smith and Jones (1970) reported similar findings in cases of severe or complete obstruction. In animals, where the bladder had not ruptured, areas of ischaemia and haemorrhages could be easily visualized. Jubb and Kennedy (1970) reported thin and almost transparent bladder wall in cases of local obstruction. Rupture was observed on the ventral, lateral and vertex of the bladder. Rupture of the bladder at different sites could not be explained except that it might be due to infiltration of the bladder wall with urine and the varying degree of pressure on the bladder wall during different postures of the animal and also pressure of other viscera might cause tear in the bladder wall. The mucosal surface of

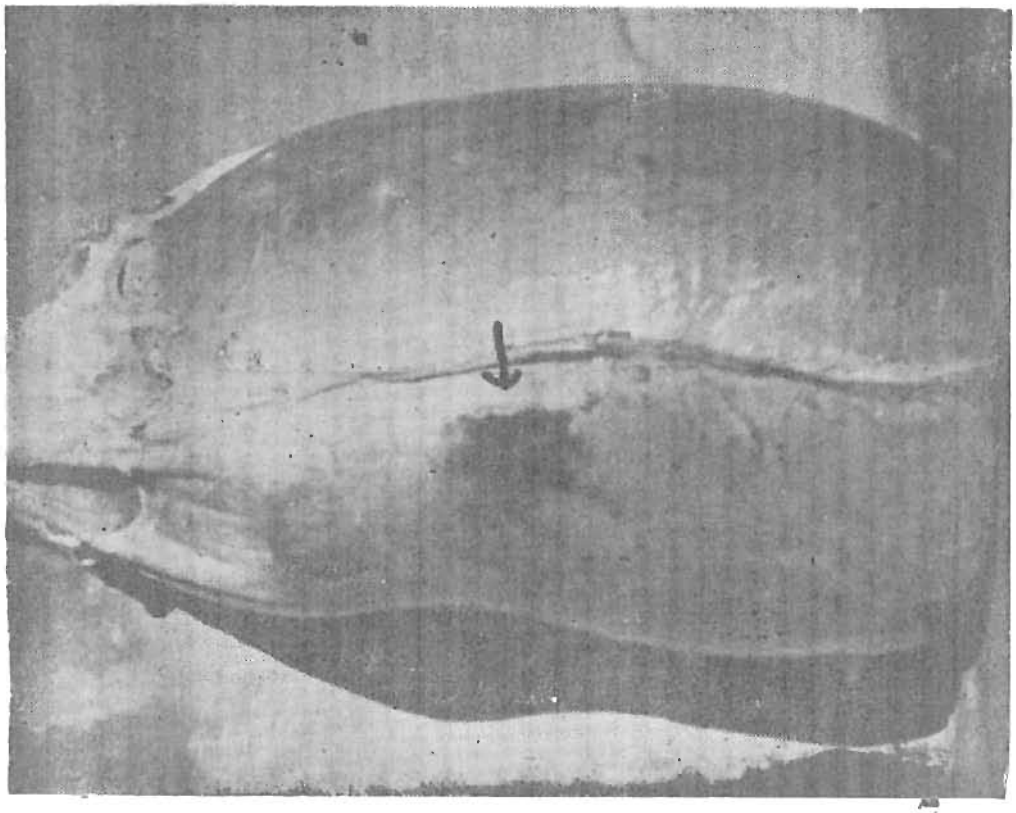


Fig. 1 Distended urinary bladder with haemorrhagic areas (arrow).

the bladder was seen congested and at placed haemorrhagic, wherein certain areas appeared to be devoid of vasculature. Haemorrhages from the dilated vessels might be severe enough to produce large clots in the bladder wall and these haemorrhagic complications were common following urethral obstruction (Jubb & Kennedy, 1970). Retention of urine might lead to infection and various degree of inflammation (Smith and Jones, 1970.)

The enlargement of the kidney and fluid infiltration was seen in almost all the cases. This might be due to increased pressure inside the organ as a result of obstruction to the outflow of urine. Petechial haemorrhages were seen as a result of uremic syndrome. Such observations have also been reported by Bhargava and Lakotia (1965).

Petechial haemorrhages were seen all over the stomachs and intestine. Intestinal mucosa indicated petechial haemorrhages and small areas of necrosis, which were also observed by Bhargava and Lakhotia (1965). This might be due to increased excretion of urea through the alimentary canal as a result of uremia and subsequent breakage of urea by intestinal microflora releasing ammonia, the latter being irritant.

Microscopic Pathology

Kidney. Necrosis of the epithelial cells of the papillary ducts and collecting tubules and presence of epithelial casts in the tubular lumen might have resulted due to accumulation of the toxic metabolites and possibly due to cellular anoxia as a result of impaired blood flow. Dilatation of Bowman's Capsular space, partial atrophy of the glomerular tufts and necrosed and desquamated epithelium of the proximal tubules were present in the cortex (Fig 2). Boyd (1970) and Smith and Jones (1970) also observed that ischaemia of the kidney was largely due to pressure of the retained fluid.

Ureters. Patchy desquamation of the epithelial lining and slight oedema of all the tunics (Fig. 3) were due to increased fluid pressure. Smith and Jones (1970) and Mohanty (1973) reported that the inflammation of the uretral mucosa occured as a part of inflammation of the entire urinary tract.

Bladder. Complete denudation of the epithelium, congestion of the underlying connective tissue of the mucosa and massive necrosis of the tunica muscularis were seen (Fig. 4). Similar observations have been reported by Smith and Jones (1970), Jubb and Kennedy (1970) and Mohanty (1973) These changes might be due to increased fluid pressure as a result of obstruction.

Urethra. There was necrosis and desquamation of the epithelial cells (Fig. 5). This might be due to increased fluid pressure above the site of ligation.

Liver. The picture was closely similar to that of generalized passive venous congestion as also reported by Jubb and kennedy (1970) characterized by the dilatation of centrilobular veins, hepatic sinusoids, centrilobular atrophy and necrosis (Fig. 6). Boyd (1970) and Smith and Jones (1970) have observed similar findings and attributed it to tissue anoxia.

Intestine. There was complete loss of villous epithelial lining and tips of

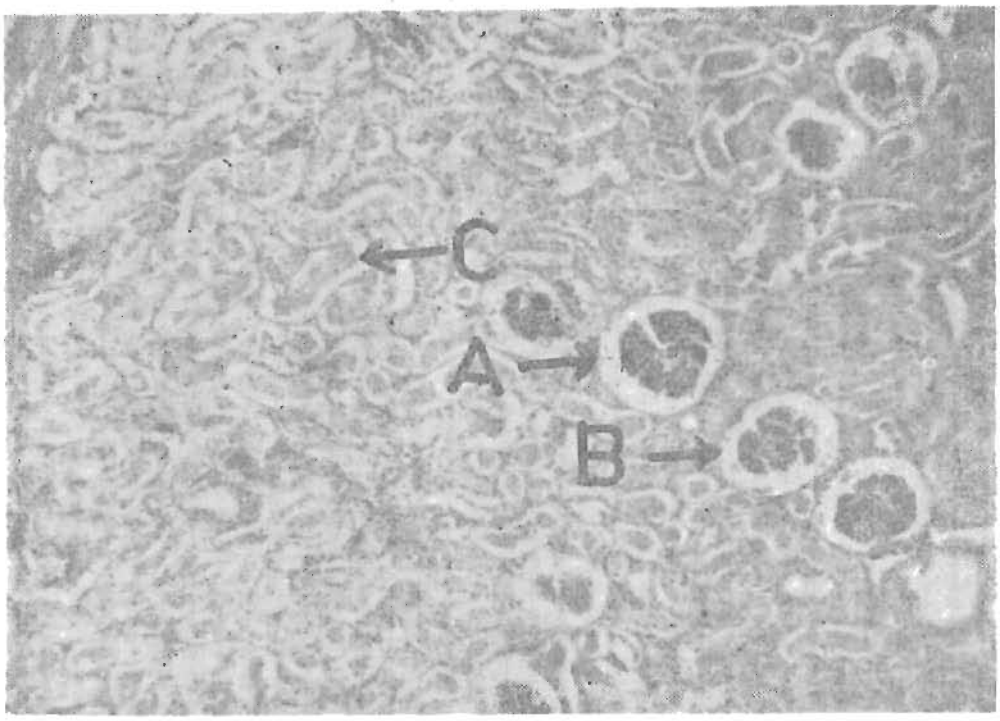


Fig. 2 Section of kidney showing dilatation of Bowman's Capsule-(A), glomerular tuft congestion-(B), and proximal tubules degenerated and accumulation of proteinacious material in the lumen-(C), H&EX70.

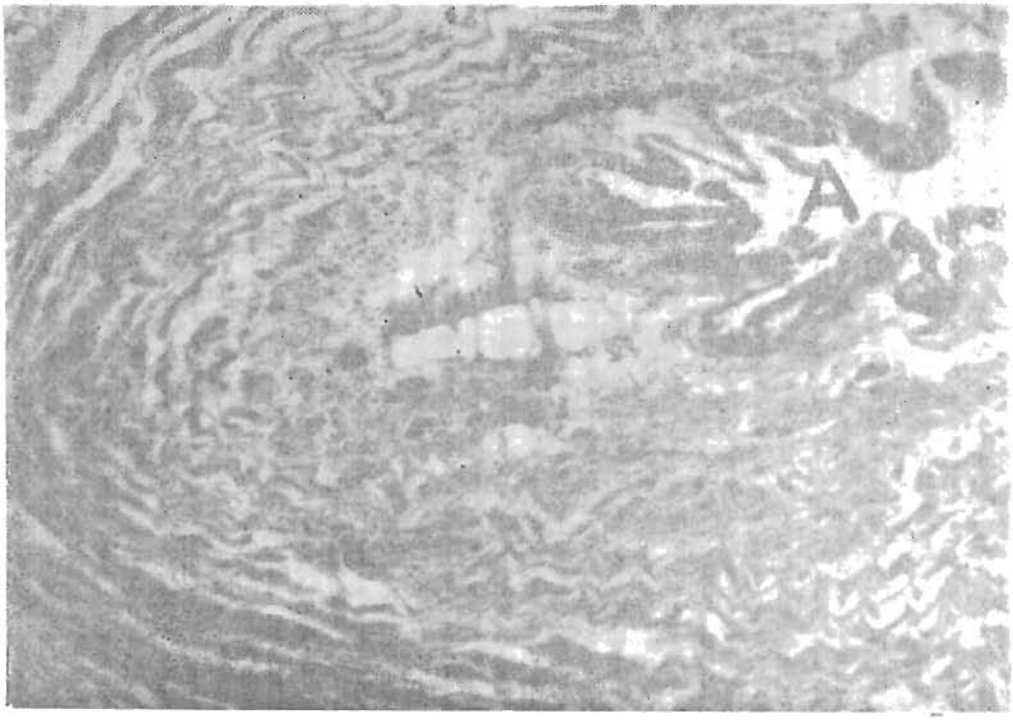
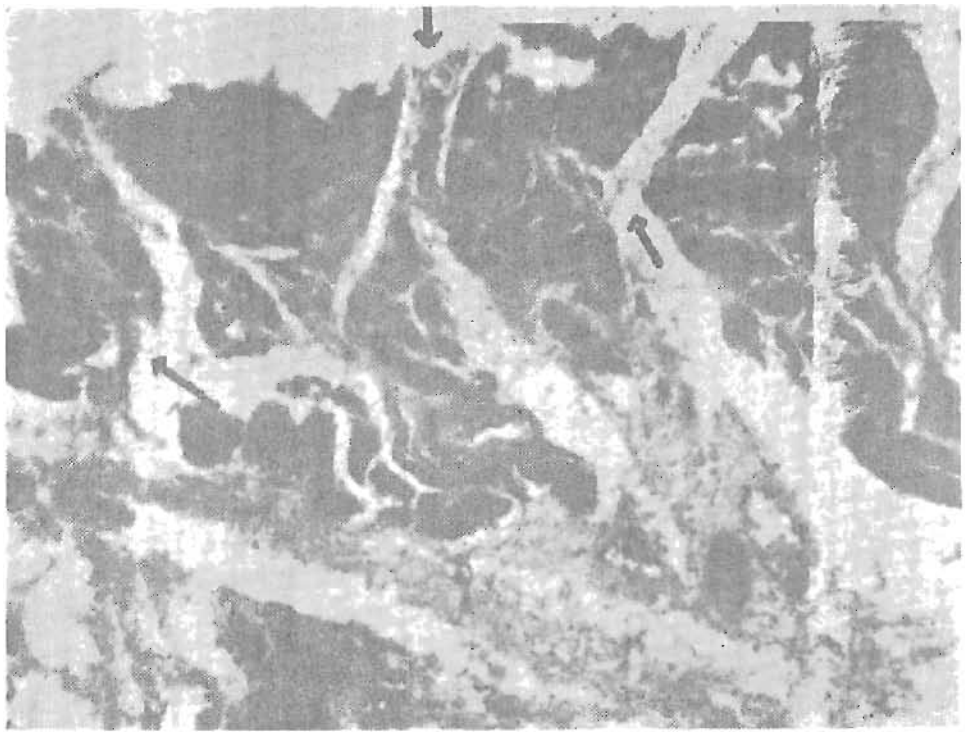


Fig. 3 Section of ureter showing patchy desquamation of the epithelial lining (A). H&EX70.



Ftg. 4 Section of Urinary bladder showing extensive haemorrhages (A) in the interstitial spaces of muscle bundles H&E-70.

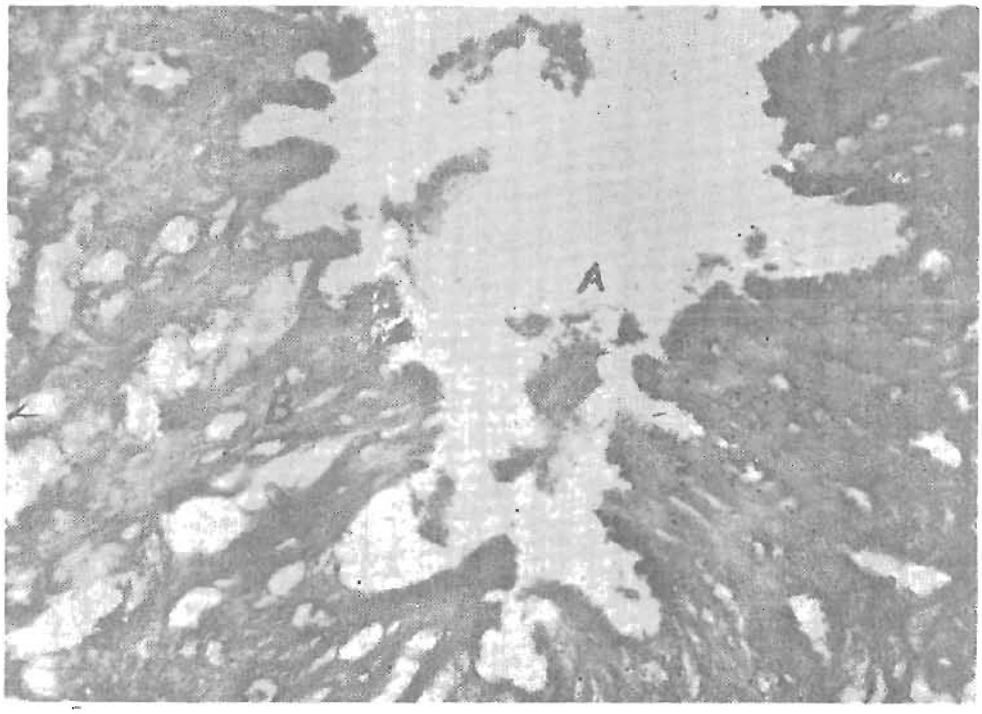


Fig. 5 Section of urethra showing disruption and desquamation of lumina epitnelium (A) and irregular distribution of Corpus Cavernosum urethrae muscles (B). H&EX70.

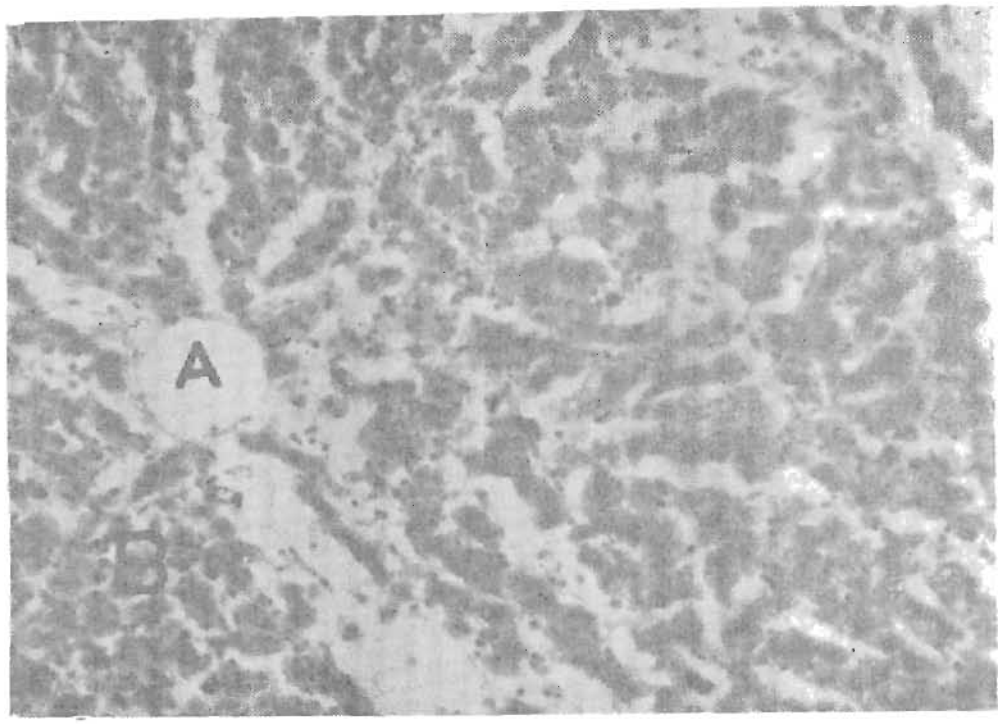


Fig. 6 Section of liver showing dilatation of central vein (A) and Congestion of sinusoids (B). H&EX70.

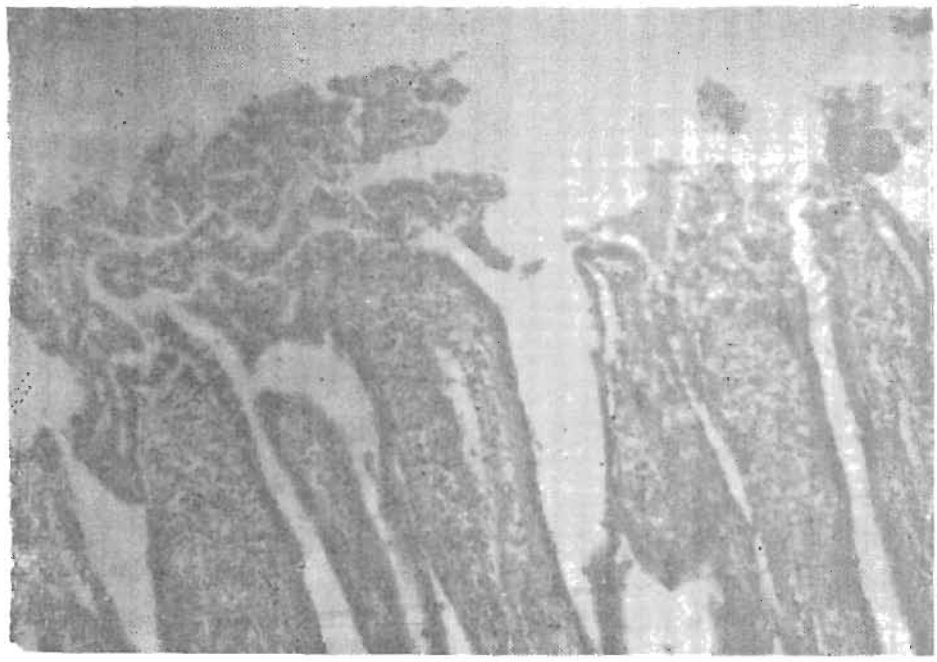


Fig. 7 Section of intestine showing sloughing and necrosis of epithelium of the tips of the villi. H&EX70.

the villi were necrotic and partly shed off (Fig. 7). Merrill and Hampers (1971) were of the view that decomposition of urea by gastro-intestinal flora might result in the liberation of ammonia which caused irritation of the gastrointestinal mucosa in the uremic cases.

ACKNOWLEDGEMENT

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REFERENCES

Jubb, K. V. F. and Kennedy, P. C. 1970. *Pathology of Domestic Animals*. 2nd Ed. New York and London. Academic Press.

Smith, H. A. and Jones, T. C. 1970. *Veterinary Pathology*, 3rd ed. Philadelphia, Lea and Febiger.

Bhargava, A. K. and Lakhotia, R. L. 1966. Uremia in a camel. *Indian Vet. J.* 42: 909.

Merrill, J. P. and Hampers, C. L. 1971. *Uremia in Pathophysiology and Treatment*. New York and London. Grune and Stratton.

Mohanty, J. 1973. Urolithiasis in calves and its treatment. Ph. D. Thesis submitted to Orissa University of Agriculture and Technology. Bhubaneswar.

Boyd, W. 1970. *A Text Book of Pathology*. 8th ed. Philadelphia. Lea and Febiger.

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STUDIES ON THE EFFECT OF CERTAIN SUMMER MANAGEMENTAL PRACTICES ON LACTATING MURRAH BUFFALOES

1. FEED AND WATER INTAKE

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ABSTRACT

A study was conducted during summer on 20 lactating Murrah buffaloes to study the effect of (I) showering, (II) provision of cooled drinking water, and (III) showering+provision of cooled drinking water on their feed and water consumption. The average daily dry matter (kg) and water (litres) intake of buffaloes under control, treatments I, II and III groups were, respectively, 12.18 and 63.78; 14.19 and 49.26; 14.18 and 53.31; and 15.03 and 54.99. Feed and water intake ratio was wide in control group compared to the treatment groups suggesting stress condition in control group due to elevated ambient temperature.

In a thermoneutral environment, voluntary feed intake of animals does not vary with temperature, but at higher temperatures it is reduced and in lower temperatures it is increased (Ragsdale *et. al*, 1948 ; Mullick, 1949), while water consumption follows a reverse trend (Ragsdale *et. al*, 1949). Many workers have observed that *Bos indicus* cattle differ significantly from *Bos taurus* cattle with respect to their responses to environmental temperature (Ragsdale *et al*; 1951; Kibler and Brody, 1951; Worstell and Brody, 1953). The buffalo is a less studied species in this regard.

A few observational trials by Fahimuddin (1975) on buffaloes indicated a significant decline in their feed consumption and increase in water intake under high environmental temperature. Earlier, Mullick (1959), Negi and Mullick (1960) and Sharma and Kehar (1961) had also reported similar trends.

The present study was aimed at studying whether this fall in feed intake of buffaloes could be reduced by means of certain tactical summer managemental practices.

MATERIAL AND METHODS

Twenty normal lactating buffaloes were selected from the buffalo herd of the Department of Livestock Production and Management, College of Animal Sciences, Haryana Agricultural University, Hissar, for the purpose of this experiment. The experiment was conducted from 15th May to 9th July, 1978,

covering the hottest part of the summer. The animals were divided into five blocks having four buffaloes in each block with similar stage of lactation, body weight and milk yield, making more or less homogeneous groups. One buffalo from each block was then allotted to each of the control and three treatments at random. The experiment was planned as a randomised block design.

All the animals were maintained throughout the experimental period in a loose house in which 4 sq. m. of covered area and 8 sq. m. of paddock area were available to each animal. However, they were taken inside the milking barn for showering and milking. The details of the treatments are given below :

Control : housed in loose house with no showering or provision of cooled drinking water.

Treatment I : Showering the buffaloes with tap water. The showering was given between 1200 hours to 1430 hours. The animals were showered for a period of half an hour twice during this period that is between 1230 to 1300 hours and 1400 to 1430 hours under specially designed showers which were able to spray water over the entire body surface of animals.

Treatment II : Provision of *ad libitum* drinking water cooled to 20.5° C temperature between 1200 hours to 1430 hours; and

Treatment III : The animals under this treatment were showered as in treatment I as well as were provided with cooled water at 20.5° C for drinking as in treatment II during 1200 to 1430 hours.

It was observed that tap water stored in earthern pitchers from 8.00 A. M. onwards in a shady and windy place got cooled to a temperature of about 20.5° C and retained this temperature upto 12.00 noon on a hot summer day. On observing similar trend on four consecutive days, it was decided to cool water upto this temperature before offering to animals under treatment II and III. Animals under these groups were also offered ordinary tap water at other times of the day.

The logic behind such a schedule of watering was that (i) first, the animals must get as much of water as they require in a day according to their physiological needs and (ii) secondly, part of this water consumed in a day was intended to be cooled to a temperature of 20.5° C and offered to the animals during the hottest part of the day, so as to ameleorate the summer heat stress on them.

The experimental animals were maintained on a uniform feeding schedule which was according to their nutritional requirements. During the period of experiment, berseem, jowar bajra and maize in green form were available to the extent of 20 to 25 kg/ animal. Data on daily milk production, milk composition, feed and water intake were recorded regularly.

Feed and water intake studies were conducted on all the buffaloes, in each treatment, once in ten days, on three consecutive days. In all, such data were recorded on 18 days during the tenure of experimental work. The preestimation period was 10 days before actual period of intake study began.

Weighed quantity of feed and fodder were offered to animals once a day. Wheat bhusa was given in the morning and green fodder after 1.30 P. M. to all animals. The residues were weighed daily to estimate the actual intake of feeds and fodder. There was no residue in case of concentrates. The dry matter content of concentrates, wheat bhusa and green fodder fed were determined each day by keeping the samples in the oven at 90°C overnight.

RESULTS AND DISCUSSION

The trend in dry matter and water consumption over the experimental period is shown in figure 1. Result of analysis variance of mean dry matter consumption and water consumption are presented in Table 1 and 2, respectively. Correlation between these two parameters and climatic attributes was also studied, the results of which are presented in Table 3.

Dry matter intake

The overall average intake of dry matter per day per buffalo was 12.18 ± 0.284, 14.18 ± 0.391, 14.18 ± 0.440 and 15.03 ± 0.269 kg in control, treatments I, II and III, respectively. The daily dry matter intake in treatments I, II and III were 16.44 %, 16.39% and 24.20 % higher than in controls. The average body weights of animals in control, treatments I, II and III were 486.4, 483.0, 483.4 and 491.8 kg., respectively, at the beginning of experiment. There was highly significant ($P < 0.01$) difference between treatments. The control group differed significantly from treatment groups (Table 1).

The trend in dry matter consumption is graphically depicted in figure 1. It is seen (Figure 1) that the dry matter intake in control group was lower than that of treatments I, II and III throughout the experimental period. As long as the ambient temperature was above 43°C, feed intake in control was depressed. Whereas on fall of atmospheric temperature towards the later half of experiments period, it increased to some extent. Similar trend was seen in all the three treatments, though the intake of dry matter was consistantly higher throughout, than in controls. Among the three treatments, treatment III had higher consumption, might be because of better condition of comfort

FIG. 1. WATER AND DRY MATTER CONSUMPTION BY DIFFERENT GROUPS OF ANIMALS DURING THE EXPERIMENTAL PERIOD AND CLIMATIC VARIABLES DURING SAME PERIOD

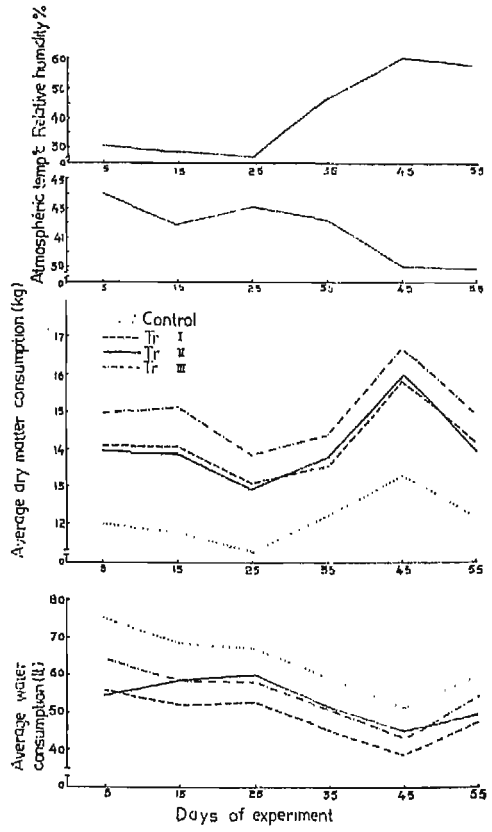


TABLE 1

Analysis of variance between average value of dry matter consumption on selected days in experimental animals

Source	d. f.	Mean Sum of Square						Overall
		5th day	15th day	25th day	35th day	45th day	55th day	average
Replication	4	4.647	2.824	1.200	1.306	3.952*	2.102	1.887
Treatment	3	8.130**	9.369**	5.906**	4.000**	10.958**	6.813*	7.313**
Error	11	0 255	0.402	0.091	0.633	0.908	1.157	0.223

*Significant at 5% level
**Significant at 1% level

TABLE 2

Analysis of variance between average value of water consumption on selected days in experimental animals

Source	d.f.	Mean Sum of Square						Overall
		5th day	15th day	25th day	35th day	45th day	55th day	average
Replication	4	47.640	67.205	22.042	24.327	41.225	69.137	28.793
Treatment	3	399.982**	232.518**	187.034**	170.995**	150.075**	146.748**	187.230**
Error	11	14.032	23.460	25.136	17.240	44.479	26.751	11.907

*Significant at 5% level.
**Significant at 1% level.

TABLE 3

Coefficients of correlation between water intake and dry matter intake and climatic variables in experimental animals

Relation	Control	Treatment I	Treatment II	Treatment III
Atmospheric temperature × water consumption	0.766**	0.713**	0.409*	0.653**
Atmospheric temperature × water consumption when humidity is held constant	0.244	0.223	0.115	0.118
Atmospheric temperature × dry matter consumption	-0.394	-0.379	-0.432	-0.327
Atmospheric temperature × dry matter consumption when humidity is held constant	-0.201	-0.253	-0.209	-0.201
Relative humidity × water consumption	-0.844**	-0.768**	-0.491**	-0.739**
Relative humidity × water consumption when atmospheric temperature is held constant	-0.576*	-0.495*	-0.299	-0.470*
Relative humidity × dry matter consumption	0.349	0.295	0.393	0.264
Relative humidity × dry matter consumption when atmospheric temperature is held constant,	0.047	-0.030	0.074	-0.009

*Significant at 5% level.

**Significant at 1% level.

created by dual effect of showering and provision of cooled water for drinking. This could also be due to slightly higher body weight in this group.

Many workers (Regsdale *et. al.*, 1951 Worstell and Brody, 1963; Mullick, 1949; Hancock, 1954; Yeck and Stewart, 1959; Sharma and Kehar, 1961 ; Misra *et. al.*, 1963; Johnston *et al.*, 1963; Razdan, 1965 and Thomas, 1966) have reported depression of feed consumption at a higher environmental temperature in cattle and buffaloes. Findings of the present study are in agreement with these reports because the dry matter consumption of buffalo cows in control group had significantly reduced as compared to those that were given cooling treatments.

The reason for decrease in feed intake was due to feeling of discomfort in animals owing to climatic stress (Mullick, 1949). Askar *et. al.* (1962) reported that under hyperthermal conditions buffaloes reduce their feed intake during day and graze during cooler hours of night. The reduced intake of feed in control group may be assigned to the above reasons in summer. This may perhaps be an adaptive reaction to heat stress. The animals eat less to check metabolic rate and heat produc-

tion in the body thereby trying to maintain physiological reactions of body at normal level (Collins and Weiver, 1961).

In the present study, it was found that the feed intake was negatively correlated with atmospheric temperature in control group, though not significant, whereas in control and all the treatments there was weak positive correlation of feed intake with relative humidity which agreed with the findings of Misra *et al.* (1963) indicating that humidity depressed only slightly feed consumption in buffaloes. The partial correlations are similar to full correlations in direction, though their magnitudes are smallar. This again indicates that ambient temperature and humidity together had a more pronounced effect on feed intake than either of them individually. This is in line with the well known fact that humidity at higher ambient temperature adds to the heat stress experienced by animals.

Water intake

The average daily water intake was 63.78±1.832, 49.26±1.574, 53.31± 0.904 and 54.99±1.224 litres in control, treatments I, II and III, respectively. The water intake of control group was higher as compared to other three treatments throughout the experiment.

Analysis of variance between mean intake of water of experimental animals is presented in Table 2. There was highly significant difference ($P < 0.01$) between treatments. The control group differed significantly from the treatments. The decrease in water consumption was 22.7, 15.7 and 14.0% in treatments I, II and III as compared to controls.

The trend in water consumption is graphically presented in figure 1. It is observed that water intake was more in control than that in treatments I, II and III throughout. As long as atmospheric temperature was high, there was more consumption of water in all groups, more so in control. With the gradual decrease of atmospheric temperature from the fifth week of experiment onwards, the water consumption also decreased. In treatment II, where cooled water was given for drinking, the trend was little uneven. However, the consumption of water in all the three treatments remained more or less uniform.

Working on buffaloes, Misra *et al.* (1963) reported 13 5% increase in water consumption inspite of sharp decline in their feed consumption in unprotected animals (exposed to hot conditions of summer). In the present study, an increase in water consumption in control group was between 14 to 22.7% over that of the treatment groups. Pal *et al.* (1973) also reported increase in water intake of buffaloes in summer; the difference between water intake of buffaloes kept inside the shed and kept tied up in exposed area of shed in summer was significant. Even though the animals in control group were not tied up in exposed area, the water intake in control was significantly higher with treatment groups given thermal protection in the present study.

The reason for large intake of water by buffalo under high temperature is for the effective regulation of its body temperature by evaporative heat loss. Therefore as already mentioned earlier, water buffaloes require a larger quantity of water for drinking, swimming and

wallowing when the ambient temperature is very high.

Misra *et al.* (1963) reported significant positive correlation between water intake and atmospheric temperature and weak negative correlation (non-significant) between relative humidity and water intake in buffalo cows. In the present study, there was a higher order positive correlation (significant) between water intake and atmospheric temperature in control group. However, relationship of relative humidity and water intake was negative and significant in control group. This suggests that the water intake has some inverse relationship with increase in relative humidity. The trend in partial correlations between water intake and ambient temperature and relative humidity again shows that temperature and humidity together has stronger influence on water consumption than either of the parameters individually

Feed intake and water consumption ratio. The average water and dry matter intake per 100 kg. body weight of animals in different treatments is given below :

Treatments	D. M. intake per 100 kg. body weight	Water intake per 100 kg. body weight	Feed and water intake ratio
Control	2.50	13.11	1 : 5.2
Treatment-I	2.94	10.19	1 : 3.4
Treatment-II	2.93	11.03	1 : 3.7
Treatment-III	3.05	11.18	1 : 3.6

It is seen that the ratio between feed intake and water consumption is wider in control group as compared to treatment groups. This very well explained the condition of stress in control group due to elevated atmospheric temperature, whereas in treatment groups, it is comparatively narrow and almost similar, suggesting comfort condition due to treatments given to them.

Feed Utilization. The average dry matter consumption per day was 12.18, 14.18, 14.18, and 15.03 kg. in control and treatments I, II and III, respectively. During the 56 days of experimental period total calculated value of dry matter consumption, therefore, was 682.330, 794.52, 794.19 and 841.79 kg. in control and treatments. The animals in control, treatments I, II and III produced 1418.37, 1751.49, 1889.96 and 1962.56 kg. (6%) fat corrected milk during this period. Therefore, consumption of dry matter per 100 kg. F. C. M. (6%) milk production was 48.10, 45.36, 42.02 and 42.89 kg. From this it can be inferred that eventhough the animals in all the three treatment groups consumed more dry matter they were efficient with regard to their feed utilization for producing milk (6% F. C. M.), i.e., less dry matter consumption per 100 kg. F. C. M. (6%) milk production compared to control. The feed utilization was best in treatment II and III.

REFERENCES

Askar, A. A., Ghany, M. A. and Ragab, M. T. 1952. Effect of exposing cattle and buffaloes to sun during summer in Egypt. *Indian J Dairy Sci* 5 : 171.

Collins, K. J. and Weiner J. S. 1968 Endocrinological aspects of exposure to high environmental temperatures. *Physiol. Rev.* 48 : 785.

Fahemuddin, M. 1975. *"Domestic Water buffalo"* Oxford and IBH publishing Co. New Delhi.

Hancock, J. 1954. The direct influence of climate on milk production. *Dairy Sci. Abstr.* 16 : 90.

Johnston, J. E., Naelappa, H. and Frye, J. B. Jr. 1963. Physiological responses of Holstein Brown-Swiss and Red-Sindhi cross-bred bulls exposed to high temperature and humidities. *J. Anim. Sci.* 22 : 432.

Kibler, H. H. and Brody, S. 1951. Influence of temperatures 50 to 51°F and 50 to 95°F on heat production and cardio-respiratory activities of dairy cattle. *Res. Bull. M. O. agric. Exp. Stn. no. 450.*

Misra, M. S; Sen Gupta, B. P. and Roy, A. 1963. Physiological reaction of buffalo cows maintained in two housing conditions during summer months. *Indian J. Dairy Sci.* 16 : 203.

Mullick, D. N. 1949. Panting in cattle, a sequal to foot & month disease II. Biochemical observations. *Am. J. Vet. Res.* 10 : 49.

Mullick, D. N. 1959. *Beng. Vet. 7,* (cited by Bianca, W., 1965)

Negi, C. S. and Mullick, D. N. 1960 *J. Scient. Ind. Ind. Res.* 19C : 194. (cited by Bianca, W. 1965).

Pal, S.; Pal, R. N. and Thomas, C. K. 1975. Effect of restricted access to water supply and shelter on physiological norms and production of Murrah buffaloes. *Indian J. Dairy Sci,* 28 (1) : 41-48.

Ragsdale, A. C; Brody, S.; Thompson, M. K. and Worstell, D. M. (1948). Influence of temperature 50-105°F on Milk production and feed consumption in dairy cattle *Res. Bull. M. O. agri. Exp. Stn.* no. 425.

Ragsdale, A. C; Thompson, H. J; Worstell, D. M. and Brody, S. 1951. Influence of increasing temperature 40-105°F on milk production in Brown-Swiss cows and on feed and water consumption and body weight in Brown-Swiss and Brahman cows and heifers. *Res. Bull. M. O. agri. Exp. Stn. no. 471.*

Ragsdale, A. C; Worstell, D. M; Thompson, H. J. and Brody, S. 1949. Influence of temperature 0 to 50°F and 50 to 95° F on milk production and body weight of Jersey and Holstein cows. *Res. Bull. M. O. agri. Exp. Stn. No. 449.*

Razdan, M. N. 1965. Studies on the physiological reactions of dairy cattle under different environmental conditions. D. Phill. thesis, Calcutta Univ.

Sharma, D. C. and Kehar, N. D. 1961. Effect of environmental temperature and hunidity on intake and digestion of nutrients. *J. Appl. Physio* 16 : 611.

Thomas, C. K. 1966. Feed utilization by dairy cattle as influenced by season and shelter. M.Sc. Diss. Punjab Univ.

Worstell, D. M. and Brody, S. 1953. Environmental physiology and shelter engineering with special reference to domestic animals XX, comparative physiological reactions of European and Indian cattle in changing temperature. *Res. Bull M.O. agri. Exp. Stn. No. 515.*

Yeck, R. G. and Stewart, R. E. 1959. A ten year summary of the psychro energetic laboratory dairy cattle research at the University of Missouri. *Trans. Am. Soc. agric. Eng.* 2 : 71.

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STUDIES ON THE EFFECT OF CERTAIN SUMMER MANAGEMENTAL PRACTICES ON LACTATING MURRAH BUFFALOES

2. MILK PRODUCTION AND COMPOSITION

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ABSTRACT

A study was conducted during summer on 20 lactating Murrah buffaloes to study the effect of(I) showering,(II)provision of cooled drinking water, and (III) showering+provision of cooled drinking water on their performance. Though statistically not significant, over a period of 56 days (from 15th May to 9th July, 1978), there was a 11.9, 24.7 and 25.4% increase in milk yield of buffaloes under treatments I, II and III, respectively, over that of control group. When comparison was made with regard to production of total milk, total butter fat, total solids, and 6% fat corrected milk, it was observed that the treatment groups had comparatively better yields than control group; treatment III was found to be superior to treatments I and II.

Unlike cattle, water buffaloes have dark pigmented skin with dark coloured sparce hair coat which makes them very sensitive to sunlight during summer (Buch, 1971). Reducing the increment in body temperature of buffaloes during summer by different ways of body wetting has been tried with various degrees of success to sustain higher levels of performance by buffaloes (Sinha and Minnet, 1947; Pal *et. al.*, 1975; Mehta and Gangwar, 1978). Modification of shelters for greater thermal protection has also been tried (Misra, 1963, Roy *et. al.*, 1968; Sastry *et. al.*, 1973).

The present study was aimed at studying the effect of body wetting and watering, applied individually and together on production of Murrah buffaloes.

MATERIAL AND METHODS

Twenty normal lactating buffaloes were selected from the buffalo herd of Department of Livestock Production and Management, College of Animal Sciences, Haryana Agricultural University, Hissar, for the purpose of the experiment. The experiment was conducted from 15th May to 9th July, 1978, covering the hottest part of the summer. Radadia *et. al.* (1979) have described the details of the experiment, which was a randomised block design with 5 buffaloes under each treatment group. The

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different treatment groups were: a) Control-housed in loose house with no showering or provision of cooled drinking water; b) Treatment I-showering twice for 30 minute duration between 1200 and 1430 hours, Treatment II-provision of *ad libitum* drinking water cooled to 20.5°C between 1200 and 1430 hours; and Treatment III-showering as in treatment I + provision of cooled drinking water as in treatment II.

RESULTS AND DISCUSSION

Milk Production: The trend in weekly milk yield of each buffalo under different treatments is shown in figure I. Total milk production in control, treatments I, II and III was 1224.2, 1370.1, 1527.8 and 1535.5 kg, respectively. Percentage increase in treatments groups over control was 11.9, 24.7 and 25.4 percent. It was seen that the mean daily milk yield in control during the first week was 5.065±0.385 kg., which was reduced to 4.371±0.579kg. by the end of eighth week. In treatment I, it was 5.608±0.723 kg at the beginning and slightly declined by the end of experimental period, but the final value was higher than that of control. In case of treatment II and III, the daily milk yield was more or less stable throughout the period under experiment.

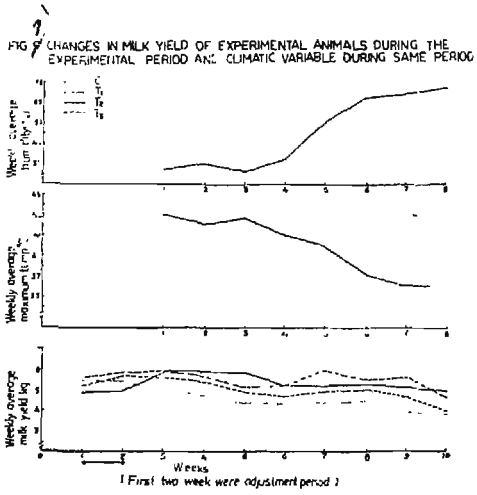


FIG 1 CHANGES IN MILK YIELD OF EXPERIMENTAL ANIMALS DURING THE EXPERIMENTAL PERIOD AND CLIMATIC VARIABLE DURING SAME PERIOD
(First two week were adjustment period)

Analysis of variance of data showed no significant difference between treatments excepting in second and third week, where it was significant ($P < 0.05$) between treatments. Since, there was significant difference in certain weeks and as it was also observed that there was increase in total production in the treatment groups as compared to control, the daily milk yield on twelve randomly selected days out of the 56 days experimental period was analysed and it was observed that there was no significant diffrerence between treatments in initial and final stages of experiment. Whereas on six days in the middle period yield differed significantly ($P<0.05$) between treatments. There was a definite decrease in milk yield in control group, whereas in treated groups there was only slight or no decrease in milk yield.

In India, Sinha and Minett (1947) reported that body wetting buffaloes by splashing water was essential and if it is not practiced as a routine, milk yield decreases and becomes more irregular. Misra *et. al.* (1963) also noted a net increase of 30% in milk yield in protected group of buffaloes which were showered for five minutes every two hours in summer. Pal *et al.* (1975) also reported that in lactating Murrah buffaloes, provision of shelter was beneficial to milk yield. The results of the present study are in confirmation with findings of these workers in that the treated animals especially those that were showered as well as provided with cooled drinking water yielded undoubtedly higher than the control (25.4%).

There was significant difference in milk yield between treatments in the middle period of experiment. The average ambient temperature from 12th to 39th day (28 days) of experiment remained on an average 45.6°C, whereas from 40th day to 56th day (17 days) of later part of experimental period it had gone down to 31.3°C causing a difference of 14.3°C, which might have resulted in decline of milk yield in control and caused significant difference.

Johnson (1965) reported that environmental temperature modified the ability of mammals to secrete milk. The pathway of this temperature influence are pastulated to be direct via (a) cutaneous receptors and central nervous system and, thus, affecting the neuroendocrine system, via, the pituitary, (b) change in body temperature of the blood perfusing the hypothalmic region, and (c) temperature changes in the mammary tissues, thereby, altering the metabolic activity of mammary tissues. Indirect effects of temperature are shown by altering appetite or nutrient intake of the animals and thus providing less substrate or less available milk precursors for the mammary gland. As has been reported earlier, reduction in feed intake (appetite) with rise in ambient temperature has been observed in the present study also.

Correlation coefficients between milk yield and climatic variables, as well as partial correlations between milk yield and ambient temperature keeping humidity constant and between milk yield and relative humidity keeping ambient temperature constant were also worked out and presented in Table I.

A positive and significant correlation between milk yield and ambient temperature observed in the present study is rather surprising. Findings of several workers abroad indicate that in *Bos taurus* cattle, there was a fall in milk yield with rise in ambient temperature. This peculiar trend observed in the present study is probably due to simultaneous reduction in ambient temperature from the beginning to the end of experiment due to change of seasons and fall in daily milk yields of buffaloes over the

TABLE 1

Correlation coefficients and interactions between milk yield and climatic variables in experimental animals

Relation	Control	Treatment		
		I	II	III
Air temperature × milk yield	0.624**	0.677**	0.50**	0.18
Milk yield ×	0.268*	0.337**	0.336**	0.125
Air temperature when humidity is held constant. Relative humidity × milk yield	0.669**	−0.685**	−0.733**	0.243
Milk yield × relative humidity when Air temp. is held constant.	−0.402**	−0.390**	−0.537**	−0.081

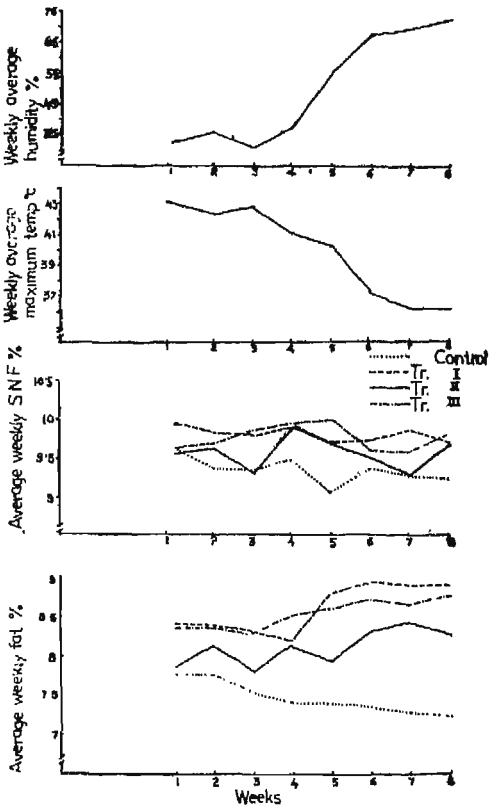
experimental period due to progression of declining phase of lactation (Fig. I).

The negative correlation of milk yield with relative/humidity is due to steep rise in its level as the experiment progressed due to early start of rains during this year. The rains, which started by about the fourth week of the experiment, might have also contributed to sharper fall in ambient temperature during this summer. The levels of partial coefficients of correlation indicate that higher ambient temperature plus relative humidity together have far greater influence on milk production than either of them individually.

The greater reduction in milk in case of animals under control group is perhaps due to the fact that they have been exposed to thermal stress. Studies on physiological reactions conducted along with the present study indicate to this fact. The other cause may be the indirect effect of heat stress causing reduction in feed intake. **Butter fat.** The mean fat percent in milk was7.46±0.177, 8.60± 0.342, 8.12±0.442 and 8.55±0.564 kg in control treatment I, II and III, respectively. There was gradual decrease in fat percent in control (Fig. 2). It was 7.78± 0.135 kg. in the beginning and 7.24± 0.240 kg. at the end of eight week. In treatment I, there was slight decrease upto fourth week, thereafter it increased till the end of experiment. In treatment II, there was slight increase on the whole, whereas in treatment III it gradually increased throughout the period.

The analysis of variance of weekly means of fat percentage showed no significant difference between treatments. Total yield of fat in kilogram during the entire period in control treatments I, II and III was 90.05, 114.97, 118.73 and

FIG. 2. CHANGES IN MILK COMPOSITION OF EXPERIMENTAL ANIMALS DURING THE EXPERIMENTAL PERIOD AND CLIMATIC VARIABLE DURING SAME PERIOD



128 81 kg, respectively The total milk production, fat yield, total solids and 6% F. C. M. production in different treatments is given in Table 2. **Solids not-fat.** Mean weekly solids-not-fat percentages were 9.398±0.128, 9.605±0.061, 9.566±0.087 and 9.805±0.044 in control, treatments I, II and III, respectively. There was reduction in solids not fat percentage in control as compared to other three treatments, whereas it was stable in all the three treatments till the end of experiment (Fig. 2). The analysis of variance of weekly means of solids not-fat percent revealed a highly significant difference between treatments.

TABLE 2

Comparative yield of milk, fat and total solids in different treatments over the 56-day experimental period

Treatments	Total milk yield (kg)	6% F. C. M. Milk (kg)	Total fat yield (kg)	Total solids yield (kg)
Control	1224.20	1418.37	90.05	207.90
Treatment—I	1370.10	1561.49	114.97	249.89
Treatment—II	1527.80	1889.97	122.73	268.63
Treatment—III	1535.40	1962.66	128.81	278.93

The increase in total yield of butter fat in the three treatment group as compared to control group is due to increase in milk yield in treated groups. When comparison was made with regard to total milk, yield fat yield, total solids and 6% F.C.M. production, it was seen that the treatment groups had comparatively better yield than control group. Among the treatments, treatment III was found superior to treatments I and II.

Thus, it is observed that due to rise of ambient temperature, there was reduction in milk yield, fat percent and solids-not-fat content in control group, whereas it was sustained in treatment groups indicating that during summer measures such as showering and provision of cooled drinking water to buffaloes helped in sustaining their milk production at satisfactory levels.

REFERENCES

Buch, N. C. 1971. Recent development and future research in reproductive physiology of buffaloes. *Guj. Vet.* 5 : 95-100.

Johnson, H. D. 1965. Environmental temperature and lactation (with special reference to cattle). *Int. J. Biometeor* 9.(2): 103-116.

Mehta, S. N. and Gangwar, P. C. 1978. Effect of cooling on reproductive efficiency and certain blood constituents of buffaloes. *Indian Vat. J.* 55 : 501.

Misra, M. S.; Sen Gupta, B. P. and Roy, A. 1963. Physiological reactions of buffalo cows maintained in two housing conditions during summer months. *Indian J. Dairy Sci.* **16** : 203.

Mullick, D. N.; Murthy, V. N. and Kehar, N. D. 1952. Seasonal variation in the feed and water intake of cattle. *J. Anim Sci.* **11** : 42.

Pal, S; Pal, R. N. and Thomas C. K. 1975. Effect of restricted access to water supply and shelter on physiological norms and production of Murrah buffaloes. *Indian J. Dairy Sci.* 28(1):41-48.

Radadia, N. S.; Pal, R. N.; Juneja, I. J. and Sastry, N. S. R. 1979. Studies on effect of certain summer managemental practices on lactating Murrah buffaloes. 1. Feed and water intake. *Haryana Agric. Uni. J.* Res. 10(1) : 144-151.

Roy, A; Raizada, B. C.; Tewari, R. B. L.; Pandey, M. D.; Yadav, P. C. and Sen Gupta, B. P. 1968. Effect of management on the fertility of buffalo cows bred during summer. *Indian J. Vet. Sci. & Anim. Husb.* 38 : 554.

Sastry, N. S. R.; Thomas, C. K.; Tripathi, V. N., Pal. R. N. and Gupta, L. R. 1973. Effect of shelter and water sprinkling during summer and autumn on some physiological reactions of Murrah buffalo heifers. *Indian J. Anim. Sci.* 43 : 95.

Sinha, K. C. and Minnet, F. C. 1947. Application of water to the body surface of water buffaloes and its effect on milk yield. *J. Anim. Sci.* **6** : 258.

Haryana agric. Univ. J. Res., Vol. X, No. 1, pp. 157–158 (March 1980)

INCIDENCE OF TUBERCULOSIS AND PARATUBERCULOSIS OF DAIRY CATTLE IN HAU DAIRY FARM

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(Received : February 9, 1979)

An investigation to ascertain the level of prevalence of tuberculosis and paratuberculosis among cattle was undertaken in the year 1978 in Haryana Agricultural University (HAU) Farm, Hissar. Six hundred and twenty eight cattles from the Department of Animal Breeding (HAU) were tested simultaneously on either side of neck by single intradermal bovine tuberculin and johnin test. The positive reactors were retested with specific protein purified derivative (ppd) for confirmation. The overall percentage of positive reactors of tuberculin and johnin in cattle was 2.39 and 1.59, respectively.

Though the incidence of tuberculosis in cattle was considered to be very infrequent in India (Datta, 1935-36), but recent studies, made during the last few years, have shown that the disease is far more prevalent than was formerly supposed (Bali and Khanna, 1979). Dhanda *et. al.* (1950-51); Saroop (1952); Lall (1952-55); Dwivedi and Singh (1966); Abdul Khader (1972) and Krishnaswamy *et al.* (1973) recorded the incidence of tuberculosis in animals to be fairly high in some states, while it was extremely low in other states. In India, cases of Johne's disease were probably observed first in 1913 by Twort and Ingram followed by Bali *et. al.* (1978) and Sultan (1978). This paper records the results of single intradermal tuberculin and johnin tests carried out at the University Farm to know the status of the Farm in order to chalk out suitable control measures.

A total of 628 cattle on the Haryana Agricultural University Farm in the year 1978 were tested simultaneously on either side of neck against tuberculosis and paratuberculosis (Johne's disease) with concentrated bovine tuberculin and Johnin, respectively (obtained from Indian Veterinary Research Institute, Izatnagar), with single intradermal test. The fold of skin over the site of injection was measured with a pair of callipers after 96 hours.

Cattle showing the difference in the skin fold thickness of 4 mm or above than the original measurement were kept isolated from other animals. These animals were retested after 8 weeks with specific protein purified derivative (ppd) obtained from Weybridge (England) to eliminate the possibility of cross reaction.

The animals showing the difference in skin fold thickness of 4 mm or above were declared as positive reactors, whereas less than 4 mm as negative.

A total of fifteen animals were found reactors to tuberculin and ten to johnin in the year 1978, showing the percentage to be 2.39 and 1.59, respectively. The prevalence of tuberculosis was found to be low than the previous year 1977 as reported by Bali and Khanna (1979). The prevalence of tuberculosis approximately agrees with the findings of Sultan (1978). However, the prevalence was found to be low than the previous years of 1976 and 1977 as reported by Bali *et al.* (1978). The decrease in the prevalence percentage of tuberculosis and paratuberculosis in the year 1978 might be due to the fact that the positive reactors were isolated immediately and were sent to Gosadan.

REFERENCES

Abdul Khader, T. G. 1972. Paper presented at Conference on Zoonotic diseases, held in New Delhi.

Bali, M. K. and Khanna, R. N. S. 1979. Prevalence of tuberculosis among dairy cattle. *Indian J. Dairy Sci.* (under press).

Bali, M. K., Khanna, R. N. S., Singh, R. P. and Kaushik, R. K. 1978. Prevalence of Johne's disease in dairy cattle. *Haryana Agric. Univ. J. Res.* 8 : (1). 59-61.

Datta, S. C. A. 1935-36. Prevalence of tuberculosis among cattle in *India*. *Indian Vet. J.* 12 : 8.

Dhanda, M. R., Rajagopalan, V. R. and Lal, J. M. 1950-51, 1955. Work reported in the annual progress reports of Indian Council of Agricultural Research scheme for the Investigation of tuberculosis and Johne's disease at the Indian Veterinary Research Institute, Mukteswar-Kumaon for the years 1950-51 and 1955-56.

Dwivedi, J.N. and Singh, C.M.1966. Pulmonary tuberculosis in buffaloes. *Indian J. Vet. Sci.* 14 : 100.

Krishnaswamy, S., Nagaraja, K. V., Keshavamurthy, B. S., Nanjiah, R. D. and Adinarayaniah, C. L. 1973. Control of bovine tuberculosis by tuberculin testing and segregation in an organised dairy herd. *Mysore J. Agri. Sci.* 7 : 615-620.

Lall, J. M. 1952-55. Work reported in the annual progress reports of the Indian Council of Agricultural Research scheme for the investigation of tuberculosis and Johne's disease in animals at the Indian Veterinary Research Institute, Mukteswar-Kumaon for the years 1952-53, 1953-54, 1954-55.

Saroop, H. H. 1952. Tuberculosis in cattle. *Indian Vet. J.* 29 : 47-49.

Sultan, Chaman Lal 1978. A survey of the incidence of Johne's disease among cattle, buffaloes and sheep in certain parts of Andhra Pradesh. Thesis abstracts *Haryana Agric. Univ., Hissar,* 2 : 147.

Twort, F. W. and Ingram, G. L. Y. 1913. *A monograph on Johne's disease.* London Bailliere, Tindall and Cox.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 1, pp. 159–161 (March 1980)

A SHORT NOTE ON SPONTANEOUS TUBING OF THE CONNECTING CAECAL FLAP AFTER CAECOCYSTOPLASTY IN BUFFALO CALVES*

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(Received : November 15, 1978; Revised : July 24, 1979)

Although there is little information for the tube made from the part of the large intestine in bovine, yet bladder substitution has been reported from caecum (Prasad *et al.*, 1973) and Colon and Caecum (Sharma and Khan, 1978) in buffalo calves.

The surgery was conducted on 8 healthy male buffalo claves weighing between 86 to 108 kg in the present study. Material and methods as well as results of caecocystoplasty have elaborately been described and discussed previously by the authors (1978) without any postoperative complication or mortality. The present study disscusses the macroscopic study after caecocystoplasty.

Though, the connecting caecal flap in between the caecal stump and the grafted area of the bladder (Fig. 1) was kept intact for getting blood supply to the graft and its longitudinal margins were unsutured having both the lips opened at the time of surgery, yet this was noted at the time of gross examination of the organ and its removal for histopathology that the former turned spontaneously into a blind tube in each operated animal (Fig. 2). But none had developed a vesicocaecal fistula or any other disturbance due to this blind passage.

As far as reconstruction of a part or whole of the ureter or urethra is concerned, there is little information on this aspect in bovine. It can now be very well discussed on the basis of the result of the present study. Spontaneous tubing of the connecting caecal flap is one of the indicatives in author's opinion that the seromuscular caecal flap may also be utilised for remodeling a part or whole of the ureter and/or urethra in large animals, as many surgeons (Foret and Heusghem, 1953; Baum, 1954; Pyrah, 1956; Houtapel and Grundemann, 1960;

*Part of the M. Sc. (Vet) Thesis submitted to the Rejendra Agricultural University, Bihar (1973) by Senior author.

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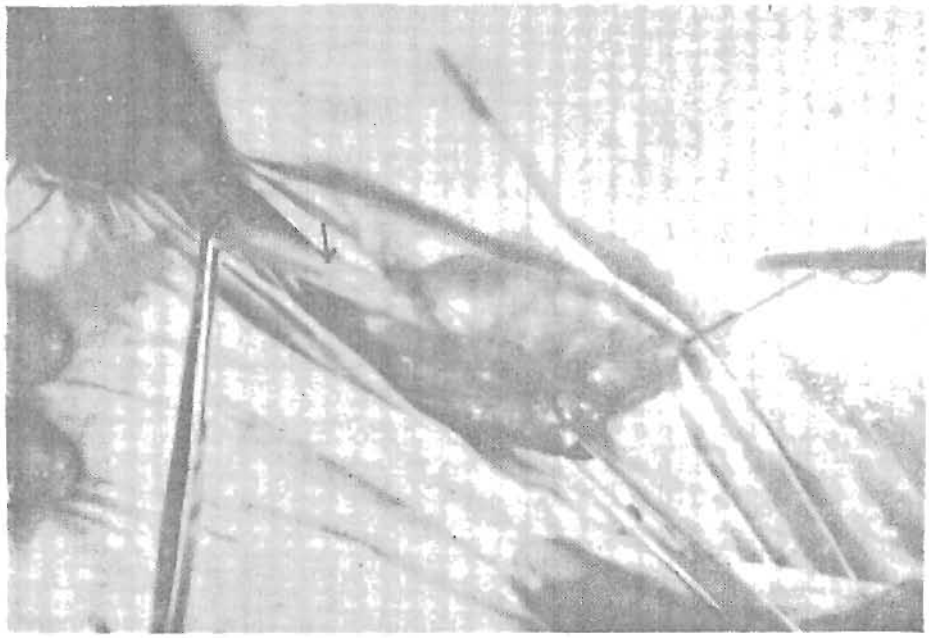


Fig. 1. Damaged area of the bladder completely repaired after caecocystoplasty and attached only with the intact caecal wall (arrow marked) for getting nurishment.

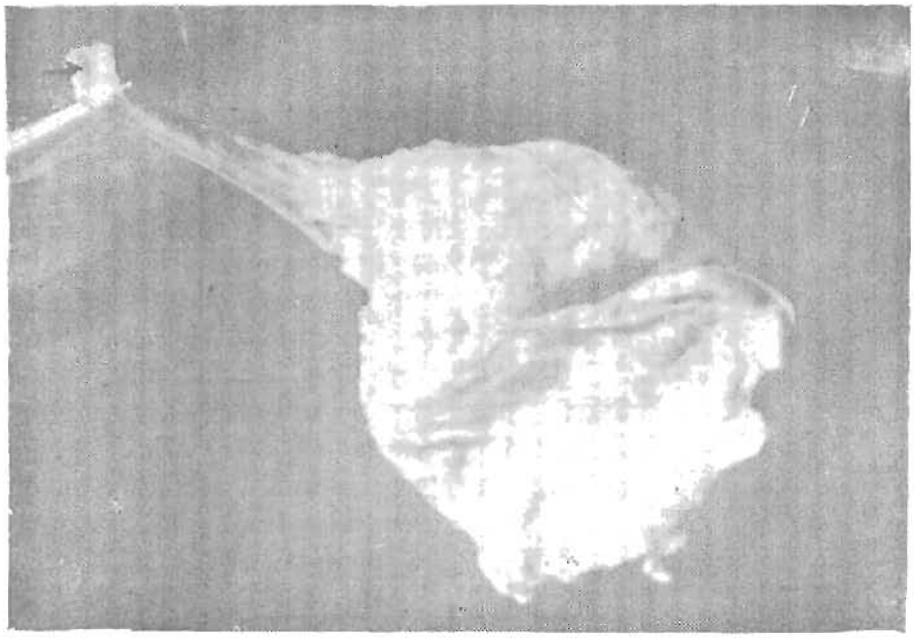


Fig 2. Completely healed bladder on 15th postoperative day of caecccystoplasty showing the arrow mark as spontaneous tubing of the connecting caecal flap.

Torbey and Leadbetter, 1962; Askari *et al.*, 1964) have replaced it either with a seromuscular tube or isolated intact tube from the bowel in dogs and men successfully.

REFERENCES

Askari, S. A., Morales, P. A. and Hotchkiss, P. S. 1964. Complete replacement of the ureter by an ileal segment. *J. Urol.* 91 : 654.

Baum, W. C. 1954. The clinical use of terminal ileum as a substitute ureter. *J. Urol.* 72 : 16-33.

Foret, J. and Housghem, C. 1953. Replacement of both ureters by an ileal graft. *Lancet*, 1 : 1181.

Houtapel, H. C. E. M. and Grundemann, A. M. 1960. Observations on ileoplasty. *Br. J. Urol.* 32 : 255-266.

Prasad, B., Tyagi, R. P. S. and Ramakumar, V. 1973. Caecocystoplasty in buffalo calves. *Indian Vet. J.* 50(10) : 1046-1051.

Pyrah, L. N. 1956. Some uses of ileum in urology. *Br. Med. J.* 1 : 135-139.

Sharma, S. P. and Khan, A. A. 1978. Studies on colocystoplasty for partial substitution of the urinary bladder in buffalo calves. *Indian Vet. J.* 55(4) : 326-332.

Sharma, S. P. and Khan, A. A. 1978. Studies on catgut and silk as suture materials for cystoplasty in buffalo calves. *Haryana agric. Univ. J. Res.* 8 : 101-106.

Sharma, S. P. and Khan, A. A. 1978. Colocystoplasty Versus caecocystoplasty in buffalo calves. *Bihar J. Vet. Sc. & A. H.* 3(3) : 50-55.

Torbey, K. and Leadbetter, W. F. 1962. Use of seromuscular layer of an ileal loop for ureteral replacement. *J. Urol.* 88 : 746-757.

Haryana agric. Univ. J.Res., Vol. X, No. 2, pp. 163—165 (June 1980)

POST-HARVEST STUDIES ON BER FRUITS (*ZIZYPHUS MAURITIANA* LAMK) I-PREPARATION OF CANDY

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(Received : December 8, 1978)

ABSTRACT

Ber candies were prepared in 1977, stored for one year at room temperature and compared with that prepared in 1978. There was a reduction in moisture, ascorbic acid and yeast count and increase in total sugar, reducing sugars and acidity content on storage. The ascorbic acid content was reduced to 4-12 mg/100 g of pulp compared to 120 mg/100 g in fresh fruits. The organoleptic quality was also improved in storage.

Ber can be successfully grown on marginal lands in the semi-arid zones of Northern India. Besides its nutritive value, it is highly remunerative and, therefore, the area under this fruit is increasing very fast in Haryana, Punjab and adjoining States. The fruit has short storage life and hence, there is a glut in the market with the result the growers get low price. No systematic work has been done so far for processing of ber fruits and keeping this in view, a pilot project was undertaken to prepare ber candy and to see its quality and storage life.

MATERIAL AND METHODS

Well matured ber fruits of Kaithli cultivar at colour break stage were taken from the experimental orchad and candies were prepared in the post-harvest technology laboratory of the Department of Horticulture, Haryana Agricultural University, Hissar.

Method of preparation

Freshly harvested fruits were washed with water and cleaned thoroughly. After pricking with the stainless steel fork, fruits were blanched in steam for 5 minutes in a canning retort and dipped in about 40% sugar solution (1 kg sugar solution for 2 kg fruits) for 10-15 days after adding 5 g citric acid. Concentration of sugar solution was raised to 50-55% by adding more sugar in which the fruits were kept for another 10-15 days. Again the concentration was raised to 65-70% and the fruits were kept for 25-30 days. Care was taken that the dipped fruits did not show any shrinkage. The fruits were taken out, drained off the solution and kept at $40\pm2°C$ in an oven to make them semi-dry (candy) with about 12% moisture.

The candies prepared in 1977 were stored at room temperature for one year and compared with the candies prepared in 1978 by same method, through chemical analysis, microbiological examination and organoleptic rating.

Chemical analysis was done for reducing sugars and total sugars by Hulme's

ferricyanide micromethod (1931), ascorbic acid, total titratable acidity and moisture content by A. O. A. C. methods (1970). Microbiological examination for yeast, bacteria and fungi was carried out according to the APHA methods (1970). Organoleptic test was done by a panel of six judges according to the method given in the book "Sensory Evaluation foods", Amerine et al, (1965).

RESULTS AND DISCUSSION

Reducing sugars, total sugars and total acidity were higher in ber candies prepared in 1977 as compared to those of 1978 (Table 1), whereas the ascorbic acid and moisture contents were low. High sugar in candies prepared in 1977 was mainly due to the loss of moisture during storage. The reduction in ascorbic acid content might be due to its oxidation to dihydroxy-ascorbic acid during storage.

The data further revealed that the ascorbic acid from fresh fruit containing about 120 mg/100 g was reduced to 4 or 12 mg/100 g fruits. This was due to the destruction of vitamin C by heat processing. The interesting part of this study was the presence of high amount of reducing sugars in candies prepared in 1977 which was about 50% more than 1978 candies. This could not be only due to loss of moisture but might be due to the conversion of sucrose to reducing sugars during storage.

Microbiological examination (Table 2) indicated a reduction in yeast colonies during storage. This might be due to the preserving effect of sugar and low moisture content of the candy. However, the counts of yeasts were far below the microbiological standards suggested for fruit preserves by Frazier (1967). Not even a single colony of bacteria and fungi was observed. This further ruled out any harmful character of the candy for human consumption.

In organoleptic rating (Table 3), the candies prepared in 1977 were rated to be highly acceptable as compared to the

TABLE 1

Physico-chemical characteristics of ber candy

Year of processing	Reducing sugar (%)	Total sugars (%)	Ascorbic acid (mg/100 g)	Titratable acidity (%)	Moisture content (%)
1977	47.94	85.88	4.0	0.45	7.0
1978	30.94	82.08	12.0	0.33	12.0

TABLE 2

Microbial examination of ber candy (Number of colonies/g candy)

Year of processing	Yeast	Bacteria	Fungi	Total counts
1977	10.0	0.0	0.0	10
1978	40.0	0.0	0.0	40

TABLE 3

Organoleptic rating of ber candy

Year of Processing	Colour	Flavour and aroma	Acceptability
1977	Dark Brown	Fruity flavour and good aroma	Highly acceptable
1978	Dark yellow	Fruity flavour and good aroma	Moderately acceptable

candies prepared in 1978 which were found moderately acceptable. This shows that the quality of candies was improved during storage.

REFERENCES

American Public Health Association 1970. *Recommended methods for the microbiological examination of foods*. American Public Health Association, New York.

Amerine, M. A., Pangborn, R. M. and Roessler, E. B. 1965. *Principles of sensory evaluation of food*. Academic Press, New York and London.

A.O.A.C. 1970. *Official methods of analysis*. 11th ed. Washington. D C.

Frazier, W. C. 1967. *Food Microbiology*. Mc. Graw-Hill Book Company, New York.

Hulme, A. C. and Narain, R. 1931. The ferricyanide method for the determination of reducing sugars. A modification of Hagedern Jenson-Hones technique. *Biochem. J.* 25: 1051.

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ALTERNARIA LEAF SPOT RESISTANCE IN RAYA

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ABSTRACT

RC 781, a Alternaria leaf spot resistant line of *raya*, was found after screening 1360 assessions under natural as well as under artificial conditions for several years. RC 781 was crossed with Prakash RH 30, RL 18 and T 59 for incorporating resistant genes in the latter. F_2 population indicated that resistance was governed by a dominant gene. Disease reaction along with vegetative characteristics have been studied.

Raya (Brassica juncea (L.) Gzern and Coss) is an important winter oilseed crop of Haryana. It suffers from several diseases and Alternaria leaf spot caused by *Alternaria brassicae* and *A. brassicicola* is the most serious disease among the leaf spot diseases and reduces yield by 10-25% every year, depending upon weather conditions. In Haryana, the damage caused by *A. brassicae* is greater because it appears earlier than *A. brassicicola*. The damage increases when the organism approaches the inflorescence region, particularly pods. At this stage normal grain formation does not take place. *Alternaria* sp. being a destructive parasite, resistance against it is rare. None of the commercially released varieties is resistant to this disease. It was, therefore, felt necessary to screen the available germplasm and to incorporate resistant genes in cultivated varieties to minimize the loss.

MATERIAL AND METHODS

One thousand three hundred and sixty germplasm lines were sown in 3 m long, two row plot and were screened under natural conditions during 1971-72 and 1972-73 crop seasons.

Inoculum of *Alternaria brassicae* was prepared by two methods, viz, mycelial mat grown on Czapek's nutrient solution for 10 days at 30 $\pm$ 1°C was homogenized in 'Waring blender' for 3 minutes in sterilized water and was sprayed on selected lines. This spray was followed by another spray of conidial suspension prepared by washing the *Alternaria* affected leaves after 30 days. Data on disease intensity were obtained from 50 leaves from 10 randomly selected plants from each plot. The rating ranged from 0 to 5, based upon 0=no lesion to 5=maximum lesions. In another set, selected lines were sown as such and were screened under natural conditions.

In another test, a resistant selection RC 781 having tall plants, late maturity, profuse secondary and tertiary branches, hairy and small leaves with purple margine and small pods and grains, was crossed with standard varieties, namely,

TABLE 1

Performance of F_1 crosses and parents under natural and artificial inoculation conditions against Alternaria leaf spot

Parents/F_1 crosses	% disease incidence	
	Natural condition	Artificial condition
Prakash	39.7	57.2
RH 30	29.2	46.2
RL 18	30.0	44.0
T 59	34.2	52.0
RC 781	0.0	5.2
Prakash X RC 781	2.5	10.0
RH 30 X RC 781	3.3	6.0
RL 18 X RC 781	0.0	4.0
T 59 X RC 781	18.6	30.5

TABLE 2

F_2 segregation and Chi-square test for different crosses

Crosses	Total No. of plants	Observed		Expected		Chisquare	Probability range
		Resistant	Susceptible	Resistant	Susceptible		
Prakash × RC 781	510	390	120	381.5	127.5	0.588	Between 0.5 to 0.4
RH 30 × RC 781	475	310	165	356.3	118.7	24.017	< 0.001
RL 18 × RC 781	526	364	162	394.5	131.5	9.432	Between 0.01 to 0.001

TABLE 3

Comparative performance of parents and F_2 crosses for different characters

Parents/Crosses	Disease reaction	Plant height (cm)	Main Shoot length (cm)	No. of primary branches	No. of secondary branches	Pod length (cm)	No. of grains/ pod	1000 grain weight (g)
Prakash	S	221.6	79.0	8.2	19.0	3.1	14.2	3.4
RH 30	S	175.2	60.5	6	16.8	4.5	11.8	5.8
RL 18	S	280.8	56.53	7.8	20.0	3.4	14.0	3.2
RC 781	R	215.2	68.8	8.6	11.6	3.2	11.5	2.1
Prakash×RC 781	R	226.1	77.8	11.6	46.6	2.8	12.8	2.0
Prakash× RC 781	S	209.7	81.7	9.6	34.6	2.9	12.6	2.1
RH 30×RC 781	R	159.0	60.9	110.6	16.7	2.2	13.2	3.0
RH 30×RC 781	S	163.6	81.1	9.2	17.2	2.9	12.7	3.0
RL 18×RC 781	R	202.4	61.3	10.4	32.4	3.1	13.3	2.2
RL 18×RC 781	S	271.0	73.7	10.0	30.4	3.4	13.2	2.4

Prakash, RH 30, RL 18 and T 59 which were susceptible to highly susceptible under natural and artificial conditions. Disease intensities of F_1 crosses along with parents were noted after artificial inoculations by the method described above. Similarly, F_2 populations were also screened. on the basis of performance under both the conditions resistant and susceptible plant populations were subjected to Chi-Square test. (Table 2)

RESULTS AND DISCUSSIONS

Of 1360 germplasm lines tested, 86 were found resistant under field conditions in two years trials. These 86 lines were screened under artificial and natural conditions for another two years and RC 781 was found to be resistant against *Alternaria* sp. and was selected fot crossing work.

To incorporate resistant gene from RC 781 to Prakash, RH 30, RL 18 and T 59, crosses were made and seeds obtained from these crosses were sown in two sets. One set was inoculated artificially while other was kept as such for comparison. Table 1 indicates the performance of F_1 population of different crosses. T 59 × RC 781 which showed higher disease intensities in natural and artificial conditions was rejected for further studies. Plant height, maturity duration, branching and pod and grain character F_1 crosses were found to be similar to original parents.

During 1976–77 crop season, F_2 populations were raised and inoculated artificially. Data on the resistant and susceptible ratio, of F_2 populations of Prakash X RC 781, RH 30 × RC 781 and RL 18 × RC 781 when subjected to Chi-square showed that observations were perfectly in agreement in the ratio of 3 : 1 except for cross RH 30 × RC 781, meaning thereby that resistance against Alternaria leaf spot in RC 781 was governed by a single dominant gene.

Morphological characters were studied to observe the effect of crossing RC 781, a resistance source, with cultivated varieties (Table 3). It was recorded that vegetative characters were improved, whereas grain yield characters, viz, pod length, grain number and 1000 grain weight were considerably reduced. It indicated that reduced pod length, grain number and seed weight were linked with dominant gene responsible for resistance.

In all the resistant plants, the leaves were purple, thick, lobed with prominent veins and veinlets. All these characters can be used as marker genes for early screening genotypes for resistant in large populations.

Further, pod length, number of seeds/pod and grain weight were smaller in populations having resistant genes. The work is in progress to improve these qualities to get a desirable plant type.

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HETEROSIS IN DESI COTTON (*G. ARBOREUM* L.)

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ABSTRACT

The performance of 30 F1 hybrids involving 13 *desi* cotton (*G. arboreum* L.) varieties of diverse origin was assessed to study the extent of heterosis over mid and better parent for 7 quantitative characters. Four crosses for bolls per plant and boll weight have manifested symultaneous heterosis for high yield. It was concluded that yield of seed cotton might be increased by exploiting some of the yield components particularly bolls per plant and boll weight.

In Haryana and Punjab *desi* cotton is grown in over 50% of the total area under cotton. The farmers are not ready to give up the cultivation of *desi* cotton, because of its resistance to insect-pests and drought as compared to upland cotton. The success of Hybrid 4 (Patel. 1971) and Varalaxmi (Katarki, 1971) in some southern parts of the country has aroused interest for developing superior hybrids in *desi* cotton also. For developing such hybrids, selection of the parents on the basis of genetic diversity and better in *per se* performance is most important (Marani, 1967 and Patil, 1973). The information in respect of heterosis in literature is scanty. The present study was, therefore, undertaken to know the magnitude of heterosis in inter-varietal crosses of *G. arboreum* L.

MATERIAL AND METHODS

A set of 30 crosses involving 10 females (1. S 42-462, 2. AC 627, 3. Co 5, 4. C. J. D. 164×14 yhb., 5. Climies S. L., 6. H. 476, 7. 10-2×24164, 8. D 48-154, 9. AK 277 and 10. AH 235) and 3 males (11, G 27, 12, Shamli and 13. Lohit) were made during 1973. The 43 entries were grown in a randomized block design with 3 replications during *Kharif*, 1974. A distance of 60 cm and 30 cm was kept between rows and plants, respectively. Five competitive plants were selected for recording the observations on 7 quantitative characters, viz., plant height (cm), bolls per plant, boll weight, halo-length, ginning out-turn, seeds per locule and yield of seed cotton. The heterosis was estimated over mid and better parent.

RESULTS AND DISCUSSION

Analysis of variance

The mean performance of the parents and their 30 F1's has been given in Table 1. The analysis of variance (Table 2) in respect of genotypes, parents and hybrids showed highly significant differences for all the characters, except for plant height among the parents. It indicated the genetic diversity among

TABLE 1

Mean values of parents and hybrids for seven quantitative characters in *desi* co ton

Parents	Plant height (cm)	No. of bolls/ plant	Boll weight (g)	Halo-length (mm)	Ginning out-turn (%)	No. of seeds/ locule	Yield of seed cotton (g)
1. S 52-462	142.33	32.33	1.53	18.41	32.64	6.14	40.93
2. AC 627	150.10	29.60	1.53	22.10	28.71	6.59	28.97
3. Co 5	110.55	15.35	1.37	20.80	34.17	5.69	15.75
4. C. J. D. 164× 14 yhb.	165.55	33.72	2.26	21.48	32.71	6.66	63.16
5. Climies S. L·	129 89	29.55	1.92	23.85	42.07	7.19	34.63
6. H 476	106.19	31.53	1.28	24.33	35.61	6.55	51 30
7. 10-2×24164	140.00	28.25	1.38	18.52	32.92	6.26	24.00
8. D 48-154	146.92	21.37	2.33	17.94	40.17	8.80	22.83
9. AK 277	134.08	25.27	2.08	19.79	35.93	7.01	63.97
10. AK 235	132.08	9.38	2.55	13.62	40.11	11.26	36.60
11. G 27	155.73	45.47	1.84	14.80	38.13	7.53	64.47
12. Shamli	151.00	38.87	2 43	15.05	36.03	7.53	35.33
13. Lohit	145.33	36.47	1.75	15.83	34.83	7.08	69.80
Crosses							
1×11	181.08	49.42	2.04	18.20	35.47	7.63	72.00
2 × 11	142.01	44.49	2.02	19.74	35.65	7.57	78.56
3 × 11	152.17	48.68	1.92	19.24	33.17	7.42	66.05
4 × 11	166.67	46.00	2.47	21.63	30.37	8.01	66.53
5 × 11	161.47	50.37	2.59	20.63	38.69	8.01	71.33
6 × 11	151.25	46.97	1.97	19.64	36.33	7.08	60.53
7 × 11	145.67	47.53	1.90	17.01	36.35	7.07	66.17
8 × 11	151.11	45.20	2.21	20.27	37.62	8.28	54.43
9 × 11	149.33	49.53	2.23	19.03	36.92	7.46	58.49
10 × 11	166.83	25.20	2.43	16.14	39.92	9.16	41.75
1 × 12	152.42	26.60	2.21	19.59	34.15	7.67	37.20
2 × 12	179.98	46.53	1.76	20.40	34.98	7.93	48 39
3 × 12	139.15	35.20	1.35	19.03	34.10	7.06	23.93
4 × 12	152.42	38.98	2.01	18.52	35.90	7.20	36.27
5 × 12	146.79	40.73	2.10	25.56	40.42	7.46	64.71
6 × 12	132.67	38.13	1.99	20.50	35.20	7.51	60.33
7 × 12	145.89	31.80	2.21	20.30	33.85	7.10	48.64
8 × 12	147.33	40.23	2.38	20.76	43.20	7.76	49.87
9 × 12	165.67	45.33	2.39	19.57	37.12	7.58	65.07
10 × 12	173.00	23.70	2.53	18.14	36.88	9.09	32.07
1 × 13	172.55	45.20	1.99	17.18	29.48	7.41	59.43
2 × 13	173.65	45.59	2.03	17.82	34.33	6.96	73 78
3 × 13	180.33	49.00	2.05	17.46	33.35	7.04	76.70
4 × 13	164.67	44.52	2.66	18.45	35.67	6.74	58.89
5 × 13	137.50	35.75	2.11	18.21	37.08	8.16	58.05
6 × 13	152.89	42.40	2.05	20.03	33.96	7.77	59.35
7 × 13	161.58	53.73	1.99	18.25	37.03	7.46	94.28
8 × 13	168.00	40.67	2.27	18.80	36 27	7.88	51.73
9 × 13	160.64	41.28	2.23	18.38	34.64	7.27	74.15
10 × 13	165.70	41.00	2.32	15.93	36.21	8.74	65.83
Error	246.60	54.37	0.13	3.06	9.08	0.42	146.07
C. D. at 5%	25.13	11.80	0.59	2.80	4.82	1.04	19.33
at 1%	32.95	15.47	0.77	3.65	6.32	1.36	25.34

TABLE 2

Mean sum of squares for some quantitative characters in *desi* cotton

Source	Degrees of freedom	Plant height	Bolls/ Plant	Boll weight	Halo-length	Ginning out-turn	Seeds/ locule	Yield of seed-cotton
Genotypes	42	839.95**	305.26**	0.3601**	17.34**	26.75**	2.59**	918.86**
Parents	12	851.92	277.13**	0.5679**	36.37**	41.04**	6.17**	879,07**
Hybrids	29	532.33**	174.98**	0.2113**	10.04**	21 74**	1.05**	681.12**
Parents v/s hybrids	1	9617.15**	4560.81**	2.1800**	0.99	0.29	4.27**	8290.99**
Error	84	246.60	54.37	0.1282	3.06	9.08	0.42	146.07

* and ** represent level of significance at 5% and 1%, respectively.

the parents involved in the crosses. Parents as a whole were found differing significantly from their hybrids for all the characters except halo-length and ginning out-turn.

Heterosis

The estimates of heterosis have been presented in Table 3. In general, heterosis was high for plant height, bolls per plant, boll weight and yield of seed-cotton. It was medium to low for seeds per locule, halo-length and ginning out-turn. For plant height, heterosis ranged from —7.13 to 40.95% over mid-parent and —12.14 to 24.08 over better parent. Twelve crosses showed significant heterosis for tallness over better parent, Of them, 5 crosses gave positive and significant heterosis for yield, while others showed low heterosis. Therefore, it may be concluded that plant height did not follow a particular direction in the manifestation of heterosis for yield of seed-cotton.

Appreciable amount of heterosis was observed for bolls per plant and boll weight. The range of positive heterosis over mid-parent was 4.65 to 89.12% for bolls per plant and 1.74 to 37.89% for boll weight. For bolls per plant as many as 13 crosses showed positive and significant heterosis over their better parents, Among these, 8 crosses also gave heterosis for yield. In case of boll weight, 9 crosses manifested positive and significant heterosis over better parent and out of these, 5 also gave high yield. The heterosis recorded either for bolls per plant or boll weight was generally accompanied by heterosis for yield. Similar findings were also reported by Singh *et al.* (1974) in *desi* cotton and Chhabra (1974) and Singh and Gupta (1968) in upland cotton. It is again very interesting to note that the crosses S 52-462 × G 27, Climies S L.× G 27, AC 627 × Lohit and Co 5 × Lohit displayed heterosis simultaneously for bolls per plant, boll weight and yield of seed-cotton.

For halo-length and ginning out-turn positive heterosis ranged from 0.33 to to 31.40% and 0.24 to 13.38%, respectively, over mid-parent. For seeds per locule the range was recorded from 0.61 to 14.29%. Seven crosses were found to be positive and significant over better parents for halo-length and seeds per locule where only one was significant for high ginning out-turn. For yield of seed-cotton, 10 crosses showed con-

TABLE 3

Heterosis (%) over mid-parent and better parent for seven characters in *desi* cotton

Crosses	Plant height		Bolls/Plant		Boll weight		Halo-length	
	Mid-Parent	Better parent	Mid parent	Better parent	Mid parent	Better parent	Mid parent	Better parent
1 × 11	12.50**	16.28**	27.03**	8.69*	21.15**	11.05*	9.59**	—1.16
2 × 11	—7.13	—8.81	18.52**	—2.15	20.20**	9.96	6.98**	—10.69
3 × 11	14.29**	—2.29	60.09**	7.07	19.50**	4.35	8.11**	—7.48
4 × 11	3.75*	0.67	16.18**	1.17	20.55**	9.28*	19.27**	—0.73
5 × 11	13.07**	3.68	34.29**	10.79*	37.89**	35.13**	6.75**	—13.50
6 × 11	15.49**	—2.88	21.99**	3.30	26.63**	7.25	0.37	—19.29
7 × 11	—1.49	—6.46	28.96**	4.54	17.89**	3.26	2.09	—8.15
8 × 11	—0.14	—2.97	35.26**	—0.59	5.75	—5.43	23.79**	12.95**
9 × 11	3.05	—4.11	40.05**	8.94	13.60*	7.05	13 88**	—3.84
10 × 11	15.93**	7.13*	—8.11	—44.57	10.64*	—4.71	13.56**	9.03**
1 × 12	3.92	0.94	—25.28	31.56	11.26*	—9.31	17.08**	6.39**
2 × 12	19.54**	19.19**	35.91**	19.71**	—11.11	—27.67	9.81**	—7.71
3 × 12	6.40**	—7.85	29.84**	—9.43	—29 90	—44,38	6.14**	—8.52
4 × 12	—3.70	—7.93	4.85	—2.27	—14.55	—17.53	1.40	—13.77
5 × 12	4.52	—2.79	19.05**	4.78	—3.60	—13.83	31.40**	7.15**
6 × 12	3.17	—12.14	8.33	—1.89	7.46	—18.08	4.10	—15.75
7 × 12	0.26	—3.39	—5.24	—18.18	15.98**	—9.04	20.95**	9.63**
8 × 12	—1.09	—2.43	33.59**	3.52	—0.14	—2.19	25.84**	15 70**
9 × 12	16.22**	9.71**	41.37**	16.64**	5.76	—1.92	12.37**	—1.08
10 × 12	22.22**	14.57**	—1.76	—39.02	1.74	—0.52	28.45**	22.35**
1 × 13	19.96**	18.73**	31.39**	23.95**	20.89**	13.31*	0.33	—6.70
2 × 13	17 55**	15.69**	38.01**	25.02**	23.78**	15.78**	—6.05	—19.38
3 × 13	40.95**	24.08**	89.12**	34.37**	30.92**	16.73**	—4.68	—16.06
4 × 13	5.93*	—0.53	26.86**	22.08**	32.45**	17.52**	—1.10	—14.09
5 × 13	—0.08	—5.39	8.30	—1.96	15.17**	10.26*	—8.24	—23.66
6 × 13	21.57**	5.20	24.70**	16.27**	35.31**	16.92**	—0.28	—17.70
7 × 13	13.26**	11.18**	66.06**	47.35**	27.10**	13 69**	—6 26	—1 44
8 × 13	14.97**	14.35**	40.63**	11.52*	10.93*	—2 86	11.32**	4.77
9 × 13	14.98**	10.53**	33.75**	13.21*	16.14**	7.21	3.18	7.13
10 × 13	19.46**	14.01**	78.84**	12.43*	8.06*	—11.12	8 19**	0.63
C. D. at 5%	21.76	25 13	10.22	11.82	0.50	0.57	2.44	2.81
C. D. at 1%	29.34	33.89	13.78	15.92	0.68	0.77	3.29	3 79

Crosses	Ginning out-turn		Seeds/locule		Yield of seed-cotton	
	Mid parent	Better parent	Mid parent	Better parent	Mid parent	Better parent
1 × 11	0.24	−6.97	11.26**	1.24	88.81**	75.89**
2 × 11	0.67	−6.52	7.27**	0.53	144 36**	122.35**
3 × 11	−8.25	−13.02	12.22**	−1.50	158.60**	86.93**
4 × 11	−14.27	−20.37	12.82**	6.28**	35.10**	5.34
5 × 11	−3.53	−8.05	8.83**	6.37**	103.91**	101.89**
6 × 11	−1.46	−4.72	0.61	−5.97	39.75**	18.00
7 × 11	2.31	−4.68	2.59	−6.11	199.66**	84.43**
8 × 11	−3.91	−6.34	1.35	−5.95	87.16**	54.06**
9 × 11	−0.31	−3.91	2.52	−6.11	17.80**	−8.57
10 × 11	2.03	−0.48	−2.52	−18.65	16.08*	14.07
1 × 12	−0.54	−5.22	12.19**	1.81	−29.41	−42.29
2 × 12	8.07	−2.91	12.27**	5.22*	3.57	−24.94
3 × 12	−2.85	−5.36	6.78**	−6.70	−40.34	−62.88
4 × 12	4.45*	−0.37	1.46	−4.42	−42.70	−43.28
5 × 12	3.51	−3.92	1.36	−0.93	30.59**	0.38
6 × 12	−1.73	−2.31	6.63**	−0.36	4.23	−6.41
7 × 12	−1.30	−6.05	2.92	−5.80	9.98	−24.53
8 × 12	13.38**	7.55**	−5.02	−11.86	14.24*	−22.65
9 × 12	3.17	3.02	4.22*	0.62	1.32	0.93
10 × 12	−3.12	−8 04	−3 30	−19.30	−36.54	−50.26
1 × 13	−12.63	−15.38	12.61**	5.13*	18.00**	−0.61
2 × 13	8.06**	−1.44	1 90	−1.65	66.23**	23.37**
3 × 13	−3.32	−4.25	10.26**	−0.56	103.04**	28 26**
4 × 13	0.56	2.39	−1.89	−4.80	−4.19	−6.75
5 × 13	−0.36	−11.86	14.29**	13.39**	23.01**	−2.87
6 × 13	−2.20	−4.64	14.04**	9.74*	6.85	−0.75
7 × 13	9.32**	6.31	11 87**	5.37*	125 02**	57.66**
8 × 13	−3.29	−9.71	−0.76	−10.45	25.21**	−13.49
9 × 13	−2.10	−3.60	3.12	12.64	19.82**	15.92**
10 × 13	−3.37	−9.73	−4.69	−22.38	36.58**	10.09
C. D. at 5%	4.18	4.82	0.90	1.04	16.75	19.34
C. D. at 1%	5.64	6.50	1.21	1.40	22.59	26.08

spicuous heterosis and the estimates ranged from 0.38 to 122.35% over better parent. The combinations showing marked heterosis were S 52-462 × G 27, AC-627 × G 27, Co 5 × G 27, Climies S. L. × G 27, 10-2-24164 × G 27, D 48-154 × G 27 and 10-2-24164 × Lohit.

From the present study, it may be concluded that bolls per plant and boll weight are the two main components of yield of seed-cotton. The hybrids involving G 27 in almost all the cases were characterised by high yield. This line might be intensively used in the crossing programme for evolving pure lines possessing high yield potential. The selection of the parents for the crossing on the basis of their phenotypic performance might not prove useful.

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REFERENCES

Chhabra, B. S. 1974. A study of heterosis and combining ability in cotton. M. Sc. Thesis, Haryana Agricultural University, Hissar.

Katarki, B. H. 1971. Varalaxmi—a high yielding hybrid cotton of quality. *Indian Farm.* 21 : (81) 35-36.

Marani, A. 1967. Heterosis and combining ability in intraspecific and inter specific crosses of cotton. *Crop Sci.* 7 : 519-22.

Patel, C. T. 1971. Hybrid-4 a new hope towards self sufficiency in cotton. *Indian cotton Development.* 1 (2) : 1-5.

Patil, M. S. 1973. Combining ability for some agronomic characters in *G. herbaceum* L. *Indian J. Agric. Sci.* 41 (12) : 1048-49.

Singh, R. B. and Gupta, M. P. 1968. Multivariate analysis of divergence in upland cotton (*G. hirsutum* L.) *Indian J. Genet.* 28 : 151-57.

Singh, T. H., Kandola, H. S. and Sandhu, S. S. 1974. Genetic analysis of yield and other important characters in *G. arboreum* L. *Cotton Grow. Rev.* 51 : 138-48.

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ASSOCIATION ANALYSIS IN SPRING WHEAT

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ABSTRACT

Correlations and path coefficients were studied in 40 genotypes of wheat under two environments. Genotypic correlations were higher than phenotypic correlations. Grain yield was found to be positively correlated with effective tillers per plant, 100-grain weight and ear emergence. All the components of yield except 100-grain weight were *positively associated with each other. Path coefficient analysis revea*led that tillering was the most important component of grain yield in wheat because effective tillers per plant registered maximum direct effects on grain yield in both the environments. The 100-grain weight and ear emergence also showed high direct effects. In the light of present findings, component selection with greater emphasis on tillering was suggested in wheat.

Yield is the ultimate criterion which a plant breeder has always to keep in view in his attempts to evolve improved types of any crop plant. However, yield itself, as is well known, is not a simple character but is an outcome of the interaction of a number of component traits. Realising this, a number of correlation studies have been made in wheat. But these studies may not be a reliable guide for handling and entirely new genetic material because inter relationships are known to depend on genetic material and invironmental conditions (Jatasra and Paroda, 1977 and 1978). Earlier, Adama (1967) has pointed out that since yield component are determined at different stages in the ontogeny of the plant they are affected differentially by the environmental factors. Compensation between yield components may lead to variation in correlation pattern and, therefore, he stressed the need for continual investigation of inter-relationships between components. With the introduction of Norin 10 dwarfing gene in India such studies are of particular importance. Hence, in the present study, correlation and path coefficients were worked out using 40 wheat genotypes of Indian and Maxican origin.

MATERIAL AND METHODS

Experimental material comprised of 40 wheats varieties, viz , Hira, Sonora 64, Sonalika, Kalyansona, PV 18, Lerma-Rojo, C 306, NP 809, UP 301, Agra Local, C 281, C 591, NP 876, WG 357, Raj 821, HD 1977, HD 2009, WH 111, Moti, WL 212, Raj 856, Raj 857, HP 916, HD 1925, HD 1981, HD 1982, HD 2016, HD 2021, HD 2056, M 241, WG 377, WL 303, WL 396, WL 399, WH 113,

WH 114, WH 120, UP 310, UP 315 and UP 319. Sowing was done in a randomized block design with three replications at Haryana Agricultural University Farm, Hissar, under two fertility conditions (E_1=high fertility, E_2=low fertility). Seeds were dibbled in 3 m long rows keeping row to row distance 30 cm. The plant to plant distance was kept at 15 cm. Five plants were selected at random from each single-row plot and observations were recorded on grain yield per plant, tillers per plant, 100-grain weight, plant height and ear emergence The observed values were averaged over plants and general correlations were worked out separately for both the environments. Path analysis was carried out following Dewey and Lu(1959).

RESULTS AND DISCUSSION

Genotypic and phenotypic correlation coefficients between all possible pairs of five quantitative traits are presented in Table 1. Genotypic correlation coefficients were higher than their corresponding phenotypic coefficients revealing, thereby, the lack of association between attributes at the environmental level. Grain yield was positively correlated with ear emergence and tillers per plant under high fertility conditions (E1). However, under low fertility (E2), the correlation estimates were not significant. Gene expression is known to vary from environment to environment and, therefore, the association pattern also undergoes changes in different environments. In the present case, non-significant correlation estimates of grain yield with ear emergence and tillers per plant might be due to the fact that these traits could not have fully expressed under low fertility conditions. Jatasra and Paroda (1978) studied correlation estimates under six environments and observed that these estimates vary considerably from environment to environment. Positive association between yield and tillering has also been reported by Sikka and Jain (1958), Gandhi *et al.* (1964), Paroda and Joshi (1970) Anand *et al.* (1972) and Jatasra and Paroda (1978).

Grain yield was found to be positively associated with 100-grain weight in E2.

TABLE 1

Genotypic (upper, right) and phenotypic (lower, left) correlation coefficients under two environments in wheat

Character	Env.	Ear emergence	Plant height	Tillers per plant	100-grain weight	Grain yield
Ear	E1		0.503**	0.457**	−0 266	0.598**
emergence	E2		0.479**	0.412**	−0.314*	−0.076
Plant height	E1	0.454**		0.512	0.192	0.186
	E2	0.421**		0.388**	0.181	0.300
Tillers per	E1	0.397*	0.118		−0.313	0.676**
plant	E2	0.290	0.272		−0.047	0.292
100-grain	E1	−0.234	0.176	−0.278		−0.261
weight	E2	−0.319*	0.173	−0.085		0.737**
Grain yield	E1	0.505	0.158	0.587**	−0.201	
	E2	−0.035	0.237	0.430**	0.508**	

*Significant at 5% **Significant at 1%

Sikka and Jain (1958), Paroda and Joshi (1970) and Anand *et al.* (1972) also reported positive correlation between these attributes. In the present study, the lack of association under high fertility conditions (E1) might be attributed due to the fact that the genetical material constituted mostly of the Mexican wheats in which number of grains rather than kernel weight appeared to be more important yield component. Jatasra and Paroda (1978) also could not obtain any association between these traits. Singh *et al.* (1970) in durum wheat even found negative association between yield and Kernel weight.

Ear emergence was highly significantly and positively associated with plant height and effective tillers in both the environments. These results indicated that late varieties were, in general, tall and had more number of tillers per plant. Interrelationship between ear emergence and 100-grain weight was negative. Plant height ear emergence and tillering were positively associated with each other, whereas 100-grain weight had negative relationship with both ear emergence and tillers per plant. Correlation studies indicated negative association between tillering and 100-grain weight, both of which are important yield components. Obviously an adjustment between tillers per plant and 100-grain weight has to be sought maximize grain yield in wheat.

The path coefficient analysis which permits the separation of correlation coefficients into direct and indirect effects gives a better picture of relationship existing between pairs of characters. Studies on the direct and indirect effects (Table 2) revealed that tillers per plant contributed maximum to grain yield in both the environments. The indirect contribution of tillering through ear emergence was also positive. The 100-grain weight in E2 and ear emergence in E1 had also very high direct effects.

Ear emergence had not only high direct effect but also contributed to grain yield through tillers per plant. Indirect effect of this trait, via, 100-grain weight was negative. The indirect effects of 100-grain weight through all the traits

TABLE 2

Direct and indirect effects of some quantitative traits on yield of wheat

Character	Env.	Effects Via				Genotypic correlation with yield
		Ear emergence	Plant height	Tillers/ plant	100-grain weight	
Ear Emergence	E1	0.435	−0.059	0.231	−0.009	0.589**
	E2	0.015	0.018	0.126	−0.235	−0.076
Plant height	E1	0.219	−0.116	0.077	0.007	0.186
	E2	0.007	0.038	0.119	0.135	0.300
Tillers/ plant	E1	0.199	−0.018	0.506	−0.011	0.676**
	E2	0.006	0.015	0.0307	−0.036	0.292
100-grain	E1	−0.116	−0.022	−0.158	0.035	−0.261
	E2	−0.005	0.007	−0.015	0.750	0.737**

Residual effects : E1=0.428, E2=0.347

Note : Underlined values denote direct effects.

studied were negative. This further explains the negative correlation of 100-grain weight with grain yield in high fertility. The 100-grain weight had a positive direct contribution but due to the negative indirect effects, via, other components the overall correlation resulted into negative estimate.

From the present study, it could be concluded that out of the three traits, viz., ear emergence, tillers per plant and 100-grain weight which showed highly significant and positive correlations with grain yield, tillers per plant was found to be the most important component trait because it not only had high direct effect consistently in both the environments but also contributed indirectly, via, ear emergence. Therefore, due emphasis should be given to tillers per plant while selecting for high grain yield in wheat.

ACKNOWLEDGEMENT

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REFERENCES

Adams, M. W. 1967. Basis of yield components compensation in crop plants with special reference to the field bean *Phaseolus vulgaris*. *Crop Sci.* 7 : 505-10.

Anand ,S. C., Aulakh, H. S. and Sharma, S. K. 1972. Association among yield components in dwarf wheats. *Indian J. agric. Sci.* 42 : 935-38.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron J.* 51 : 515.

Gandhi, S. M., Sanghi, A. K. Nathawat, K. S. and Bhatnagar M. P. 1964. Genotypic variability and correlation coefficients relating to grain yield and a few other quantitative characters in Indian wheats. *Indian J. Genet.* 24 : 1-8.

Jatasra, D. S. and Paroda, R. S. 1977. *Studies on synchrony of tillering in wheat* (*T. aestivum* L.). 1st National Seminar on Genetics and Wheat Improvement, Ludhiana. A. K. Gupta (Ed.). PP 161-65.

Jatasra, D. S. and Paroda, R. S. 1978. Character association in three generations of wheat under different environmental conditions. *Cereal Res. Comn.* 6 : 85-91.

Paroda, R. S. and Joshi, A. M. 1970. Correlations, path coefficients and the implication of discriminant function for selection in wheat (*T. aestivum* L.). *Heredity* 25 : 383-92.

Sikka, S. M. and Jain, K. B. L. 1958. Correlation studies and application of D. F. in *aestivum* wheats for varietal selection under rainfed conditions. *Indian J. Genet.* 18 : 178-86.

Singh, S. P., Shrivastava, M. S. and Valanker, S. V. 1970. Variability and correlation coefficients for grain yield and other quantitative characters in *T. durum Desf. Indian J. agric. Sci.* 40 : 1042-45.

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COMBINING ABILITY FOR QUALITY CHARACTERS IN TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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ABSTRACT

Combining ability for quality characters were studied in a line x tester cross of tomato. A significant difference for all characters for female (except for juice and pulp ratio and ascorbic acid content), male and female × male were observed. Varieties Gamed, Sioux and I. M. for pericarp thickness; PH 14, SI 120 and Pusa Ruby for number of locules and Sel 152 for juice and pulp ratio exhibited high gca effects. Crosses Gamed × Sioux for pericarp thickness, Pb. Tropic × SI 120 for number of locules, Pb. Tropic × KAL for juice pulp ratio and Pb. Tropic × Sioux for ascorbic acid were found to show h gh sca effects.

In tomato, quality characters are of considerable importance for daily use in general and for processing in particular. Ibarbia (1969), Kaul and Nandpuri (1972) and Kalloo *et al* (1974) have studied combining ability for quality and yield characters. In the present paper, attempt has been made to study general combining ability of parents and specific combining ability of hybrids of certain quality characters in order to select suitable parents and hybrids in a line × tester cross of tomato.

MATERIAL AND METHODS

Experiment was conducted at Vegetable Research Farm of Haryana Agricultural University, Hissar, during 1976-77. Varieties HS 101, Gamed and Punjab Tropic (Pb. Tropic) were used as testers and varieties. Pantnagar Hybrid 14 (PH 14), Sioux, S 12, Pusa Ruby, SL 120, Kalianpur Angurlata (KAL), Improved Meeruti (IM), Pusa Lal Meeruti (PLM), Sweet 72, Marglobe, HS 102 and Sel 152 were used as lines. Testers were used as femal and lines as male parents. Seedlings of 36 crosses along with 15 parents were transplanted in a randomized block design with three replications in 60 cm rows and plants spaced at 45 cm. Recommended cultural practices were followed during experimentation. Observations were recorded on five competitive plants on thickness of pericarp (mm), number of locules/fruit, juice and pulp ratio, ascorbic acid content (mg/100 gm), acidity, T. S. S. and disease incidence. Data were statistically analysed for the study of gca and sca according to the method suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

A highly significant difference among progeny was observed for all the characters (Table 1). Analysis of variance for gca and sca presented in Table 2,

TABLE 1

Analysis of variance for different characters in tomato

Characters	M. S. S. replication	M. S. S. Progeny	M. S. S. error
1. Thickness of pericarp (mm)	0.30	2.25**	0.22
2. Number of locules/fruit	0.33	1.70**	0.19
3. Juice & pulp ratio	0.00	0.06**	0.01
4. Ascorbic acid content (mg)	9.49*	24.57**	3.51
5. Acidity	0.08	0.13**	0.02
6. T. S. S.	0.05	0.53**	0.09
7. Disease incidence	5.09	42.64	2.64

*Significant at P=0.05
**Significant at P=0.01

TABLE 2

Analysis of variance of gca and sca for different characters in tomato

Characters	Source of variation			
	Males	Females	Females × male	Error
1. Thickness of pericarp (mm)	0.31**	8.47**	0.14**	0.07
2. Number of locules/fruit	0.76**	3.19**	0.22**	0.06
3. Juice & pulp ratio	0.03**	0.02	0.02**	0.01
4. Ascorbic acid content (mg)	10 45**	1.38	7.69**	1.17
5. Acidity	0.03**	0.10**	0.03**	0.01
6. T. S. S.	0 28**	0.47**	0.19**	0.03
7. Disease incidence	17.78**	76.82**	8.50**	0.89

**Significant at 1% level.

has indicated a significant difference for all the characters for male, female (except for juice and pulp ratio and ascorbic acid content) and female × male. This shows the importance of additive and non-additive gene action. In general, magnitude of variances due to gca of the parents was higher than sca of the crosses, which indicates the superiority of additive gene action.

Estimates of gca are presented in Table 3. Of the 12 male and 3 female parents, 6 were significant for thickness of pericarp, 9 for number of locules/fruit, 5 for ascorbic acid content, 1 for acidity, 9 for T. S. S. and 10 for disease incidence Varieties Gamed, Sioux and IM for pericarp thickness; PH 14, SI 120 Marglobe and Pusa Ruby for number of locules; Sel 152, S 12 and KAL for juice and pulp ratio, Sweet 72, SI 120, PH 14 and IM for ascorbic acid content; PH 14 Sel 152 and Pb . Tropic for acidity and Sel 152, PLM and Sweet 72 for T. S. S. exhibited high gca effects.

Estimates of sca of crosses presented in Table 4, has indicated that 18 crosses for pericarp, 20 for number of

TABLE 3

Estimates of general combining ability effects for different characters in tomato

Parents	Thickness of pericarp (mm)	Number of locules/ fruit	Juice & pulp ratio	Ascorbic acid content (mg)/ 100gm fruit	Acidity	T. S. S.	Disease incidence
Males							
PH 14	−0.15	0.71*	−0.07	1.40*	0.17*	−0.15	−2.68*
Sioux	0.50*	−0.05	−0.10	−1.26	0.01	0.04	1.18
S 12	0.14	0.00	0.08	−3.45*	−0.06	−0.23*	−1.08
Pusa Ruby	−0.49*	0.38*	0.03	0.75	−0.11	0.22*	2.92*
SI 120	−0.13	0.51*	0.01	1.80*	−0.09	0.24*	−2.52*
KAL	−0.14	−0.50*	0.08	0.82	0.04	−0.33*	−1.30*
I. M.	0.39*	−0.11	−0.06	1.04	0.07	−0.55*	−3.15*
PLM	−0.03	0.22	0.05	0.00	−0.05	0.36*	4.68*
Marglobe	0.15	0.51*	−0.05	−0.56	0.09	−0.17	−1.51*
Sweet 72	0.14	−0.86*	−0.11	3.01*	0.06	0.28*	1.19
H. S. 102	0.18	−0.12	0.02	−3.68*	−0.05	−0.13	0.50
Sel 152	0.56*	−0.69*	0.12	0.13	0.10	0.42*	1.77*
Range	−0.56 to 0.60	−0.86 to 0.71	−0.11 to 0.12	−3.45 to 3.01	−0.11 to 0.17	−0.55 to 0.42	−3.15 to 4.68
Females							
Gamed	0.88*	−0.60*	0.00	0.38	−0.08	0.23*	−2.75*
H. S. 101	−0.80*	0.29	−0.04	−0.25	−0.02	−0.11	0.51
Pb. Tropic	−0.08	0.31*	0.04	−0.13	0.10	−0.12	2.24*
Range	−0.80 to 0.88	−0.60 to 0.31	−0.04 to 0.04	−0.25 to 0.38	−0.08 to 0.10	−0.12 to 0.23	−2.75 to 2.24

*Significant at 5% level.

locules/fruit, 12 for juice and pulp ratio, 15 for ascorbic acid content, 19 for acidity, 20 for T. S. S. and 21 for disease incidence showed significant sca. Cross Gamed × Sioux, Gamed × Sweet 72 and Pb. Tropic × Marglobe for pericarp thickness; Pb. Tropic × SI 120 and HS 101 × Marglobe for number of locules; Pb. Tropic × KAL and Gamed × Sel 152 for juice and pulp ratio; Pb. Tropic × Sioux, HS 101 × S 12 and Pb. Tropic × Pusa Ruby for ascorbic acid; HS 101 × KAL, HS 101 × Sweet 72 and Pb. Tropic × HS 102 for acidity and Gamed × Sel 152 and Gamed × Pusa Ruby for T. S. S. exhibited high sca effects. In cross Gamed × Sweet 72 for thickness of pericarp, Pb. Tropic × SI 120 for locule number, Pb. Tropic × KAL for pulp-juice ratio, Pb. Tropic × HS 102 for acidity and Gamed × Sel 152 for T. S. S. one of the parents showing high gca was involved and such crosses could be used for further sel-

TABLE 4

Estimates of specific combining ability for fourteen different characters in tomato

Hybrids	Thickness of pericarp (mm)	Number of locules/ fruit	Juice & pulp ratio	Ascorbic Acid content (mg)/100gm	Acidity	T. S. S.	Disease incidence
	1	2	3	4	5	6	7
Gamed × PH-14	−0.58*	0.65*	−0.01	2.07*	0.08	0.19	−1.74*
Gamed × Sioux	1.37*	0.00	−0.08	1.29	−0.07	−0.28*	−6.70*
Gamed × S-12	0.84*	0.12	0.20*	−0.70	−0.13*	−0.14	−2.30*
Gamed × Pusa Ruby	−0.01	−0.07	−0.07*	−1.09	0.04	0.60*	−1.02
Gamed × Sl-120	0.54*	−0.66*	0.19*	2.34*	0.19*	0.15	−0.36
Gamed × KAL	0.28	−0.68*	−0.01	−0.47	−0.09	0.11	−0.62
Gamed × I.M.	0.32	0.08	−0.08	−2.68*	−0.08	−0.32*	−1.54*
Gamed × PLM	0.86*	−0.82*	−0.05	−0.07	−0.06	0.36*	1.77*
Gamed × Marglobe	−0.16	−0.29	−0.12*	0.16	0.03	0.40*	−2.39*
Gamed × Sweet-72	1.13*	−0.83*	−0.11	0.96	−0.22*	0.07	−0.37
Gamed × H.S. 102	0.21	−0.15	−0.08	−1.23	−0.27*	−0.42*	−0.60
Gamed × Sel-152	−0.34*	−0.33*	0.22*	−1.13	0.07	0.63*	−1.37*
H.S. 101 × PH-14	0.19	0.72*	−0.01	−1.39	0.21*	−0.14	0.22
H.S. 101 × Sioux	−0.04	−0.02	0.15*	−6.38*	−0.15*	0.02	3.53*
H.S. 101 × S-12	−0.47*	0.65*	0.03	3.07*	−0.16*	−0.54*	2.59*
H.S.101 × Pusa Ruby	−0.56*	0.51*	0.01	0.24	−0.14*	−0.07	0.14
H.S. 101 × Sl-120	−0.37*	0.39*	−0.13*	−0.45	−0.18*	−0.31*	−2.13*
H.S. 101 × KAL	−0.43*	0.23	−0.12*	2.03*	0.35*	0.15	−3.05*
H.S. 101 × I.M.	−0.29	0.44*	−0.01	1.76*	−0.11	0.58*	−2.24*
H.S. 101 × PLM	−0.60*	−0.21	−0.03	1.12	−0.05	−0.10	5.11*
H.S. 101 × Marglobe	0.60*	0.99*	−0.13*	−1.94*	−0.04	−0.33*	−1.12
H.S. 101 × Sweet-72	−0.45*	0.06	0.05	1.04	0.27*	0.14	1.10
H.S. 101 × H.S. 102	0.06	−0.34*	0.03	1.54*	−0.05	−0.05	−2.93*
H.S. 101 × Sel-152	−0.53	−0.42*	−0.07	−0.05	−0.15*	−0.03	3.54*
Pb. Tropic × PH-14	0.16	0.43*	−0.07	1.53*	0.02	−0.28*	−2.51*
Pb. Tropic × Sioux	0.12	−0.02	−0.23*	3.35*	0.23*	0.32*	4.82*
Pb. Tropic × S-12	−0.16	0.51*	−0.10	−1.19	0.20*	0.33*	−0.08
Pb.Tropic × Pusa Ruby	−0.17	0.12	0.09	2.46*	0.01	0.20	5.23*
Pb. Tropic × Sl-120	−0.35*	1.09*	−0.06	0.87	−0.11	0.52*	−1.28*
Pb. Tropic × KAL	−0.02	−0.20	0.26*	−0.35	−0.22*	−0.75*	1.90*
Pb. Tropic × I.M.	−0.25	−0.65*	0.01	−2.82*	0.12*	−1.10*	−0.93
Pb. Tropic × PLM	−0.31	0.70*	0.15*	−1.06	0.06	0.25*	−0.64
Pb. Tropic × Marglobe	0.99*	0.14	0.19*	2.32*	0.19*	−0.33*	1.26*
Pb.Tropic × Sweet-72	−0.48*	−0.45*	−0.03	0.16	0.03	0.20	1.05
Pb. Tropic × H.S. 102	0.02	0.47*	0.08	−2.76*	0.27*	0.28*	4.16*
Pb. Tropic × Sel-152	0.02	−0.28	0.05	1.37	0.25*	0.00	0.49
C.D. at 5%	0.47	0.44	0.18	1.94	0.18	0.32	1.68
Range	−0.60 to 1.37	−0.83 to 1.09	−0.23 to 0.26	−6.70 to 3.35	−0.27 to 0.35	−1.10 to 0.63	−6.70 to 5.23

*Significant at 5% level.

ection of superior transgressive segregants. For good keeping quality and transportation pericarp thickness is important. In cross Gamed × Sioux for pericarp thickness both the parents showing high gca were involved and this cross could be used for selecting pure lines.

REFERENCES

Ibarbia, G. M. 1969. Combining ability of tomato lines for fruit quality. *Res. Bull Ohio Agric. Expt. Sta.* 956 : 31.

Kalloo; Singh, R. K. and Bhutani, R. D, 1974. Combining ability studies in tomato *(Lycopersicon esculentum* Mill.*) Theor. Appl. Genet* 44 : 358-363.

Kaul, D. L. and Nandpuri, K. S. 1972. Combining ability studies in tomato *(Lycopersicon esculentum* Mill.*) Punjab Agric. Univ. J. Res.* 9 (1) 15-18.

Kempthorne, O. 1957. *An introduction to genetic statistics.* John wiley and Sons, Inc. New York PP 458-471,

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CROPPING PATTERN IN JIND DISTRICT

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ABSTRACT

The existing cropping pattern of four villages, having different irrigational facilities, in each block of Jind district, were studied under irrigated and rainfed conditions. A simple correlation was analysed between irrigated crops and irrigated area. As the percentage of irrigated area decreased, the area under paddy, sugarcane and wheat also decreased but the area under bajra, cotton and gram increased.

Jind district, lat. 29° 4' to 29° 51' N, long. 75° 54' to 76° 47' E and altitude 229 m above M. S. L., comprising an area of 26 9, 300 ha. is composed of 7 National Extension Service Blocks of Narwana, Kalyat, Uchana, Rajound, Jind, Safidon and Julana. The topography is mainly upland plain without any hill and river. The soils in Narwana, Kalyat, Uchana and Rajound blocks are mostly sandy loam in the surface underlain by loam to clay and in Jind, Julana and Safidon, the soil is deep, poorly drained, sandy loam in the surface and clay loam below. The climate is hot and semi-arid with an isohyet of 500 mm. normal annual rainfall that passes north-south through the middle of the district. May and June are the hottest, while January and February are the coldest months. Of the total area, 85% is under cultivation and about 5% under salinity-alkalinity and 1.5% is water logged. Approximately 35% of cropped area is rainfed and 65% is irrigated, 96% of it being through canals.

MATERIAL AND METHODS

Four villages, having different irrigational facilities, were selected to study the existing cropping pattern from each of the 7 N. E. S. blocks. 'Agricultural Land Use' data collected by revenue department of the district for 1975-76 and 1976-77, were used. In order to correlate the important irrigated crops with irrigated area, scatter diagram was drawn with the quadrant method. The selected villages were grouped into four categories on the basis of "the total irrigated area as the percentage of total cultivated area" (Table 1). The distribution of 28 villages selected in 7 N. E. S. blocks of Jind district (Table 1) is shown in Fig. 1 which shows that the villages selected were fairly well distributed all over the district to give a representative character to the study.

RESULTS AND DISCUSSION

The most important crops grown in Jind district under irrigated condition

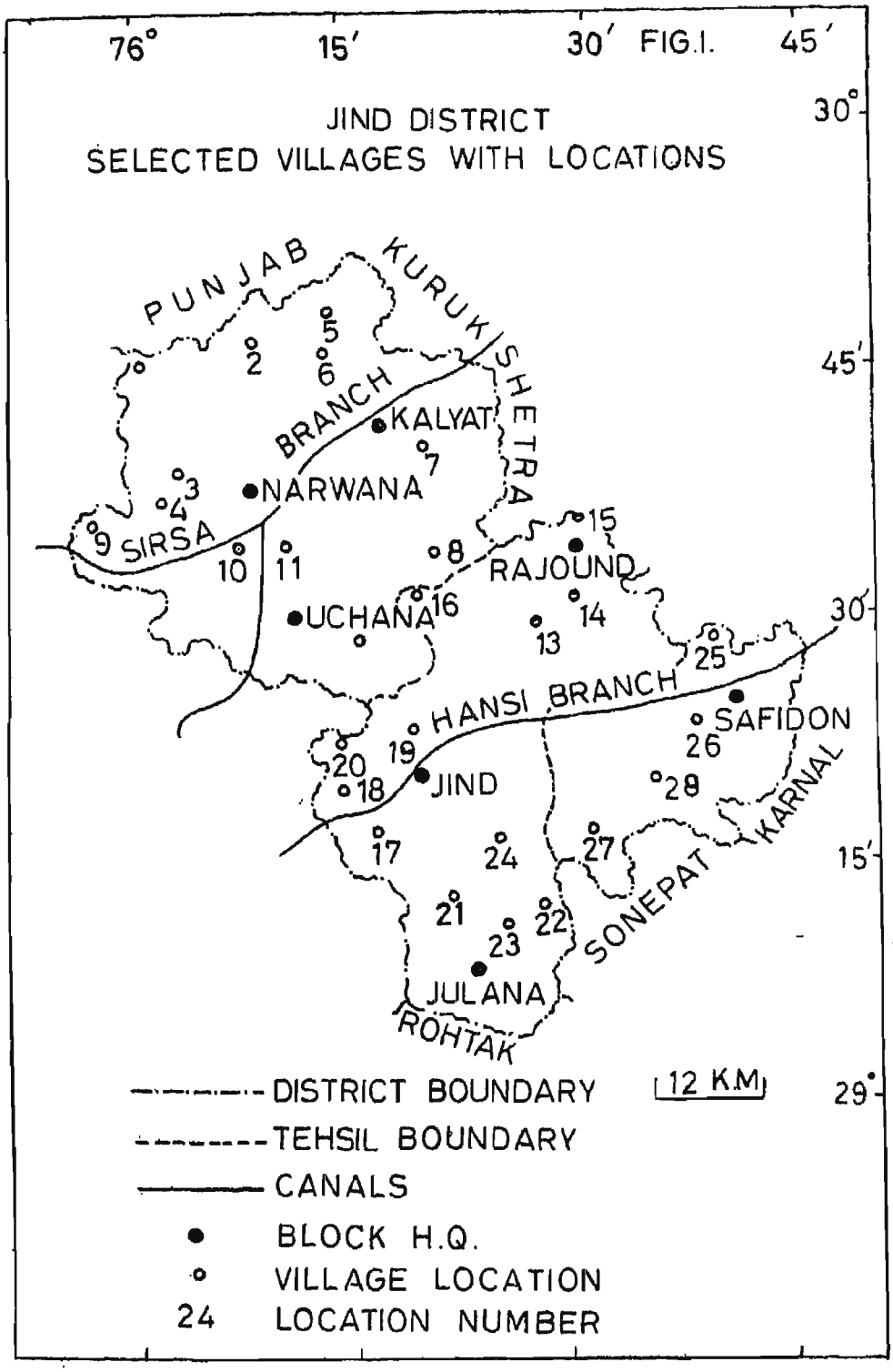

76°
15′
30′
45′
FIG.I.
JIND DISTRICT
SELECTED VILLAGES WITH LOCATIONS
30°
45′
30′
15′
29°
PUNJAB
KURUKSHETRA
BRANCH
KALYAT
NARWANA
SIRSA
RAJOUND
UCHANA
HANSI BRANCH
SAFIDON
JIND
KARNAL
SONEPAT
JULANA
ROHTAK
2
3
4
5
6
7
8
9
10
11
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
DISTRICT BOUNDARY
12 K.M.
TEHSIL BOUNDARY
CANALS
BLOCK H.Q.
VILLAGE LOCATION
24 LOCATION NUMBER

TABLE 1

Selected villages block-wise and categoriwise and extent of irrigated area

Sr. No.	Block	Name of the Village Irrigated area as the percentage of the total cultivated area			
		(A) Above 80	(B) 65-80	(C) 50-65	(D) Below 50
1.	Narwana	—	Kalwan-1(2372) Pipaltha-2(1071) Phurain-Kalan-3 (755) Bhekhe-wala-4 (405)	—	—
2.	Kalyat	Julani Khera-7 (421)	Dhanauri-5 (1857)	Koel-6 (407) Chattar-8 (1975)	—
3.	Uchana	Ghaso Kalan-11 (454)	Tohana Khera-10 (400)	Bithmara-9 (1774) Kasoon-12 (461)	—
4.	Rajound	—	Santokh Majra-15 (408)	Alevah-13 (1653) Baghana-14 (889)	Kacharna Khurd-16 (345)
5.	Jind	Rajpura-18 (929)	Ramrai-17 (231) Tegbahadurpur-19 (127)	—	Kheri Jajwan-20 (168)
6.	Julana	Lajwana 23 (682)	—	Kinana-21 (725) Nandgarh-22 (490)	Padana-24 (290)
7.	Safidon	Ratta Khera-26 (315)	Malakhpur-25 (748) Ladana-27 (678) Bagroo Kalan-28 (258)	—	—
	Total No. of villages and irrigated area.	5 (2801)	12 (9310)	8 (8574)	3 (803)

Note : The figures without parenthesis are location numbers of the villages as in Fig. 1 and these within parenthesis refer to total irrigated area in hectares in each village.

TABLE 2

Distribution of crops on quadrant basis under irrigated conditions

Crops	*Irrigated area* as the %age of total cultivated area (Distt. average)*	*Percentage of* total cropped area (Distt. average)*	*Quadrants and* number of villages				
			High irrigated area, high spread	High irrigated area, low spread	Low irrigated area, high spread	Low irrigated area low spread	Total No. of villages
			I	II	III	IV	
Wheat	65.0	33.3	8	6	2	12	28
Gram	65.0	20.0	4	10	10	4	28
Bajra	65.0	10.4	2	12	9	5	28
Cotton	65.0	7.4	6	8	8	6	28

Note : *Irrigated area and acreage under wheat, gram, bajra and cotton of Jind district have been taken to analyse the simple correlation between *irrigated area and irrigated crops* based on quadrant method in 28 villages. It is clear from Fig. 2 that irrigated area has been taken on *vertical line and acreage of different crops on horizontal line.*

during *kharif* season were bajra, cotton, sugarcane, paddy and jowar and during the *rabi* wheat, gram and barley while in the corresponding of seasons for rainfed conditions dominating crop were bajra and gram.

Cropping pattern under irrigated conditions. Under irrigated conditions, wheat was the dominating crop followed by gram. Wheat accounted first rank in 18 villages, gram in 8 villages, sugarcane in 1 village and bajra in 1 village (Table 3).

Wheat. It occupied more than 50% of the total cropped area in Ram-rai, Rajpura, Baghana, Ladana and Bagroo Kalan villages. Wheat covered 30 to 50% area in Alevah, Santokh-Majra, Nandgarh, Lajwana, Malakpur, Ratta Khera, Kasoon, Koel and Kalwan villages (Table 3). The correlation between irrigated area and wheat acreage is presented in

TABLE 3

Cropping pattern (Percentage of total cropped area) under irrigated conditions

Village*	Paddy	Bajra	Cotton	Sugar-cane	Other Kharif crops	Wheat	Barley	Gram	Rabi Oil-seeds	Other rabi crops
1	2	3	4	5	6	7	8	9	10	11
Ram rai	3.0	3.3	15.7	9.9	3.9	57.4	0.4	2.0	—	4.4
Rajpura	0.7	3 5	10.7	5.7	4.1	52.0	3.6	11.4	2.9	5.4
Teghahdurpur	0 5	15.6	6.5	5.0	16.0	26.8	8.0	13.6	—	8.0
Kheri Jajwan	0.3	17.3	9.5	3.8	17.3	22.8	1.3	22.5	1.3	3.9
Alveh	6.4	4.4	6.4	9.3	16.1	35.3	1.6	15.8	4.2	0.5
Baghana	5.3	2.3	4.5	3.5	0.8	52.9	4.0	12.3	8.5	5.9
Santokh Majra	2.1	5.0	14.9	6.0	7.8	33.2	0.9	17.9	9.5	2.7
Kacharana Khurd	—	17.2	7.6	7.6	6.7	28.2	1.7	23.7	2.9	5.4
Kinana	3.9	4.3	9.2	4.9	7 6	30 1	2.4	30.2	2.8	4.5
Nandgarh	2.6	9.1	4.4	15 6	19.4	32.0	1.5	10.9	0.1	4.4
Lajwana	0.1	0.5	0.4	18.7	0.4	46.4	1.2	26.9	0.1	5.3
Padana	3.6	7.3	11.4	21.2	15.3	17.3	6.6	13.1	0.6	3.6
Ladana	1.7	1.0	3.0	14.9	3.7	57.1	1.7	8.4	0.2	8.3
Bagroo Kalan	4.5	0.4	1.8	7.8	4.6	68.7	1.8	4.4	—	6.0
Malakpur	28.6	4.7	5.9	2.4	14.2	33.3	0.7	2.3	4.3	3.6
Ratta Khera	21.0	6.6	2.6	5.2	12.4	41.5	0.6	2.6	—	7.5
Bithmara	—	23.5	9.8	2 2	14.2	15.0	6.6	15.8	4.5	10.4
Tohana Khera	0.4	8.6	12.6	8.0	12.4	15.4	2 8	31.6	2.6	5.6
Ghaso Kalan	0.2	9.8	13.8	7.9	11.7	15.3	3.6	26.6	2.4	8.7
Kasoon	—	8.7	6.5	5.6	5 5	30.8	2.8	31.6	4.3	4.2
Dhanauri	9.2	14.7	3.3	4.1	9.0	25.8	2.6	22.2	2.1	7.0
Koel	3.3	3.6	7.2	6.7	5.3	30.6	8.5	23.4	2.8	8.6
Julani Khera	3.1	10.6	9.9	2.8	15.5	20.4	2.4	21.6	7.0	6.7
Chhattar	0.2	6.3	10.9	8.0	9.8	23.2	4.2	25 4	3.2	8.8
Kalwan	5.8	5 4	7.8	3.5	11.3	33.6	6.7	11.3	5.3	9.3
Pipaltha	13.7	11.7	3.8	2.7	6.1	29.4	0.7	18.8	7.2	5.9
Phurain Kalan	—	13.2	11.9	3.0	7.4	14.8	4.0	32.5	8.2	5.0
Bhekhewala	—	14.8	9.8	2.2	10.6	11.8	4.2	37.6	4.2	4.8

Note : *Villages, categorywise and blockwise may be seen from Table 1.

Table 2 Fig. 2. Villages in quadrant I had >65% irrigated areas as the percentage of total cultivated area and >33.3% acreage under wheat and they are 8 in number. In quadrant II villages with >65% irrigated area and <33.3% wheat acreage were placed and their number was six. Quadrant III had only 2 villages which have got <65% irrigated area and >33.3% acreage while quadrant IV contained 12 villages with <65% irrigated area and <33.3% acreage under wheat. Thus, maximum number of villages fell in quadrant I and IV having high irrigated area, high spread (8 villages) and low irrigated area, low spread (12 villages). Out of 28 villages, 20 villages had positive correlation and in 8 villages had no correlation between irrigated area and wheat acreage. Villages of quadrant I and IV either had high irrigated area, high acreage under wheat or low irrigated area, low acreage under wheat crop.

Gram. This crop attained more than 20% of the total crop land in Kheri Jajwan, Kachrana Khurd, Kinana, Lajwana, Tohana Khera, Ghaso Kalan, Kasoon, Dhanauri, Koel, Julani Khera, Chattar, Phurian Kalan and Bhekhewala villages. Quadrant I had >65% irrigated area and >20% acreage under gram. The respective figures were for quadrant II : >65% and <20%; quadrant III : < 65% and > 20% and quadrant IV : <65% and <20%. Quadrants having high irrigated area, low spread; low irrigated area, high spread, were II and III with 10 villages in each.

Bajra. Bajra occupied the first ranking only one village, i.e., Bithmara. Villages recording more than 10% of the total cropped area were Tegbahdurpur, Kheri Jajwan, Kachrana Khurd, Dhanauri, Julani Khera, Pipaltha, Phurian Kalan and Bhekhewala. Villages in quadrant I having high irrigated area and high spread and were 2 in number. But quadrant II showing high irrigated area and low spread had 12 villages. While, in quadrant III, with low irrigated area and high spread the number of villages was 9, and quadrant IV with low irrigated area and low spread had 5 villages.

Cotton. Villages having more than 10% acreage under cotton were Ramrai, Rajpura, Santokh Majra, Padana, Tohana Khera, Ghaso Kalan, Chattar and Phurian Kalan. Quadrants I, II, III and IV have 6, 8, 8 and 6 villages each, respectively. Values of quadrants may be seen from Table 2.

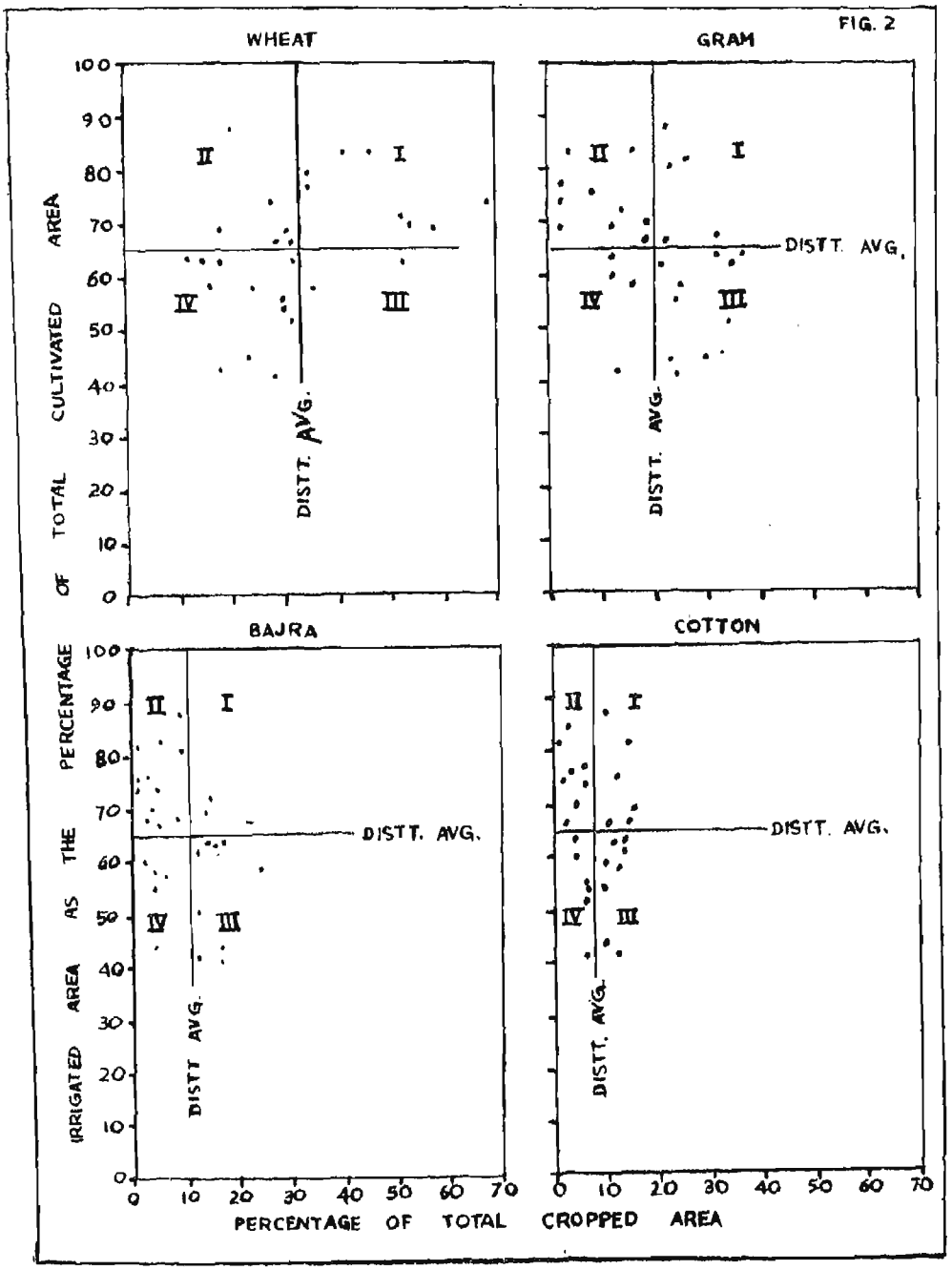
Sugarcane. There were 11 villages which occupied more area under this crop than the district average, i.e., 6.4% of the total crop land. Sugarcane accounted for more than 10% acreage in Lajwana, Nandgarh, Ladana and Padana.

Paddy. Paddy accounted for 28.6 and 21.0% of the total cropped area in the comparatively more Tubewell irrigated villages of Malakpur and Ratta Khera, respectively. Other villages which grow paddy were Ramrai, Baghana, Dhanauri, Kalwan and Pipaltha.

Other crops. Maize, Jowar, Kharif fodder barley, sarson, taramira and rabi fodder crops were also grown to a limited extent in Jind district with low percentage under irrigated conditions.

Cropping pattern under rainfed conditions

Bajra was the most important crop followed by gram under rainfed conditions. Bajra covered more than 50% area of the total cropped area in 15 villages, namely, Ramrai, Rajpura, Teg-


FIG. 2
WHEAT
GRAM
BAJRA
COTTON
DISTT. AVG.
PERCENTAGE OF TOTAL CULTIVATED AREA
IRRIGATED AREA AS THE PERCENTAGE OF TOTAL CROPPED AREA
I
II
III
IV
0
10
20
30
40
50
60
70
80
90
100

bahdurpur, Alevah, Santokh Majra, Kinana, Nandgarh, Padana, Bichmara, Ghaso-Kalan, Kasoon, Julani Khera, Chhattar, Kalwan and Bhekhewala (Table 4).

Gram occupied more than 50% of the total crop land only in Lajwana and Koel villages. It covered 30 to 50% area in Kheri Jajwan, Baghana, Tohana Khera, Kasoon and Phurian Kalan. Guara accounted more than 10% of the total cropped area in Rajpura, Tegbahdurpur, Lajwana, Chhattar and Bhekhewala villages. Sarson and taramira were grown in Kachrana Khurd, Malakpur, Bithmara and Pipaltha villages with more than 10% of the total crop land.

Wheat was also grown under rainfed conditions in the villages of Safidon block. In Ladana, Bagroo-Kalan, Ratta Khera

TABLE 4

Cropping pattern (Percentage of total cropped area) under rainfed conditions

Village*	Bajra	Jowar	Guara	Kharif others	Wheat	Barley	Gram	Rabi oil-seeds	Rabi others
1	2	3	4	5	6	7	8	9	10
Ramrai	62.6	8.7	8.2	—	—	3 8	14.8	1.9	—
Rajpura	68.1	3.6	11.6	0.3	—	—	15.2	1.2	—
Tegbahdurpur	73.4	—	11.1	—	—	4.4	11.1	—	—
Kheri Jajwan	45.8	—	7.2	0.4	—	—	39.2	7.4	—
Alevah	63.4	5.6	9.0	9 8	—	1.6	10.6	—	—
Baghana	49.8	—	3.4	10.5	—	—	34.1	1.0	1.2
Santokh Majra	60.5	8.7	1.5	3.1	—	—	22.3	1.2	2.8
Kocharana Khurd	35.7	15.9	4.2	10.6	—	4.7	17.8	11.4	—
Kinana	71.8	8.6	6.5	3.0	—	—	6.5	3.6	—
Nandgarh	56.5	24.0	3.5	3.5	—	—	11.5	—	1.0
Lajwana	20.0	3.9	14.0	2.3	3.1	—	54.3	0.8	1.6
Padana	64.1	4.8	—	—	—	1.2	25.2	2.9	1.8
Ladana	23.4	6.8	7.2	7.2	24.6	0.8	27.2	0.8	2.0
Bagroo Kalan	28.2	7.7	5.0	2.0	35.0	5.1	17.1	—	—
Malakpur	35.6	4.2	5 8	16.4	3.2	5 4	9.4	20.0	—
Ratta Khera	44.8	2.6	—	7.9	31.6	2.6	10.5	—	—
Bithmara	54.8	2.7	2.9	3.4	—	10.3	13.9	12.0	—
Tohana Khera	37.8	18.6	—	5.6	—	2.2	32.8	2.5	0.5
Ghaso Kalan	88.9	2.4	1.8	3.8	—	—	3.1	—	—
Kasoon	54.4	4.0	5.1	—	—	2.9	33.4	0.2	—
Dhanauri	45.7	11.9	3.9	4.2	—	5.7	27.1	0.7	0.8
Koel	36.1	8.6	—	—	—	2.0	53.3	—	—
Julani Khera	68.9	15.8	5.3	—	—	—	10.0	—	—
Chhattar	58.3	2.8	10.2	6.1	—	1.9	19.2	1.5	—
Kalwan	67.3	1.4	—	7.0	—	4.5	15.3	1.6	2.9
Pipaltha	30.0	12.1	8.4	11.4	—	1.2	16.6	20.3	—
Phurain Kalan	42.0	9.0	—	4.6	—	6.2	34.5	3.7	—
Bhekhewala	71.4	6.0	12.3	3.8	—	1.6	4.9	—	—

*Villages categorywise and blockwise may be seen from Table 1.

and Malakpur villages wheat accounted 24.6, 35.0, 31.6 and 3.2% of the total rainfed crop land. Other crops which were grown under rainfed conditions with very low percentage are jowar, kharif fodder and barley.

Overall cropping pattern of irrigated and unirrigated categories

It is clear from Table 5 that as the percentage of irrigated area decreased, the area under high water requiring crops like paddy, sugarcane and wheat decreased. Wheat covers 36.4% of the cropped area in category-A and it was 20.8% in category-D. More villages having tubewell irrigation come under category-B (Table 7) and that was why paddy occupied 5.8% of the total cropped area in this category, which was the highest amongst all the categories. Area under bajra, cotton, jowar and gram increased as the per cent of area irrigated decreased. Bajra accounted for 7.0% of the total cropped area in category-A but area under it was 17.3% in category-D. Area under gram crop was not affected much by the degree of irrigation.

The overall cropping patterns under rainfed conditions are given in Table 6. It is seen that Bajra was the most important crop followed by gram while Wheat was grown under rainfed conditions; particularly in Safidon block (Table 4).

Cropping patterns of tubewell irrigated categories

The overall cropping pattern of tubewell irrigated categories (Table 7) are given in Table 8. In *kharif*, in category-A', paddy covered 24.8% of the total cropped area while in category-D', it was only 3.4 per cent. In *rabi*, villages

TABLE 5

Categorywise cropping pattern under irrigated conditions (Percentage of total cropped area)

Category	Irrigated area		Kharif crops							
	(as the %age of total cultivated area)	No. of villages*	Paddy	Maize	Bajra	Cotton	Jowar	Guara	Sugarcane	Kharif fodder
A	Above 80	5	5.0	0.2	7.0	7 5	4.4	0.7	8.1	2.8
B	65-80	12	5.8	0.6	8.2	8.3	5.3	1.6	5.8	2.6
C	50-65	8	2.7	—	10.8	8.4	6.8	1.1	4.9	2.3
D	Below 50	3	1.3	—	17.3	12.8	7.6	3.0	3.8	2.0

Category	(Irrigated area as the %age of total cultivated area)	No of villages*	Wheat	Barley	Rabi Crops					
					Gram	Rabi Pulses	Sarson	Taramira	Methi	Rabi fodder
A	Above 80	5	36.4	2.3	20.8	1.2	1.4	0.2	0.5	1.5
B	65-80	12	34.1	2.2	21.0	1.0	1.2	0.3	1.0	1.0
C	50-65	8	31.2	2.5	22.7	0.5	2.1	0.4	0.2	3.4
D	Below 50	3	20.8	3.2	23.5	—	1.4	0.2	1.3	1.8

*The names of the villages blockwise and category wise are given in Table 1.

TABLE 6

Categorywise cropping pattern under rainfed conditions
(Percentage of total cropped area)

Category	Unirrigated area as the %age of total cultivated area	No of villages*	Bajra	Jowar	Guara	Kh. fodder	Wheat	Barley	Gram	Sarson	Taramira
A	Below 20	5	56.1	5.6	8.5	1.6	6.9	0.5	20.2	0.5	0.1
B	20-35	12	48.2	7.9	5.2	5.4	5.2	3.3	21.3	2.6	0.9
C	35-50	8	55.9	6.9	5.1	4.2	—	2.3	22.8	1.9	0.9
D	Above 50	3	48.5	6.9	3.8	3.6	—	2.0	27.3	6.5	1.4

Note : *The names of the villages, block-wise and category-wise are given in Table 1.

TABLE 7

Category-wise distributions of tubewell irrigated villages

Category	(Tubewell irrigated area as %age of total cultivated area)	Name of villages with blocks and categories*					
		Narwana	Kalyat	Rajound	Jind	Julana	Safidon
A'	Above 50						Malakpur (B')
B'	30-50				Ramrai (B')	Kinana (C')	Ratta Khera (A')
C'	10-30	Kalwan (B')		Aleva (C') Baghana (C')	Rajpura (A')	Nandgarh (C')	
D'	Below 10	Pipaltha (B')	Dhanauri (B')				

*The categories in parenthesis are as in Table 1.

having more than 50% area irrigated by tubewells, i.e., category-A', wheat dominated and it covered 41.2% of the total cropped area but in category-D', the acreage under wheat fell to 27.6 per cent.

Bajra occupied 5.7% of the total cropped area in category-A', 8.1% in category-B', 9.2% in category-C', and 13.2% in category-D', Cotton covered 4.2, 6.9, 9.6 and 10.6% of total crop land in categories A', B', C' and D', respectively. Area under wheat and paddy tended to decrease and under bajra and cotton increased with the decreasing trend in tubewell irrigation.

TABLE 8

Category-wise cropping pattern as percentage of total cropped area in the tube-well irrigated villages

Category	Tubewell irrigated area as the %age of total cultivated area	No. of villages	Kharif Crops							
			Paddy	Maize	Bajra	Cotton	Jowar	Guara	Sugarcane	Kharif fodder
A'	Above 50	2	24.8	3.1	5.7	4.2	2.3	2.7	3.8	4.5
B'	30-50	2	4.6	0.4	8.1	6.9	3.0	1.3	4.2	2.5
C'	10-30	5	3.7	1.7	9.2	9.6	4.2	1.2	6.8	2.6
D'	Below 10	2	3.4	0.5	13.2	10.6	2.4	2.4	5.0	3.5

Category	Tubewell irrigated area as the %age of total cultivated area	No. of villages*	Rabi Crops							
			Wheat	Barley	Gram	Rabi Pulses	Sarson	Taramira	Meethi	Rabi fodder
A'	Above 50	2	41.2	0.6	2.5	0.3	2.3	—	2.0	—
B'	30-50	2	39.1	3.2	19.3	0.7	2.8	—	0.5	3.4
C'	10-30	5	36.8	2.7	14 2	0.5	3.5	0.3	1.2	1.8
D'	Below 10	2	27.6	1.7	20.5	0.8	4.8	0.5	0.2	3.7

*The names of the villages blockwise and categorywise are given in Table 7.

CONCLUSION

Under irrigated conditions, wheat and gram were important crops. Wheat covered more than 50% of the total cropped area in 5 villages and gram more than 20% in 13 villages. Bajra and gram were two main crops under rainfed conditions by those more than 50% of the total cropped area were covered in 15 and 2 villages, respectively. The area under high water demanding crops like paddy, sugarcane and wheat were decreasing and under bajra, cotton, jowar and gram were increasing as the per cent of area irrigated decreased. The similar trend was also found under tube-well irrigated conditions.

REFERENCES

Kanwar Singh and Ram Singh 1978. Cropping pattern of district Hissar. *Haryana agric. Univ. J. Res.* 8 (1) : 1-10.

Singh, K. N. and Singh, B. 1970. Land use, cropping pattern and their ranking in Shahagenj Tehsil-A geographical analysis. *Nat. Geog. J. India*. 16 : (III & IV). 221-235.

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SMOKING AMONG UNDER GRADUATES- A SOCIOLOGICAL ANALYSIS

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ABSTRACT

The study revealed that smoking had no bearing on academic performance of the smokers. However, 53% respondents reported its harmful effects on health. The percentage (85%) of smokers among hostelers was more than the non-hostelers. Respondents belonging to farming families smoked more than the non-farming families. Company of a smoker was found responsible for the spread of smoking among the students. Loneliness, picture hall, tour, study and frustration were the typical situations which encouraged smoking. More than 80% respondents started smoking in the matric, pre-university and B.Sc. I year classes. About 55% students preferred cigarette smoking because of taste and prestige, whereas the rest liked bidies due to their easy availability, both in term of money and distance.

The study suggested following points for checking smoking among under-graduates : (i) special attention and guidance is required in the 10th, 11th and 12th classes when the chances of acquiring smoking habit is more, (ii) keep off the smokers from the company of non-smokers, (iii) keep the under-graduates busy in study and other cultural activities and (iv) make the availability of all kinds of smokes difficult.

Smoking is a social habit of long standing. It has been praised variously as a stimulant for work, as a sedative for relaxation, as a cure for colds and *catarh*, and as indispensable for social inter-course. On the other hand it has been condemned as a major health hazard.

It was reported in the encyclopedia (1968) that regular smoking usually begins in mid-adolescence to late-adolescence. WHO Experts Committee (1970) stated that diseases related to smoking had very harfmul eftect on health and had been an important cause for disability and premature death. Rivero (1974) also stressed that smoking was one of the greatest health hazards in modern times and yet was avoidable. WHO Experts Committee (1975) stated that in developing countries like India the use of too much tobacco by school children would become a prominent health hazard. Therefore, effective action is needed to check its proliferation, however, an increased awareness of smoking hazards among Europeans and Americans, resulted in the reduction of tobacco consumption. Mathews (1978)

reported that a Chinese news paper, had published articles highlighting the harmful effects of smoking. However, in earlier times, the Chinese leadership was fully aware that it was not an easy habit to break. Krishan (1978) stated that cigarette smoking in the developing countries was on the increase. The Hindustan Times (1978) reported that hostelers were addicted to smoking more than the day scholars. Kapila (1979) reported that irrespective of the scientific opinion about smoking and its injurious effects on health, millions of people in India were smoking and their number was on the increase. Bhatti (1979) suggested that decisive steps should be taken by the Government to curb the rising consumption of tobacco, especially cigarettes and bidies.

However, in developing countries like India and Egypt, an increasing use of tobacco smoking by school children was noticed. It, thus, seems likely that unless effective action is taken to control smoking, the habit will progressively become as prominent a health hazard as in Europe and North America. Keeping the above stated issues and problems into consideration, the present study was undertaken to know the situation among the university under-graduates. The following were its specific objectives :

(i) To investigate the social background of smokers

(ii) To find out the factors associated with smoking

(iii) To suggest a strategy for checking smoking habit

MATERIAL AND METHODS

The present study relates to the constituent colleges of Haryana Agricultural University, (Hissar Campus), Hissar. A list of the smokers was prepared in consultation with the under-graduates. Of 887 male under-graduates, 130 were regular smokers. Being a small number, almost all the smokers were selected for the purposes of data collection. The data for the present study were collected with the help of mailed questionnaire sent to the respondents in the year, 1978. Simple tabular analysis was done and percentages were calculated.

RESULTS AND DISCUSSION

It was noticed that almost equal proportion of both first and second division students were in the habit of smoking. This was equally true both at the Matric/ Higher Secondary and in their present classes. It, thus, appeared that smoking did not affect their academic attainments adversely. A further analysis revealed that 45% respondents were Jats whereas 14% were of the Arora sub-caste, 10% were Brahmans and 8% were Yadavs. We may conclude that Jats were fond of smoking followed by Aroras, Brahmans and Yadavs. The possible reason for this situation may due to the large proportion of these caste's students among under-graduates, respectively.

It was also seen that 73% smokers were from rural areas. It may be concluded that smoking habit was more among rural respondents. However, they constituted about 60% strength amongst the under-graduates. Eighty five percent respondents were hostelers. It indicates that the habit of smoking was found more among hostelers. Similar views were also reported in the Hindustan Times, 1978. This may be due to their free living with negligible parental control

in the hostels. Fifty six, 29 and 13% smokers belonged to the families of farmers, servicemen, and businessmen, respectively. It may be concluded that the undergraduates belonging to farming families and living in hostels were prone to smoking than the rest of the students.

Sixty eight percent respondents reported that their family members were in the habit of smoking. However, 82% said that their neighbours were also smokers. It shows that the habit of smoking was also acquired by the surrounding social environment of smokers, in which the respondents lived. Similarly, three fourth respondents reported that their room mates/friends/class-mates were also smokers.

Only 16% respondents were chain smokers. Hence, the scope to break the habit of smoking among majority of the respondents existed, as they were in the initial stages of smoking. For keeping company, 58% respondents had to smoke. However, 25, 22, 15 and 9% respondents did smoke mainly due to loneliness, in the picture hall, while on tour, and when studying, respectively. Only 8% reported that characteristics like tension, and frustration were the other causes for smoking with them.

More than 80% respondents started smoking at the matric, pre-university and B.Sc. I year classes. Similar views were reported in the encyclopedia of social sciences (1968) and by Krishna (1978). The possible reason may be a change from parentally controlled environment to a free one. Fifty five percent students preferred cigarettes, whereas the rest liked bidies. However, as per the circumstances, these respondents used bidi/cigarettee/hubble-bubble etc. as a smoke. Moreover, those who smoked cigarettes, liked these mainly because of taste and social prestige, whereas the bidi smokers preferred these due to their easy availability in terms of money and distance. As per the intensity of smoking, 53% respondents smoked 10 to 20 cigarettes every day. In case of bidi smokers, it was equally high i.e., 12 to 24 bidi/day.

Fifty three percent respondents reported the harmful effects of smoking on their health. It was felt in the form of reduced stamina, decay of teeth, foul smell and cough etc. WHO Experts Committee (1970), Rivero (1974) and Mathews (1978) also reported similar results. Four fifth of respondents were advised by their parents, friends and other family members to stop smoking as it was a great health hazard and financial loss to them. However, none could stop smoking, because of the prevalent surrounding social environment.

Based upon the above analysis, the following suggestations emerged for breaking smoking habit of the university undar-graduates.

First, most of the under-graduates started smoking at the 10th, 11th and 12th classes. Encyclopedia (1968) also reported similar views. Therefore, it is the most crucial stage because of decreased parental supervision as most of them start living in hostels. Hence, special attention and much guidance is required at this stage. Knowledge about the hazards of smoking should be disseminated through the existing mass media by publishing and broadcasting the views of health experts frequently. WHO report (1975) suggested similar measures to check smoking.

Second, care should be taken to keep-off smokers from the company of non-smokers. This could be achieved initially by persuading smokers not to smoke on public places and in fhe company of non-smokers, otherwise, through legal enactments. Bhatti (1979) also suggested strict measures for curbing smoking habits. Third, try to keep young ones busy in study and other cultural activities by restructuring the existing system of education which is generating tension, frustration and an attitude of prejudice towards manual labour in the mind of our educated youth and, thereby, encourage smoking.

Finally, make the availability of all kinds of smokes difficult. This could be achieved by legally banning the sale of difterent kinds of smokes to chiidren and adolescents, reducing their production and making it (all kinds of smokes) a dearer commodity.

REFERENCES

Encyclopedia, Sills, D. L. 1968. Smoking. International Encyclopedia of the Social Sciences. The Macmillan company and the free press. vol. 14 pp 335-339.

WHO Experts committee 1970. *Additional evidence on the effects of smoking on health; smoking and its effects on health* published by WHO, Geneva, p. 8.

Rivero, T. D. 1974. Report of a WHO Expert Committee, *Smoking and its effects on health*, published by WHO, Geneva, p. 7.

WHO Experts Committee 1975. *Smoking Trends in the world; smoking and its effects on health*, published by WHO, Geneva, p. 18.

Mathew, L. 1978. *Anti-Smoking Drive in China*, The Indian Express, September 14, 1978.

Krishan, I. 1978. *Hypertension a silent killer*, the Hindustan Times, Sept. 15, 1978.

The Hindustan Times 1978. *Public School Students more drug prone*, September 25, 1978.

Kapila, K. K. 1979. *How to stop smoking*; The Tribune, February, 1979, p. 4.

Bhatti, S. 1979. *Anti-Smoking Drive*, The Tribune, March, 1979, p. 4.

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COMPOSITIONAL VARIATIONS IN DIFFERENT STRAINS OF SOYBEAN (*GLYCINE MAX* L.)

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ABSTRACT

Thirty six promising soybean strains were analysed for protein, oil, total minerals, sulphur, iron, potassium, calcium, sodium, zinc crushing hardness and yield. The correlation co-efficients between yield and protein, yield and crushing hardness, and protein and oil were also calculated. The protein content in these strains ranged from 29.87 to 40.07%; oil from 18.44 to 27.30% and the total minerals from 5.23 to 7.47 per cent. Sulphur, iron, potassium, calcium, sodium and zinc contents varied from 44.90 to 83.70; 2.33 to 6.91; 1780 to 2140; 54.6 to 461.2; 2.14 to 10.80 and 3.53 to 5.84 mg/100 g, respectively. The crushing hardness ranged from 16.08 to 20.00 and the yield varied from 907 to 2853 kg/ha. Yield was found to be positively correlated with protein production and protein content expressed on dry weight basis. Combining the yield and compositional factors, genotype Ankur, PK 73-92, PK 73-64, and PK 73-94 were found superior to the rest and are recommended for general cultivation and further breeding programmes.

Soybean is used in a number of ways and for many different kinds of products. It is now a well recognised staple food for its high protein and oil contents. Among grain legumes, soybean offers itself as a potential source of protein for human consumption (Markley, 1950). This has encouraged its use in diets and in recent years, there has been increasing interests in its cultivation in our country. With the new strategy in agriculture and introduction of new high yielding varieties of soybean, it has now been possible to increase grain yield considerably. However, in the ultimate analysis, the nutritive value of these varieties is the most important factor from the view point of public health. One of the important pre-requisites for a successful breeding programme aimed at the quality improvement of food grains is the availability of chemical and biochemical data in genetic stocks. Earlier studies from these laboratories on spring and late sown varieties of soybean (sood *et al*, 1977) showed wide variations in protein, fat, carbohydrate and inorganic matter contents. In continuation of the above work, the varietal differences in chemical composition of 36 more genotypes of soybean are reported here.

MATERIAL AND METHODS

Thirty six genotypes of soybean were procured from the Department of Plant Breeding, Haryana Agricultural University, Hissar. The grains were

thoroughly cleaned, dried in a hot air oven at 100°C and ground to pass through a 80 mesh sieve and then stored in air tight containers.

Protein was estimated by conventional micro Kjeldhal procedure (N×6.25). Fat, Ash, Iron and calcium were determined by A. O. A. C. (1970) methods. Sodium and Potassium were analysed using Flame Photometer, model type 121, as described by Wilde *et al*, (1964). Sulphur was estimated according to the methods of Chesnin and Yein, (1951), whereas Zinc was determined by atomic absorption spectra. Crushing hardness was determined with the help of hardness tester model kiya seisakusho, Tokyo.

RESULTS AND DISCUSSION

The data on grain yield, protein content, oil content and crushing hardness are presented in Table 1. The grain yield varied from 907 kg/ha in JS 75-92 to 2853 kg/ha in Ankur variety. All the other 34 genotypes had the grain yield in between these two extremes. Protein content varied from 29.87% (PK 74-271) to 40.07% (JS-395) with an average of 34.62 per cent, whereas variation in oil content was from 18.44 % in UPSM 960 to 27.30% in DS 74-24-1 with an average value of 23.33 per cent. When expressed in terms of production, the protein and oil contents had the similar trend as that of the yield except in few cases. The Ankur variety had the maximum protein production of 1069.30 kg/ha and the maximum oil production of 702 kg/ha; whereas JS 75-92 had the minimum of 303 kg/ha of protein production and PK 317 had the minimum of 200 kg/ha of oil production, respectively. The protein content expressed as per cent on oil free basis varied from 39.38% (PK 74-271) to 56.58% (DS 74-14) with an average value of 45.48 per cent. In general, a variety with low oil content was found to be richer in protein than those with high oil content. However, there were varieties such as Ankur, JS 72-1, Bragg and JS 72-128 which were having relatively higher contents of both oil and protein.

The present trend of variation for these components was more or less similar to that reported earlier (Bailey *et al* 1935; Sood *et al* 1977). Several investigators estimated the protein content in various varieties of soybean under different agroclimatic conditions. Kuzayali *at al* (1966) reported a lower range of 30.3%, whereas Sexana and Pandya (1971) reported a narrow range between 39.5 and 43.2 per cent.

The crushing hardness (kg/seed) ranged from 16.08 (Bragg) to 20 00 (PK 73-94, KS 73-113, BC 1, JS 92-184) with the average values of 19.13 kg/seed. Seed hardness is dependent upon the protein content and is important from crushing and milling point of view. The results reported here for crushing hardness had shown a narrower range than that reported by Sood *et al* (1977) who indicated the values to vary between 11.10 and 19.90 for soybean. According to them, there was a direct correlation between the protein content and crushing hardness. However, no such relationship was observed in the present investigation.

The total mineral and sulphur, iron, potassium, calcium, sodium and zinc contents of different genotypes are included in Table 2. The total mineral content of these varieties varied from

TABLE 1

Chemical composition of different strains of soybean

Genotype	Yield	Protein content %			Oil content		Crushing hardness (kg/seed)
	(kg/ha)	Dry wt basis	Oil free basis	kg/ha	% Dry wt basis	kg/ha	
1	2	3	4	5	6	7	8
PK 71-21	1464	33.44	44.33	489.56	24.59	360.0	18.56
Ankur	2853	37.48	49.72	1069.30	24.62	702.4	19.64
PK 73-64	2338	36.94	48.59	863.65	23.98	560.7	19.40
PK 73-92	2700	39.59	50.78	1068.93	22.04	595.1	19.72
JS 72-395	1429	40.07	50.70	572.60	20.97	299.7	18.83
PK 73-94	2400	35.52	46.19	852.48	23.11	554.6	20.00
DS 73-16	1735	32.81	43.38	569.25	24.38	423.0	19.04
PK 73-86	2092	34.61	45.51	724.04	23.96	501.2	18.36
JS 72-1	976	34.61	46.15	337.79	25.02	244.2	19.80
KS 73-113	1410	33.76	43.30	476.01	22.04	310.8	20.00
PK 74-262	1710	34.94	46.47	597.47	24.82	424.4	19.24
Bragg	1078	35.52	47.92	382.90	25.89	279.1	16.08
JS 72-44	984	33.12	43.81	326.90	24.41	240.2	19.28
UPSM-960	1093	36.94	45.50	403.75	18.83	205.8	19.76
DS 74-57-2	1519	33.12	43.43	503.09	23.74	360.6	19.90
HM-1	2276	34.03	44.75	774.52	23.96	545.3	19 26
JS 75-92	907	33.44	42.98	303.30	22.20	201.4	19.76
PK 327	1453	36.78	46.80	534.41	21.42	311.2	19.02
JS 72-280	1226	33.39	40.93	409.36	18 44	226.1	19.80
DS 74-20-2	1643	35.19	45.89	578.17	23.32	383.2	18.52
PK 321	1615	37.43	49.34	604.49	24.15	390.0	19.68
DS 74-14	1440	34.03	56.58	490.03	23.96	345.0	19.34
PK 74-271	1693	29.87	39.38	505.69	24.15	408.9	19.84
PK 326	1254	36.78	46.79	461.22	21.41	268.5	19.60
DS 74-24-1	1226	31.24	42.97	383.00	27.30	334.7	19.74
BC 1	1350	33.43	42.52	451.30	21.38	288.6	20.00
JS 72-184	1366	34.07	43.45	465.39	21.80	295.1	20.00
PK 307	1241	36.40	46.81	451.72	22.25	276.1	17.98
SL 19	1220	33.76	44.15	411.87	23.54	287.2	19.92
JS 72-128	953	33.76	46.22	321.73	26.96	228.3	18.98
SL 4	1344	33.12	42.95	445.13	22.90	307.8	19.68
JS 117	1240	34.35	44.80	425.94	23.33	289.3	18.08
PK 300	1306	33.75	44.64	440.77	24.41	318.8	19.92
DS 74-24-2	1434	31.83	42.10	456.44	24.40	349.9	19.40
PK 317	916	35.52	45.43	325.36	21.83	200.0	16.88
Bragg	1417	31.83	42.10	451.03	24.40	345.8	18.80
Mean	1508	34.62	45.48	525.77	23.33	351.50	19.13
S. D.	488.0	2.18	3.24	190.00	1.88	120.40	0.97

TABLE 2

Mineral contents of different varieties of soybean

Genotype	Ash %	Sulphur	Iron	Potassium	Calcium	Sodium	Zinc
				mg/100 g			
1	2	3	4	5	6	7	8
PK 71-21	6.55	81.30	3.07	1940	192.9	4.77	4.03
Ankur	5.23	83.70	3.02	1920	295.9	4 43	4.24
PK 73-64	6.50	83.70	3.02	2140	141.5	5.08	5.84
PK 73-92	6.36	82.90	3.35	1980	54.6	5.46	3 59
JS 72-395	6.72	66.30	3.32	2110	207.6	4.71	3.65
PK 73-94	6.06	81.30	3.21	1940	316.7	4.39	3.65
DS 73-16	6.83	73.10	3.50	2000	253.3	4.35	4.03
PK 73-86	5.72	73.10	2.54	1950	212 0	4 56	4.03
JS 72-1	6.06	61·50	3.71	2010	303.2	3.18	3.92
KS 73-113	6 38	70.00	4.60	2140	171.2	5.35	4.56
PK 74-262	7.13	81.30	4.17	2030	122.0	2.18	4.38
Bragg	6.40	44.90	4.39	2030	158.4	3.53	3.53
JS 72-44	6.98	44.90	4.49	2030	219.4	2.89	3.89
UPSM 960	6.59	82.10	4.00	2050	239.8	2.27	4.61
DS 74-57-2	6.89	78.10	4.12	1980	372.4	2.14	3.71
HM 1	6.19	77.40	2.76	1840	146.2	2.23	3.92
JS 75-92	6.25	65.70	3.60	1890	192.9	2.65	5.13
PK 327	5.43	73.10	2.54	1780	127.2	2.76	3.92
JS 72-280	6.23	65.20	4.61	1830	321.2	2.65	3.98
DS 74-20-2	5.98	65.70	2.33	1840	249.1	4.24	3.98
PK 321	6.18	65.10	4.10	1840	347.5	7.25	4.54
DS 74-14	6.42	65.70	3.92	1870	338.1	5.41	4.28
PK 74-271	6.30	72.50	5.41	1870	382.2	3.57	3.88
PK 326	6.02	77.40	2.44	1910	314.8	3.71	4.03
DS 74-24-1	5.29	76.70	3.57	1870	335.0	3.57	4.36
BC 1	6.85	78.80	6.91	1930	344.5	3.24	3.99
JS 72-184	5.89	82.10	4.00	2050	314.3	10.80	4.73
PK 307	6.58	70.20	2.59	1920	435.2	10.37	4.24
SL 19	5.91	73.80	2.57	1930	179.8	10.30	3.95
JS 72-128	6.74	69.60	3.91	1980	341.3	7.60	3.61
SL 4	6.46	69.60	3.64	1820	359.5	5.89	3.65
JS 117	6.51	78.10	5.99	1980	461.2	6.42	4.63
PK 300	6.91	74.50	4.54	2030	327.2	6.48	3.81
DS 74-24-2	6.66	62.10	4.17	1960	389.5	6.53	4.26
PK 317	7.47	73.80	4.49	1870	264.3	7.06	5.48
Bragg	6.57	78.10	3.21	1930	377.7	6.53	4.50
Mean	6.37	72.30	3.77	1950	272.5	4.96	4.18
S. D.	0.49	9.30	1.00	86.00	97.70	2.30	0.52

5.23 (Ankur) to 7.47 (PK 317) per cent. Sulphur, iron, potassium, calcium, sodium and zinc contents of these varieties ranged from 44.90 (Bragg, JS 72-44) to 83.70 mg/100 gm (Ankur, PK 73-64); 2.33 (DS 74-20-2) to 6.91 mg/100gm (JS-117) 1780 (PK 327) to 2140 mg/100 gm (PK 73-64, KS 73-113); 54.6 (PK 73-92) to 461.2 mg/100 gm (JS 117); 2.14 (DS 74-57-2) to 10.80 mg/

TABLE 3

Correlation between various chemical characters of soybean

Correlation between	Correlation Co-efficient
Yield and protein production	0.9896**
Yield and protein (% on dry wt basis)	0.3395*
Yield and crushing hardness	-0.3567*
Protein (% on dry wt basis) and protein (% on oil free basis)	0.7166**
Protein (% on dry wt basis) and oil (% on dry wt basis)	-0.3706*

*Significant at 5% level.
**Significant at 1% level.

100gm (JS 72-184) and from 3.53 (Bragg) to 5.84 mg/100 g, (PK 73-64) respectively, Sulphur content showed remarkable variations, whereas the other minerals varied in a very narrow range. However, the present findings are not in agreement with Banwar (1970) who reported a much wider variation in the mineral composition of different strains of soybean. This might be because of variations in the varieties, fertilizer treatments and soil and climatic conditions as all these factors have been known to influence mineral composition quite considerably (Singh *et al*, 1977).

Correlation co-efficients between various characters of soybean are presented in Table 3. Yield was found to be positively correlated with protein production (r=0.9896) and protein content expressed on dry weight basis (r=0.3395); whereas negative correlation existed between yield and crushing hardness (r=−0.3567). The relationship of protein content expressed on dry weight basis and oil free basis was found to be positive (r=0.7166), while it was negative (r=−0.3706) with oil content expressed on dry weight basis. All these correlations were statistically significant.

Combining the yield and compositional factors, genotypes Ankur, PK 73-92, PK 73-64; and PK 73-94 seem to be superior and may be recommended for general cultivation and future breeding programmes aimed at combining quality with quantity.

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REFERENCES

A. O. A. C. 1970. *Official Methods of Analysis.* Association of official Agricultural chemists, 11th ed. Washington, D. C.

Bailey, L. H., Chapen, R. C. and Leclerk, J. A. L. 1935. The composition and characteristics of soybeans, soybean flour and soybean bread. *Cereal Chem.* 12 : 441-472.

Banwar, P. 1970. M. H. Sc. Chemical analysis and acceptability trials of different varieties of vegetable type of soyabean. Dissertation. University of Jabalpur.

Chesnin, L. and Yein, C. H. 1951. Turbidmetric determination of available sulphur. *Proc. Am. Soil. Sci. Soc.* 15 : 149-152.

Kuzayali, M. V., Cown, J. W. and Sabry, Z. I. 1966. Nutritive value of Middle Eastern stuffs. II Composition of Pulses, seeds, Nuts and cereal products of lebanon, *J. Sci. Fd. Agric.* **17** : 81-84.

Markley, K. S. 1950. Ed. *The soybeans*, M. C. Graw Hill, New York. International. Publishers Inc., New York.

Sexana, M. C. and Pandya, R. K. 1971. Varietal performance of soybean, *Indian J. Agric. Sci.* 41 : 355-359.

Singh, Randhir, Gupta, P. C. and Pradhan, K. 1977. Mineral composition of some important fodder strains/varieties of bajra. *Indian J. Nutri. Dietet.* **14** : 16-19.

Sood, D. R., wagle, D. S., Nainawatee, H. S. and Gupta, V. P. 1977. Varietal differences in the chemical composition of soybean. *J. Food. Sci. Technol.* **14** : 177-179.

Wilde, S. A., Voiegt, G. K. and Iyer, I. G. 1964. *Soil and the Plant analysis for tree culture.* 3rd Ed. p. 156, Calcutta, Oxford Publishing House.

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EFFECT OF PRE-HARVEST SPRAY OF CALCIUM NITRATE ON THE STORAGE BEHAVIOUR OF GRAPE *cv.* PERLETTE

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ABSTRACT

Calcium nitrate was sprayed 10 days before harvest on Perlette grape vines. The grapes were stored for 3 days at room temperature and analysed for loss in weight and quality. All the concentrations (0.25, 0.50, 0.75 and 1.0%) significantly reduced the weight loss and decay. Among these concentrations, 1.0% was found to be the best.

The area under Perlette grapes was increased many fold during the first few years of its introduction in Northern India. The growers also got high premium of their produce. However, with the increased production, there used to be a glut in the local market and being perishable in nature it could not stand long transportation and storage, with the result the grower did not get even normal price. Among various chemicals used, calcium nitrate is reported to be effective in increasing the firmness of fruits by delaying senescence, preserving cellular organization and retarding the respiration rate (Faust and Sheer, 1971; Johnson, 1977; Mason *et al.* 1975 and Scott and Wills, 1975). Therefore, the present studies were conducted to see the effect of calcium nitrate on the storage behaviour of grapes.

MATERIAL AND METHODS

Fifteen uniform and healthy vines were selected for these studies. The vines were sprayed with 0.25, 0.50, 0.75 and 1.0% calcium nitrate and three vines were kept as control where only water was sprayed 10 days before harvest. Grape bunches were harvested and packed in wooden crates with hay as packing material and kept at the room temperature of $34 \pm 4°C$ and relative humidity 65 per cent. The observations on physico-chemical characters, viz., loss in weight, total soluble solids (T.S.S.) per cent-acidity, organoleptic rating and healthy/spoiled ratio of berries were recorded after 3 days of storage which are presented in Table 1. Organoleptic rating was also done by a panel of judges on 0 and 3 days of storage by a adopting score card; excellent 9 and above; very good 8-9; fair 7-8 and unacceptable below 6. The characters taken into consideration were sweetness, tartness, juiciness and flavour.

RESULTS AND DISCUSSION

The data clearly indicate that all the concentrations of calcium nitrate significantly reduced the loss in weight over

TABLE 1

Effect of calcium nitrate on weight loss and quality of grapes under storage

Treatments	Loss in weight % after 3 days	Total soluble solids (%)		Acidity (%)		Organoleptic rating		Healthy/ decayed ratio
		Initial	After 3 days	Initial	After 3 days	Initial	After 3 days	
Control	41.39	12.5	12.6	0.450	0.495	8.0	5.8	0.156
0.25% Caclium nitrate	19.50	13.6	14.8	0.460	0.495	8.4	7.2	0.571
0.5% -do-	17.77	15.4	16.6	0.410	0.469	8.7	7.6	2.505
0.75% -do-	12.42	16.0	16.7	0.540	0.585	8.8	7.7	4.466
1.0% -do-	9.09	14.5	15.4	0.475	0.525	8.5	7.9	5044
C. D. at 5%	8.95	*	*	*	*	*	*	1.89

*Statistical analysis not done.

control after 3 days of storage. There was a successive decrease in per cent weight loss with the increased concentration of calcium nitrate. The lowest (9.09%) loss was observed in 1.0% as compared to 41.39% in control which is more than four times. This decreased loss in weight might be due to the fact that calcium is known to retard the rate of respiration, decay and prevents cellular disintegration by maintaining protein and nucleic acid synthesis, thus, delays senescence (Faust and Sheer, 1971; Martin and lewis, 1952 and Mason *et al.* 1975). Similarly, calcium nitrate also increased the firmness (visual) and reduced the decay of grapes under storage. Therefore, increased healthy/decayed ratio of berries with increasing concentration of calcium nitrate was obvious.

Calcium nitrate improved the initial T. S. S. and acidity level in freshly harvested berries and maintained or somewhat improved during storage. This is perhaps due to dehydration of berries and lesser utilization of sugars in metabolic process as a result of reduced respiration. Similarly, reduced rate of respiration also caused accumulation of organic acids which were oxidized at slow rate. Organoleptic rating also indicates that the quality of berries was acceptable and rated to be fair when calcium nitrate was sprayed, whereas the rating was poor in control.

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REFERENCES

Faust, M. and Sheer, C. B. 1971. The effect of calcium on respiration of apples. *J. Am. Soc. Hortic. Sci* 97(4) : 437-39.

Johson, D. S. 1977. A note on the effects of calcium and magnesium sprays on the short term storage life of rasp-berries. *Hortic. Res.* 17 : 51-56.

Martin, D. and Lewis, T. L. 1952. The physiology of growth in apple fruits. Cell characterstics and respiratory activity of light and heavy crop fruits. *Aust. J. Sci. Res. B.* 5: 315-27.

Mason, J. L; Drought, B. G. and Mc Dougald, J. M. 1975. Calcium concentration of Spartan apple in relation to amount of senescent breakdown in individual fruits. *J. Am. Soc. Hortic. Sci.* 100(4) : 339-42.

Scoot, K J. and Wills, R. B. H. 1975. Post-harvest application of calcium as a control of storage breakdown of apples. *Hortic. Sci.* 10 : 75-76.

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STUDIES ON THE EFFECT OF LASSO (ALACHLOR) ON YIELD, ITS ATTRIBUTES AND QUALITY OF PEANUT

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ABSTRACT

Studies on weed control in peanut in semi-arid tropics of Haryana showed that Lasso (Alachlor) controlled the weeds successfully when applied @ 5 and 6L/ha (2.5 and 3.0L a.i./ha). Application of Lasso increased the pods and branches per plant, oil content of kernels, oil yield and crude protein yields and decreased the dry weight of weeds. Regression equations for (I) mean pod yield $\hat{Y}=1679.51+151.03X$, (II) dry weight of weeds $\hat{Y}=2251.02-155.14X$, (III) oil yield $\hat{Y}=607.31+44.53X$, and crude protein yield $\hat{Y}=278.58+31.14X$ were worked out.

Weeds have been reported to cause great reduction in pod yield of peanut crop by competing in initial stages. Peanut crop suffers from severe weed infestation due to its poor competing ability at all crop growth phases (Leiderman *et al.* 1963). Several research workers (Chaugule and Khuspe, 1962; Kulkarni *et al.* 1963) have reported losses to the extent of 50% due to overcrowding and competition of weeds.

Bala Narasaiah and Kulkarni (1969) reported 244% greater pod yield over check by effective weed control measures in peanut in semi-arid tropical conditions of Andhra Pradesh. Thus, there is an urgent need for studying the efficacy of various weedicides in controlling the weed growth in peanut. In the present investigations, varying doses of Lasso(2-chloro-2', 6'– diethyl-N-(methoxymethyl acetanilide) were applied to study their effect on pod yield, dry matter of weeds and some quality components of peanut kernels.

MATERIAL AND METHODS

The investigations were conducted at the Research Farm of the Haryana Agricultural University, Hissar, over a period of three years from 1972 to 1974. The mean rainfall during the crop season, i.e., July to October was 311 mm, the average temperature being 28°C. The soil of the field was well drained loamy sand with a pH of 8.2, having medium phosphorus 8 kg./ha, moderated nitrogen(212 kg/ha) and large potash contents (388 kg/ha). The experiment was laid out in a Randomized Block Design with 8 treatments replicated three times. The treatments consisted of Lasso @1, 2, 3, 4, 5 and 6 L/ha (0.5, 1, 1.5, 2, 2.5 and 3 L a i./ha, respectively) as pre-emergence appli-

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cation, hand weeding (at 21, 42 and 63 days stages by handhoe weeding) and check (no weeding). C 501 variety of peanut was sown in the experiment. A basal dose of 15 kg nitrogen + 40 kg P_2O_5 per ha was applied. Data on pod yield, shelling percentage, oil content, oil yield for all the three years and data on branches per plant, pods per plant, total dry matter of weeds and crude protein content for 1973 and 1974 only were recorded. Oil content and crude protein were estimated according to A.O.A.C. (1960).

RESULTS AND DISCUSSION

Pod yield

A perusal of data in Table 1 reveals that pod yield of peanut increased significantly due to effective weed control either with the application of Lasso or due to hand weeding during all the three years of investigation. Application of the weedicide @ 6L/ha enhanced the mean pod yield by 9.44 q/ha over control. The mean increase in pod yield with lasso @ 1 to 6 L/ha varied from 6.3% to 58.1% over control. Though there had been a significant increase with the application of lasso over no weeding, yet hand weeding registered its superiority over all treatments (1973, 1974 and mean) and gave 82.6% higher pod yield over control. Hence, it is obvious that in control plots the nutrients present in the soil were shared by weeds and crop plants which ultimately resulted in the lower pod yield. There being no competition in hand weeded plots, the nutrients and moisture were fully utilized by peanut crop resulting in higher pod yield. Similar results have been reported by Kulkarni *et al.* (1963), Bala Narasaiah and Kulkarni (1969) and Brar *et al.* (1973).

The regression equation worked out for the mean pod yield $\hat{Y} = 1679.51 + 151.03X$, shows that application of 1 L/ha Lasso increased the pod yield by 151.03 kg per ha. It is also obvious that there had been linear increase in pod yield with increasing doses of Lasso upto the dose of 6 L/ha.

Shelling percentage

Variations in shelling percentage which were recorded each year (Table I) showed an inconsistant trend. Mean values for three years did not differ.

Branches per plant

Data on branches per plant were recorded during 1973 and 1974 and the beneficial effect of Lasso and hand weeding was observed (Table 2). On the basis of mean, it may be concluded that application of Lasso @ 4 to 6 L/ha and hand weeding resulted in significantly higher number of branches over control. However, higher doses of Lasso and hand weeding had the similar effect.

Pods per plant

A perusal of data in Table 2 shows that during both the years (1973 and 1974) significant differences in pods per plant were observed due to the application of Lasso and hand weeding. Increasing doses of Lasso resulted in enhanced pods per plant during the both years of study. Mean increase in pods per plant over control was 11.5, 14.3, 20.1, 28.7, 33.8 and 49.6% with the application of Lasso @ 1, 2, 3, 4, 5 and 6 L/ha, respectively. Hand weeding gave 46% higher number of pods per plant over control. These increases in pods per plant might be due to the efficient utilization of soil moisture and nutrients and favourable conditions for the development of gynophores due to effective weed control.

TABLE 1

Effect of varying doses of Lasso and hand weeding on pod yield (kg/ha) and shelling percentage

Treatments	Pod yield (kg/ha)				Shelling percentage			
	1972	1973	1974	Mean	1972	1973	1974	Mean
Control	1954	1652	1364	1623	58.9	76.6	70.0	68.5
Lasso @ 1L/ha	2106	1802	1757	1888	67.6	72.7	68.0	68.4
Lasso @ 2L/ha	2322	1949	1697	1989	67.4	74.5	69.0	70.3
Lasso @ 3L/ha	2415	1972	1984	2124	68.1	76.0	67.5	70.5
Lasso @ 4L/ha	2693	2017	2045	2252	66.7	75.2	67.2	69.7
Lasso @ 5L/ha	2762	2346	2257	2455	66 5	74.0	66.8	69.1
Lasso @ 6L/ha	2772	2856	3076	2567	68.1	73.0	70.0	70.3
Hand weeding (21,42 & 63 days)	2569	3082	3242	2964	67.3	73.5	67.0	69.2
S. Em ±	118	230	71	155	1.3	0.8	0.1	0.5
CD at 5%	334	653	201	438	3.7	2.2	0.4	2.4

Dry weight of weeds

Application of Lasso decreased the total dry matter of weeds significantly over control (Table 2). On the basis of mean values, the total dry matter of weeds of 1963, 1867, 1733, 1640, 1481 and 1342 kg/ha were recorded where Lasso was applied @ 1, 2, 3, 4, 5 and 6L/ha respectively, against 2433 kg/ha in check plot. Thus, increasing doses of the weeding resulted in gradual decrease of dry matter on the basis of mean of two years data, the regression equation was calculated as follows :

$$\hat{Y} = 2251.02 - 155.14X$$

This is evident from the equation that with the application of one L/ha of Lasso, the dry weight of weeds decreased by 155.14 kg/ha. Thus, the nutrients taken by weeds could be diverted to the crop if effective weed control management practice is executed. This may be most pronounced reason for increased pod yield with the increasing doses of Lasso which controlled weeds effectively. Decreased dry matter of weeds at harvest as a result of chemical weed control has also been reported by Bala Narasaiah and Kulkarni (1969) and Dhindsa *et al.* (1972).

Oil content

A perusal of data in Table 3 reveals that the application of Lasso increased the oil content in kernels significantly over control during 1972 and 1973. It can be seen from the mean values that there was a gradual increase in the oil content with increasing doses of Lasso upto the application @ 5L/ha (49.59%). Hand weeded plots resulted in significantly higher oil content over control but, it was less than those recorded in Lasso plots. Chopra *et al.* (1970) also reported increased oil content in kernels of peanut as a result of application of lower doses of 2, 4-D, whereas higher doses decreased oil content.

Oil yield

Variations in oil yield due to different treatments were significant during all the

TABLE 2

Effect of varying doses of Lasso and hand weeding on branches, pods and dry weight of weeds

Treatments	No. of branches per plant			No. of pods per plant			Dry weight of weeds (kg/ha)		
	1973	1974	Mean	1973	1974	Mean	1973	1974	Mean
Control	6.8	7.5	7.1	14.5	13.3	13.9	2448	2418	2433
Lasso @ 1L/ha	7.7	8.2	7.9	17.3	13.6	15.5	1518	2408	1963
Lasso @ 2L/ha	7.8	8.7	8.2	16.3	15.4	15.9	1371	2364	1867
Lasso @ 3L/ha	7.4	9.0	8.2	17.3	16.1	16.7	1133	2333	1733
Lasso @ 4L/ha	8.3	9.1	8.7	19.7	16.0	17.9	963	2318	1640
Lasso @ 5L/ha	8.0	9.4	8.7	19.9	17.3	18.6	872	2090	1481
Lasso @ 6L/ha	7.9	9.5	8.7	22.9	18.7	20.8	850	1833	1342
Hand weeding	7.5	9.9	8.7	18.2	22.4	20.3	NIL	NIL	NIL
S. Em ±	0.5	0.5	0.5	1 1	1.4	0.8	302	230	269
C. D. at 5%	1.4	1.5	1.4	3.2	4.0	2.3	856	652	760

TABLE 3

Effect of varying doses of Lasso and hand weeding on oil content and oil yield

Treatments	Oil per cent				Oil yield (kg/ha)			
	1972	1973	1974	Mean	1972	1973	1974	Mean
Control	46.30	49.05	47.14	47.49	533	583	450	522
Lasso @ 1L/ha	47.20	49.92	48.77	48.63	672	654	583	636
Lasso @ 2L/ha	47.68	51.27	48.19	49.05	746	744	564	685
Lasso @ 3L/ha	49.13	51.85	46 54	49.17	800	777	623	733
Lasso @ 4L/ha	47.64	52.37	47.45	49.16	856	794	652	767
Lasso @ 5L/ha	49.62	51.45	47.81	49.59	909	893	721	841
Lasso @ 6L/ha	49.45	51.15	46.85	49.15	933	1066	1008	1002
Hand weeding	48.75	50.70	47.37	48.94	843	1148	1029	1007
S Em ±	0.08	0.05	0.08	0.07	45	87	21	58
C. D. at 5%	0.22	0.14	0.23	0.20	128	247	61	164

TABLE 4

Effect of varying doses of Lasso and hand weeding on crude protein yield (kg/ha)

Treatments	Crude protein in		
	1973	1974	Mean
Control	285	229	257
Lasso @ 1L/ha	359	328	344
Lasso @ 2L/ha	392	317	355
Lasso @ 3L/ha	400	357	379
Lasso @ 4L/ha	380	344	362
Lasso @ 5L/ha	425	369	377
Lasso @ 6L/ha	502	518	510
Hand weeding	627	601	614

three years (Table 3). Mean increases in oil yield over control were 21.8, 31.2, 40 4, 46.9, 61.1 and 91.9%, respectively, with the application of 1, 2, 3, 4, 5 and 6L/ha of Lasso. Hand weeding registered 92.9% increase in oil yield over no weeding or control plots. Regression equation for the mean oil yield was worked out to be $\hat{Y} = 607.31 + 44.53\,X$, which shows that with the application of 1L/ha of Lasso, the oil yield increased by 44.53kg/ha. The increase in oil yield seems to be commulative effect of increased oil content in kernels and higher kernel yield due to weed control management practices.

Crude protein

It is evident from the data in Table 4 that crude protein production increased with the application of Lasso during both the years (1973 and 1974). Mean increases of 87, 88, 122, 105, 120 and 293 kg/ha in the production protein over no weeding were observed as a result of application of Lasso 1, 2, 3, 4, 5 and 6L/ha, respectively. Hand weeding also resulted in higher crude protein of 614 kg/ha over 257 kg/ha in control. Regression equation worked out for crude protein was found to be linear.

Crude protein (kg/ha)

$$\hat{Y} = 278.58 + 31.14X$$

This indicates that application of each litre Lasso increased the crude protein production by 31.14 kg/ha, which was increased due to increased Kernel yield as a result of weed control. The above observation finds support from the work of Chopra *et al.*(1970) who reported greater content of crude protein in peanut kernels as a result of weedicide application.

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REFERENCES

A. O. A. C. 1960. *Official Methods of Analysis.* Association of official Agricultural Chemists. 7th Ed.

Bala Narasaiah, D. and Kulkarni, L. G. 1969. Studies on the effect of Tok E-25 on weed control growth, and yield of ground. *Madras Agric. J.* 56 : 623-629.

Brar, L. S., Vijay Kumar and Gill, G. S. 1973. Chemical weed control in groundnut. *Indian J. Weed Sci.* 5 : 86-91.

Chagule, B. A. and Khuspe, V. S. 1962. Relative efficiency of intercultivation weeding and manuring in control of weeds in ground and fodder sorghum. *Indian J. Agron.* 6 : 270-280.

Chopra, S. L., Sudarshan Kumar and Bhatia, I. S. 1970. Effect of herbicides on the chemical composition of the ground nut crop. *Indian J. Weed. Sci.* 4 : 29-32.

Dhindsa, K. S., Gupta, S. K., Singh, B. P. and Chaudhary, M. S. 1972. Effect of harbicides on the yield and quality of groundnut. *Indian J. Weed Sci.* 4 : 29-32.

Kulkarni, L. G., Verma, S. S. and Achuta Rao, K. 1963. Studies on weeding and interculture in relation to weed control in the yield groundnut. *Indian J. Oilseeds* 5 : 126.

Leiderman, L., Pereira, R. J. C. and Sichmann, W. 1963. Pre-emergence application of herbicides in groundnut in sandy soil. *Biologico*. 29.

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EFFECT OF AUTOCLAVING ON THE DEGRADATION OF DISULFOTON IN SOIL AT DIFFERENT TEMPERATURE

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ABSTRACT

A laboratory study to determine the effect of autoclaving on the degradation of disulfoton from sandy loam soil, at different temperatures was undertaken. Autoclaved and non-autoclaved soils were treated with 100 ppm disulfoton and kept at 10, 25 and 45°C. Samples were analysed after 0, 2, 5, 10, 20, 40, 70 and 100 days of treatment by colorimetric method. The dissipation of disulfoton was slow in autoclaved as compared to non-autoclaved soil, at all the temperatures. The degradation was faster in the beginning but it decreased with the lapse of time both in non-autoclaved and autoclaved soils, so that even after 100 days of treatment, 24.38 to 50.37% of the residue persisted in non-autoclaved soil and 31.46 to 52.95% in autoclaved soil. The degradation was temperature dependent. In non-autoclaved soil, the degradation at 45°C was 1.5 times than that at 10°C. In autoclaved soil, this defference was 2 times.

Disulfoton (O, O-diethyl S-ethyl-2-thioethyl phosphorodithioate) is a systemic insecticide. It is usually available as 5% granules and is recommended either for seed treatment or soil application (Reynolds *et al.* 1957) on a variety of crops including vegetables, cotton and cereals, to control insects and other pests such as aphids, leaf hoppers, thrips, leaf miners and spider mites.

Abiotic factors such as rainfall, humidity, temperature, formulation, soil type and soil moisture and biotic factors viz crop type and soil micro-organisms are responsible for slow or fast dissipation of insecticidal residues from various substrates. Dissipation of aldrin was faster in moist soil and the minimum in autoclaved soil (Kushwaha *et al.*, 1976a). Temperature coupled with moisture influenced degradation of parathion (Jat and Srivastava, 1977). Informathion on the fate of disulfoton when mixed in autoclaved (sterilized) soil and subjected to various temperatures is not available and was investigated.

MATERIAL AND METHODS

Studies were conducted during 1977-78 in the Toxicological Laboratory, Department of Entomology, Haryana Agricultural University, Hissar. A standard solution of 10 µg/ml of disulfoton was prepared in acetone. From this solution, aliquots of 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 ml were drawn in reaction tubes with the help of a pipette. These aliquots contained 5, 10, 15, 20, 25 and 30 ug disulfoton, respectively. Insecti-

cide present in these aliquots was subjected to analysis for perfection of analytical technique following the colorimetric method of Getz and Watts (1964) and modified by Jain *et al.* (1974).

A sizeable sample of sandy loam soil was brought from the University Research Farm and air dried at room temperature. Ten Kilogram of the air dried soil was autoclaved (sterilized) for half an hour (at a pressure of 1 kg per square centimeter). To half kilogram samples of autoclaved and non-autoclaved soils, in thick cloth bags, in replicates of three, one gram disulfoton 5% gradules were thoroughly mixed, giving a dose of 100 ppm. The samples were stored in incubators set at 10, 25 and 45°C. Untreated soil samples were also simultaneously kept at each of these temperatures. The samples were tested for residues after 0, 2, 5, 10, 20, 40, 70 and 100 days of the treatment. The amount of insecticide in samples taken within an hour of treatment, was considered as 'deposit'.

At each interval, for residue analysis, a representative of 25 g soil sample was taken from each bag. The sample was extracted in acetone in the ratio of 1:2 (soil : acetone). For extraction and clean up, a rapid procedure, suggested by Agnihotri *et al.* (1973) was adopted. Microquantities of disulfoton residues were determined by the same method as was adopted for perfection of the analytical technique. The average recoveries ranged from 95.0 to 98.2% from autoclaved and 94.4 to 97.6% from non-autoclaved soils.

RESULTS AND DISCUSSION

Non-autoclaved soil :

The data in Table 1 show that the initial deposits of disulfoton in samples incubated at 10, 25 and 45°C were 80.0, 79.2 and 80.4 ppm, respectively. These deposits degraded to the level of 70.2, 65.7 and 64.0 ppm within 2 days after treatment, resulting in 12.25, 17.05 and 20.40% loss. There was a steady fall in the residue and when the experiment was terminated after 100 days of the treatment, the loss of the disulfoton residues from soil samples at 10, 25 and 45°C was to the extent of 49.63, 64.14 and 75.62%, respectively.

It is evident from the data that the loss of disulfoton depended on temperature. However, at all the three levels of temperatures, the dissipation was faster in the beginning and decreased progressively as the time lapsed. Temperature had a direct effect on degradation. At all time intervals, it was more in samples incubated at higher temperature.

Autoclaved soil :

The data presented in Table 2 indicate that the initial deposits of disulfoton in sterilized soil were 83.1, 84.7 and 85.2 ppm at 10, 25 and 45°C, respectively. After 2 days of treatment, the residues fell to the levels of 79.3, 76.9 and 72.9 ppm resulting in 4.57, 9.21 and 14.44% loss. As in non-autoclaved soil, here also the residues fell steadily and on the 100th day after treatment, their levels in samples incubated at 10, 25 and 45°C were 44.0, 33.4 and 26.8 ppm resulting in 47.05, 60.57 and 68.54% loss, respectively. The degradation of disulfoton with increase in temperature was not so fast as in non-autoclaved soil. Nevertheless, the degradation was temperature dependent. As in non-autoclaved soil, the loss was more in the beginning but decreased progressively

TABLE 1

Dissipation of disulfoton from non-autoclaved soil at different temperatures

Time interval after treatment (days)	10°C			25°C			45°C		
	Residue (ppm)	Average residue (ppm)	Dissipation (%)	Residue (ppm)	Average residue (ppm)	Dissipation (%)	Residue (ppm)	Average residue (ppm)	Dissipation (%)
0	80.0			79.0			80.4		
	80.8	80.0		72.2	79.2		83.6	80.4	
	79.2			86.4			77.2		
2	76.6			62.4			63.9		
	64.0	70.2	12.25	68.8	65.7	17.05	65.6	64 0	20.40
	69.9			66.0			62.4		
5	64.0			57.6			59.3		
	65.2	64.4	19.50	60.3	60.1	24.12	60.8	59.2	26.37
	64.0			62.4			57.6		
10	63.2			56.0			54 4		
	62.0	62 6	21.75	57.6	56.6	28.54	51.2	52.9	34.20
	62.6			56 2			53 2		
20	60.8			48.0			46 4		
	59.2	60.1	24.87	54 4	51.5	34.97	44.5	46 6	42.04
	60.3			52.0			48.9		
40.	59 3			45.6			43.2		
	57.6	58.4	27.00	48.0	46.9	40.78	41.0	41.4	48.51
	58.3			47.0			40.0		
70	54.4			40.0			37.6		
	51.2	52.6	34.25	36.4	40.4	48.99	37.6	35.1	56.34
	52 2			44.8			30.1		
100	46.5			29.6			22.7		
	36.6	40.3	49 63	27 2	28.4	64.14	16.8	19.6	75.62
	37.8			28.4			19.3		

with the lapse of time. The loss at each time interval at 45°C was about twice as much as at 10°C except at the time of final sampling when it was about one and a half times. When compared with the loss at 25°C, the loss at 45°C at all the time intervals, was about 1.25 to 1.50 times, except at 100 days time interval when it was 60.57% at 25°C and 68.54% at 45°C.

Comparing the data in Tables 1 and 2, it may be inferred that dissipation in non-sterilized soil was higher than in the sterilized soil, at all the time intervals and at all the three temperatures. The micro-organisms present in the non-sterilized soil might have possibly played a vital role in degrading the insecticide. In general, the degradation of disulfoton was slow at all temperatures irrespective of whether the soil was sterilized or non-sterilized and even on 100th day of treatment ranged from 47.05 to 75.62% dissipation.

Studies on the fate of disulfoton in soils have so far not been conducted in India. However, Vettorazzi (1976) reported that residues of disulfoton were stable under deep freeze condition, but losses occurred during cooking, heating or peel-

TABLE 2

Dissipation of disulfoton from autoclaved soil at different temperatures

Time interval after treatment (days)	10°C			25°C			45°C		
	Residue (ppm)	Average residue (ppm)	Dissipation (%)	Residue (ppm)	Average residue (ppm)	Dissipation (%)	Residue (ppm)	Average residue (ppm)	Dissipation (%)
0	82.8			84.6			90.2		
	83.2	83.1		86.3	84.7		85.4	85.2	
	83.3			83.2			80.0		
2	76.8			80.3			72.1		
	81.6	79.3	4.57	73.6	76.9	9.21	73.0	72.9	14.44
	79.5			76.8			73.6		
5	73.6			67.2			64.8		
	73.8	73.6	11.43	66 6	66 4	21.61	63.9	64.0	24.88
	73.4			65 4			63.3		
10	72.1			65.4			64.2		
	70.3	70.4	15.28	62.8	64.6	23.73	55.0	59.1	30.63
	68.8			65.6			58.1		
20	68.8			55.8			59.6		
	68.2	68.0	18.17	64.1	61.5	27.39	49.1	52.2	38.73
	67.0			64.6			48.0		
40	64.0			54.0			44.8		
	65.3	65.1	21.66	53.9	57.3	32.35	47.8	45.8	46 24
	66.0			64.1			44.8		
70	62.4			50.2			42.4		
	60.6	60.2	27.56	50.9	52.9	37.54	39.0	38.6	54.69
	57.6			57.3			34.4		
100	45.6			27.2			28.0		
	44.8	44.0	47.05	35.6	33.4	60.57	26.8	26.8	68.54
	41.6			37.4			25.6		

ing of potatoes. Kushwaha *et al.* (1976a) found more dissipation of aldrin in non-autoclaved soil than in autoclaved soil. Further, Kushwaha *et al.* (1976b) and Gupta *et al.* (1977) observed rapid loss of aldrin at higher temperatures as compared to lower temperatures. Lichtenstein and Schulz (1959) observed no loss of insecticidal residues from frozen soils, but at higher temperature, the degradation was fast. Hence, the present findings are in agreement with those of the previous workers.

REFERENCES

Agnihotri, N. P., Pandey, S. Y., Jain, H. K. and Dewan, R. S. 1973. Rapid single step extraction and clean up method for the extraction of residues of chlorinated hydrocarbon insecticides in soil. Paper presented at Symp. on "The Insecticide Act and Pesticide Control" at CFTRI, Mysore.

Getz, M. C. and Watts, R. R. 1964. Application of 4(p-Nitrobenzyl) pyridine as a rapid quantitative reagent for organophosphate pesticides. *J. Assoc. Off. agric. Chem.*, 46 : 1094.

Gupta, H. C. L., Kushwaha, K. S., Singh, R. and Pareek, B. L. 1977. Effect of temperature on the dissipation of aldrin residues from glass surface. *Comp. Physiol. Ecol.* 2 : 223-225.

Jain, H. K., Pandey, S. Y., Agnihotri, N. P. and Dewan, R. S. 1974. Re-estimation of organophosphorus insecticides. *Indian J. Entomol.*, 36 : 145-148.

Jat, N. R. and Srivastava, B. P. 1977. Effect of temperature and soil moisture on the persistence of parathion in clay loam soil. Symp. on "Insects & Environment" held at Univ. of Delhi. February, 21-23, 1977. pp. 40.

Kushwaha, K. S., Gupta, H. C. L. and Singh, R. 1976a. Effect of autoclaving, moisture and rate of application on the degradation and conversion of aldrin to dieldrin in soil. Seminar on Entomologist's Role in Rural Development held at B. C. K. V. V., Kalyani. January 23-25, 1976. pp. 6

Kushwaha, K. S., Gupta, H. C. L. and Singh, R. 1976b. Effect of temperature on the degradation of aldrin. *Indian J. Entomol.* 38 : 134-137.

Lichtenstein, E. P. and Schulz, K. R. 1959. Persistence of some chlorinated hydrocorbon insecticides as influenced by soil types, rate of application and temperature. *J. Econ. Entomol.* 52 : 124-131.

Reynolds, H. T., Fukuto, T. R., Metcalf, R. L. and March, R. B. 1957. Seed treatment of field crops with systemic insecticides. *J. Econ. Entomol.* 50 : 527-539.

Vettorazzi, G. 1976. State of the art of the toxicological evaluation carried out by the Joint FAO/WHO meeting on pesticide residues. II. Carbamate and organophosphorus pesticides used in agriculture and public health. *Residue Reviews* 63 : 1-44.

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SYNTHESIS OF 2, 3 SUBSTITUTED 4, 5, 6, 7-TETRAHYDRO-2H-INDAZOLES; 2, 4, 5, 6, 7, 8-HEXAHYDROCYCLOHEPTA(C) PYRAZOLES AND THEIR ω-t-AMINOALKYL ENOL ETHERS

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ABSTRACT

Ethyl cyclohexanone-2-carboxylate with 2-phenethylhydrazine and 4-fluorophenylhydrazine gave 2-phenethyl and 2-(4-fluorophenyl) 4, 5, 6, 7-tetrahydro-2 H-indazol-3- ols (I and VIII). Similarly ethyl cycloheptanone-2-carboxylate afforded 2-phenethyl and 2-(4-fluorophenyl)-2, 4, 5, 6, 7, 8-hexahydrocyclohepta (*C*) pyrazol-3-ols (IV and XIV). Their ω-t-aminoalkyl enol ethers are reported.

2-Phenyl-3a, 4, 5, 6-tetrahydrobenzo (6,7) cycloheptt (1,2-*C*) pyrazol-3 (2H)-one has been reported (Rastogi *et al.*, 1971; Munshi *et al*; 1971., Hesse *et al*, 1958) as potent antiinflammatory agent, comparable in its activity with phenylbutazone. Pyrazole derivatives like Isolan and Pyrolan (Melnikov 1971) have been used as aphicides. This prompted us to synthesise some 2-substituted indazoles, pyrazoles and their ω-t-amino alkyl enol ethers, with benzene residue deleted from the nucleus.

The synthesis of 2-phenethyl-4,5,6,7 tetrahydro-2H-indazol-3-ol(1) was achieved by refluxing ethylcyclohexanone-2-carboxylate (Treibevon and Neupert, 1955, Buchta and Kranz, 1955) with phenethyl hydrazine in aqueous ethanol in the presence of sodium acetate. The structure assigned to I was based on the mode of synthesis and was also supported by NMR data which showed triplets centred at 4.06 δ and 3.08 δ, J=7.0 Hz for N^2–CH_2 and ArCH_2 protons respectively, 1645 Cm^{-1} peak in IR (KBr) is in agreement with the above assignment. Similarly, ethylcycloheptanone-2 carboxylate (Hesse and Urbanek, 1958) with phenethyhydrazine afforded 2-phenethyl -2,4,5,6,7,8-hexahydrocyclohepta (*C*) pyrazol-3-ol (IV). Likewise, the synthesis of 2-(4-fluorophenyl)-4,5,6,7-tetrahydro-2H-indazol-3-ol (VIII) and 2-(4-fluorophenyl)–2,4,5,6,7,8-hexahydro-cyclohepta (*C*) pyrazol-3-ol (XIV) were achieved by condensing ethyl cyclohexanone-2- carboxylate & ethyl cycloheptanone-2-carboxylate with 4-fluorophenyl-hydrazine hydrochloride.

Another molecular modification studied was the introduction of an oxygen

function as enol ether at position 3. Alkylation of VIII with 2-N-chloroethylpyrrolidine in dry acetone and anhydrous potassium carbonate yielded a syrup. TLC and NMR data indicated it to be a mixture of two compounds (9:1), the hydrochloride of which on fractional crystallization yielded the major isomer as 2-(4-fluorophenyl) -3-(2-N-pyrrolidinoethoxy) -4,5,6,7-tetrahydro-2H-indazole (XI) in pure form. It's NMR spectrum (Malik, 1973) showed two complementory sharp triplets at 4.23 and 2.75 δ (J=6.0) for OCH_2 and N-CH_2 protons respectively. The proton m-to the fluorine atom appeared slightly downfield, centred at 7.83 δ compared to the proton o- to the fluorine atom appearing at 7.06 δ. Both the signals appeared as typical double doublets with a J value of 9.0 Hz for H-H coupling and J value of 5 and 8 Hz for F-*mH* and F-*oH* couplings (Silverstein and Bassler, 1967), respectively.

Similarly, alkylation of IV with 2-N-chloroethylpyrrolidine, 2-dimethylaminoethylchloride and 2-N-morpholinoethylchloride gave 2-phenethyl-3-(2-N-pyrrolidinoethoxy)-2,4,5,6,7,8 -hexahydrocyclohepta (*C*) pyrazole (V), 3-(2-dimethylaminoethoxy) -2-phenethyl-2,4,5,6,7,8-hexahydrocyclohepta (*C*) pyrazole (VI) and 3-(2-morpholinoethoxy)-2-phenethyl-2,4,5,6,7,8-hexahydrocyclohepta (*C*) pyrazole (VII), respectively. NMR spectra of V and VI showed broad singlet at 7.28 δ for aromatic protons, triplets at 4.08 and 3.12 δ (J=7.0) for N^3-CH_2 CH_2 Ar and ArCH_2-protons, respectively. The O-CH_2-methylene appeared as triplet at 3.81 in V and 3.75 δ with J=6.0 in VI along with their complementory triplet with J=6.0 at 2.66 and 2.82 δ. respectively, for $-OCH_2$-CH_2 N-methylene. The singlet at 2.22 δ in VI was assigned to $-N(CH_3)_2$ protons while rest of the protons appeared at their usual positions in V and VI. Physical data of the alkylated products of I, VIII and XIV is given in the Table.

EXPERIMENTAL

The compounds were checked by IR on Perkin-Elmer 137 infracord or 337 grating instrument and NMR on Varian A 60D instrument using TMS as internal reference. The chemical shift values are expressed in δ and J values in Hz and are competiable with the assigned structures. TLC was carried out on silica gel or basic alumina plates and the spots were located by spraying with 2% acidic $KMnO_4$ solution. Melting points were determined in sulphuric acid bath and are uncorrected.

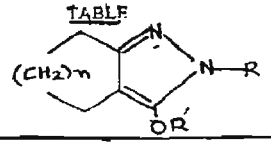
2-Phenethyl-4, 5, 6, 7-tetrahydro-2H-indazol-3-ol (I) :

A mixture of 2-phenethylhydrazine sulphate (2.34 g), aqueous ethanol (50 ml), sodium acetate (2 g) and ethyl cyclohexanone-2-carboxylate (1.70 g) was refluxed on a steam bath for 4 hrs. The mixture was cooled, diluted with water, the product filtered, washed with water and finally with little amount of ethanol. The product was crystallized from benzene-hexane to yield 2.18 g (90%) of I, IR (KBr); 1645 cm^1 (C=o), NMR ($CDCl_3$); 7.38 δ (bs, 5, Ar*H*), 7.10-7.50 (bh, 1, *NH* or O*H*), 2.16-2.92 (m, 4, *H*-4 and *H*-7), 1.42-1.92 (m, 4, *H*-5 and *H*-6).

2-Phenethyl-2, 4, 5, 6,7,8-hexahydrocyclohepta (C) pyrazol-3-ol (IV)

It was prepared in a similar manner from ethyl cycloheptanone-2-carboxylate

TABLE



Sr No	n	R	R'	Molecular formula	Solvent of crystallization	M.P. °C	Analysis % Reqd. C	H	N	Found C	H	N
I	2	$(CH_2)_2Ph$	H	$C_{15}H_{18}N_2O$	Benzene-Hexane	75	74.40	7.44	11.57	74.63	7.51	11.25
II	"	"	$(CH_2)_2$-N	$C_{21}H_{29}N_3O.C_2H_2O_4$	EtOH-Ether	112	64.33	7.22	9.79	64.44	7.38	10.02
III	"	"	$(CH_2)_2$-N O	$C_{21}H_{29}N_3O_2.C_2H_2O_4$	"	135	62.02	6.96	9.43	62.31	7.04	9.48
IV	3	"	H	$C_{16}H_{20}N_2O$	Benzene-Hexane	80	75.00	7.81	10.93	74.85	8.11	11.00
V	"	"	$(CH_2)_2$-N	$C_{22}H_{31}N_3O.C_2H_2O_4$	MeOH-Ether	170	65.01	7.44	9.48	65.22	7.52	9.25
VI	"	"	$(CH_2)_2$-N(Me)$_2$	$C_{20}H_{29}N_3O.C_2H_2O_4$	MeOH-Ether	172	63.30	7.43	10.07	63.52	7.64	10.32
VII	"	"	$(CH_2)_2$-N O	$C_{22}H_{31}N_3O_2.C_2H_2O_4$	"	145	62.74	7.18	9.16	62.88	7.48	9.36
VIII	2 C_6H_4.F(4)		H	$C_{13}H_{13}FN_2O$	"	189			12.07			12.27
IX	"	"	$(CH_2)_2N(Me)_2$	$C_{17}H_{22}FN_3O.C_2H_2O_4$	MeOH-Ether	190			10.68			11.01
X	"	"	$(CH_2)_3N(Me)_2$	$C_{18}H_{24}FN_3O.C_2H_2O_4$	"	137			10.31			9.97
XI	"	"	$(CH_2)_2$-N	$C_{19}H_{24}FN_3O.C_2H_2O_4$	"	160			10.02			10.28
XII	"	"	$(CH_2)_3$-NH_2	$C_{16}H_{20}FN_3O.C_2H_2O_4$	"	187			11.08			11.37
XIII	"	"	$(CH_2)_2$-N O	$C_{19}H_{24}FN_3O_2.C_2H_2O_4$	"	142			9.65			9.78
XIV	3	"	H	$C_{14}H_{15}FN_2O$	"	225			11.38			11.26
XV	"	"	$(CH_2)_2N(Me)_2$	$C_{18}H_{24}FN_3O.C_2H_2O_4$	MeOH-Ether	174			10.31			10.40
XVI	"	"	$(CH_2)_3N(Me)_2$	$C_{19}H_{26}FN_3O.C_2H_2O_4$	"	155			9.97			9.83
XVII	"	"	$(CH_2)_2$-N	$C_{20}H_{26}FN_3O.C_2H_2O_4$	"	170			9.69			9.51

(1.84 g) and 2-phenethylhydrazine (from 2.34 g of its sulphate) with usual working up to yield 2.2 g (85%) of IV, NMR ($CDCl_3$); 7.26 δ (s, 5, Ar*H*), 7.16-7.50 (bh, 1, *NH* or *OH*), 2.16-2.92 (m, 4, *H*-4 and *H*-8), 1.33-2.00 (m, 6, *H*-5, *H*-6 and *H*-7).

2-(4-Fluorophenyl)-3- (2-N-pyrrolidinoethoxy)-4, 5, 6, 7-tetrahydro-2H-indazole :— (XI)

A mixture of VIII (2.32 g); anhydrous K_2CO_3 (5.0 g) dry acetone (60 ml) and 2-N-chloroethylpyrrolidine hydrochloride (1.87 g) was refluxed for 16 hr. It was then cooled, filtered and concentrated. The residue was treated with water and extracted with ether (3×50 ml) The organic phase was washed with water, dried (Na_2SO_4) and the solvent removed. TLC on neutral alumina indicated it to be a mixture of two components (9:1). Oxalate of the above crude material on repeated crystallisation with methanol and dry ether afforded XI in 70% yield (2.3 g) NMR (CCl_4) : 4.23 δ (t, J=6.0, 2, $-OCH_2$) 2.75 (t, J=6.0, 2, OCH_2 CH_2), 2.16-2.83 (m, 8, *H*-2', *H*-5, *H*-4 & *H*-7), 1.50-2.0 (m,8, *H*-3', *H*-4', *H*-5' and *H*-6).

3- (2- Dimethyl aminoethoxy)- 2- (4-fluorophenyl)-2,4,5,6,7,8-hexahydrocyclohepta (C) pyrazole (XV)

A mixture of XIV (2.46 g), 2-dimethylaminoethylchloride hydrochloride (1.58 g), anhydrous K_2CO_3 (4.0 g) and dry acetone (50 ml) was refluxed for 20 hr. and its usual work up as described for XI gave 2.4 g (75%) of XV as oxalate. NMR (CCl_4); 7.27 δ (s, 5, Ar*H*), 3.75 (t, J=6.0, 2, $-OCH_2$), 2.48 (t, J=6.0, 2, OCH_2 CH_2N), 2.08-2.85 (m, 4, *H*-4 and *H*-8), 2.22 (s, 6, N $(CH_3)_2$, 1.50-2.00 (m, 6, *H*-5, *H*-6 and *H*-7).

2-(4- Fluorophenyl)-3- (2N-pyrrolidinoethoxy)-2, 4, 5,6,7,8-hexahydrocyclohepta (C) pyrazole (XVII)

Similar treatment of XIV with 2-N-chloroethyl pyrrolidine hydrochloride gave XVII in 70% yield; NMR (CCl_4), 7.28 δ (s, 5, Ar*H*), 3.82 (t, J=6.0, 2, OCH_2), 2.66 (t, J=6 0, 2, OCH_2 CH_2N), 2.25 -2.83 (m, 8, *H*-2', *H*-5', *H*-4 and *H*-8), 1.50-2.0 δ (m, 10, *H*-3', *H*-4', *H*-5, *H*-6 and *H*-7).

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REFERENCES

Rastogi, S. N. 1971. *Ph. D. Thesis*, Agra Uni. p. 16

Munshi, K. L., Kapil, R. S. and Anand, N. 1971. *Unpublished work*, CDRI, Lucknow.

Hesse, G, and Urbanek, F. 1958. *Chem, Ber.*, 91, 2733.

Melnikov, N. N. 1971, *Chemistry of pestlcides* p 196–7 Spinger-Verlog-Ed, F. A. Gunther.

Treibevon, W. and Neupert, H. J. 1955, *Ann.* 595, 219.

Buchta, E. and Krang, J. 1955. *Angew Chem.*, 67, 77.

Malik,O. P., 1973, *Ph.D. thesis*, Meerut Univ. p. 60

Silverstein, R. M. and Bassler, G. C. 1967. *spectroscopic identification of organic compounds* p 145, 209. New York, John Wiley & Sons INC

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BUILT-UP OF ALDRIN RESDUES IN SOIL AFTER ITS REPEATED APPLICATIONS FOR FIVE YEARS

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ABSTRACT

Long term field experiments were conducted from 1973-74 to 1977-78 in order to know the extent of aldrin residue built-up in soil when applied @ 1.87, 3.75 and 5.62 kg a.i./ha twice a year at sowing time of moong in *kharif* and wheat in *rabi*. Thus, in overall 10 applications @ 18.7, 37.5 and 56.2 kg a.i./ha were given in the same plot during a period of 5 years. The residue studies conducted in the last 1.5 year period revealed that built-up of residues was rather negligible under tropical conditions of Haryana State. Aldrin residue in soil at the end of five year period varied from 0.2 to 0.53 ppm. Field experiments conducted for five years as well as a pot-culture experiment conducted in *rabi* 1977-78 showed that aldrin dissipated from 44 to 60% in 2.5 to 6 months.

Aldrin, an organo-chlorine insecticide, has been reported to be highly effective against a variety of soil inhabiting pests. It may, however, persist in soil for considerable period and, thus, may adversely affect the soil fertility through its toxic action on soil microflora. The parent compound and its metabolites also get percolated into drainage water and, thus, pollute the sub soil water. Further, the toxicant may also be absorbed by the crops grown on treated soils and, thus, pose health hazards to human beings and animals.

Dissipation pattern of aldrin has been found to be quite different under tropical (Agnihotri *et al*, 1974, Gupta 1976) and temperate (Edwards, 1966) conditions. Since no information was available regarding its dissipation pattern under Haryana agro climatic conditions, it was, therefore, thought imperative to conduct studies on built-up of aldrin residues in soil under prevailing climatic conditions at Hissar.

MATERIAL AND METHODS

Field experiments were conducted in randomized block design at Research Farm of Haryana Agricultural University, Hissar, from *kharif* 1973-74 to *rabi* 1977-78. Three different treatments of aldrin, i. e., 1.87 kg, 3.75 kg and 5.62 kg a. i./ha were studied from the point of view of persistence of aldrin is soil. The application of each treatment were

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given every year, i. e., once before sowing of moong in *kharif* and then before sowing of wheat in *rabi*. In this way, same plot (50 sq. M) received 10 applications during a period of five years. In other words, a total amount of 18.7, 37.5 and 56.2 kg a.i./ha was added to the same plot in 10 applications. The insecticides after application was thoroughly incorporated in soil upto a depth of 10–15 cm before sowing of each crop.

Simultaneously, a pot-culture experiment was also conducted in *rabi* 1977-78 to know the extent of aldrin persistence in soil and its absorption by the wheat roots, straw and grains. Aldrin treatment was given in soil @ 1.87 kg a.i./ha before sowing of wheat. The soil as well as plant part samples were taken at different time intervals and processed for estimation of aldrin residues.

Entomological observations were taken throughout the experimental period but due to lack of facilities for residue studies, samples could not be analysed for the first three and half year period. Investigations pertaining to persistence of aldrin in soil were carried out for the last three crop seasons, i. e., from *rabi* 1976–77 to *rabi* 1977–78.

Sampling

Soil sampling for the first time was done in July 1977 before making insecticidal application for moong to know the extent of comulative residues resulting from the previous applications beginning from *kharif* 1973–74. Soil samples in the remaining experimental period were drawn in October 1977, i. e., harvest time of moong, November 1977 and May 1978 corresponping to sowing and harvesting times of wheat, respectively. The samples were taken from a depth of 10–15 cm at 5-6 places from each replicate and representative samples of about 1 kg each were air dried, ground and sieved through 2 mm sieve. After quartering, 100 gm soil sample was processed for estimation of aldrin residues.

From pot-culture experiment, the soil samples were drawn from the vicinity of the plant roots upto a depth of 10–15 cm at different time intervals and processed in a similar manner described above. Additionally, wheat roots, straw and grain samples were also processed for knowing translocation of aldrin into wheat plant parts.

Extraction of samples

Representative samples of soil (100 gm), wheat roots (2-4 gm), straw (10 gm) and grain (5 gm) were extracted with mixture of hexane and acetone (4 : 1) by shaking the sample in a conical flask on a rotary shaker for one hour. A suitable aliquot of the extract was washed thrice with 4% Na_2SO_4 aquous solution to remove acetone. After making a definite volume hexane extract was stored in deep freezer waiting for further analysis.

Analysis of extracts

The hexane extracts were cleaned up following technique of Kathpal and Dewan (1975). The residues were then estimated colorimetrically by phenyl azide method (Danish and Lidov, 1950; O' Donnel *et al*, 1954).

Recovery experiments

For recovery experiments, known quantities of soil samples were fortified

TABLE 1

Percentage recoveries of aldrin from fortified soil

Sr. No.	Amount of aldrin added (μ g)	Amount recovered (μ g)	Average recovery* (%)
1.	15.0	16.05	103.00
2.	25.0	27.48	110.00
3.	50.0	41.79	84.00
		Average of average recoveries	99.00

*Average of three replicates.

TABLE 2

Residues of aldrin after 8th and 9th applications in soil*

S No.	Dose a.i. (kg)/ha	Days after application	Residues (ppm) R_1	R_2	R_3	Av. residues	Cover crop
			Residues after 8th application				
1.	1.87	243	BDL	BDL	BDL	BDL	Wheat
2.	3.75	243	BDL	0.22	BDL	0.07	,,
3.	5.62	243	0.23	0.64	0.21	0.36	,,
			Residues after 9th application				
4.	1.87	98	0 26	0.27	0.25	0.26	Moong
5.	3.75	98	0.84	0.54	0.54	0.64	,,
6.	5.62	98	1.17	1.04	1.25	1.15	,,

*8th and 9th applications were given on 19.11.76 and 20.7.77 respectively.
BDL=Below detectable level.

TABLE 3

Deposits and residues of aldrin in soil after 10th application*

S. No.	Dose a.i. (kg)/ha	Days after application	Deposits/residues (ppm) R_1	R_2	R_3	Av. residues (ppm)	Reduction (%)	Cover crop
			Cumulative deposits (Soon after 10th application)					
1.	1.87	0	0.46	0.31	0.55	0.44	—	Wheat
2.	3.75	0	1.14	0.26	0.55	0.65	—	,,
3.	5.62	0	1.81	0.22	0.79	0.94	—	,,
			Cumulative Residues (After 174 days of 10th application)					
1.	1.87	174	0.25	1.16	0.19	0.20	54.54	,,
2.	3.75	174	0.36	0.50	0.21	0.36	44.61	,,
3.	5.62	174	0.53	0.43	0.62	0.53	43.61	,,

*10th application was given on 8-11-77.

with varying concentrations of aldrin, kept for 24 hours, extracted with mixture of hexane and acetone and processed in the way described above. As evident from Table 1, the recoveries of aldrin ranged from 84.0 to 110.0% with an average of 99.0 per cent.

Meterological data prevailing during experimental period have been given in Table 5.

RESULTS AND DISCUSSION

Long term field experiments

The analytical data obtained by analysis of soil samples collected in July 1977, i. e., before sowing of moong where fresh soil application had been given in November 1976, i. e., before sowing of wheat are given in Table 2. The cumulative aldrin residues resulting from 8 applications given so far was below detectable level at lowest treatment, i. e., 1.87 kg a. i./ha, whereas the average residues were 0.07 and 0.36 ppm corresponding to 3.75 and 5.62 kg a.i /ha, respectively. In other words, aldrin residues 243 days after the 8th application corresponding to above 3 treatments were not detectable at 1.87 kg a.i./ha level while at higher doses the residues ranged from 0.07 to 0.36 ppm.

The data pertaining to soil samples, collected 98 days after 9th application, made immediately before sowing of moong in July 1977 are given in Table 2. The average amount of aldrin residues found in soil were 0.26, 0.64 and 1 15 ppm at the harvesting of moong in October 1977 i. e., 98 days after fresh (9th) application of aldrin. The residue figures obtained after a lapse of 98 days after 9th application were much higher in comparison to the amounts remaining 243 days after 8th application. The slow rate of degradation might have been due to comparatively low temperatures prevailing during a period of 98 days in comparison to 243 days after 8th application. Cumulative aldrin deposits and residue built-up have been given in Table 3. Cumulative deposits which include residues from the previous 9 applications and deposits from the 10th application given in November 1977 were 0.44 ppm, 0.65 ppm and 0.94 ppm corresponding to 1.87, 3.75 and 5.62 kg a. i./ha treatments, respectively. The final residues of aldrin, 174 days after the 10th application, were 0.20, 0.36 and 0.53 ppm, showing thereby, a reduction of about 44 to 55 per cent. In other words, about 45 to 56% of the cumulative deposits persisted after lapse of about 6 month period.

Pot-culture experiment

The residue data pertaining to pot-culture experiment are given in Table 4. The soil samples immediately after the soil treatment @ 1.87 kg a.i./ha contained 1.44 ppm average deposits which dissipated by about 60% in 70 days and the corresponding residues found were 0.45 ppm.

Absorption of aldrin by the wheat roots also occurred. Average residues in 33-day-old wheat roots were as high as 4.33 ppm which dwindled down to 0.64 ppm after 70 days and below detectable level after 164 days, i. e., harvest of wheat. The wheat straw as well as grain samples pertaining to harvest stage did not contain any detectable residues. FAO (1972) tolerance level for aldrin and dieldrin singly or together for various food commodities varies from .02 to 0.2 ppm.

TABLE 4

Residues of aldrin in soil and its translocation into wheat plant and grains (Pot-culture experiment)

S. No.	Dose a.i. (kg)/ha	Days after application	Deposits/residues (ppm) R_1	R_2	R_3	Av. residues (ppm)	Reduction (%)
			Soil				
1.	1.87	0	1.02	1.31	1.09	1.14	—
2.	,,	17	0.70	0.93	0.98	0.87	14.91
3.	,,	33	0.35	0.60	0 56	0.50	56.14
4.	,,	70	0.35	0.63	0.36	0.45	60.50
			Wheat roots				
5.	,,	33	—	—	—	4.33	—
6.	,,	70	—	—	—	0.64	85.22
7.	,,	164	BDL	BDL	BDL	BDL	100.00
			Straw (At harvest)				
8.	,,	164	—	—	—	BDL	—
			Grains (At harvest)				
9.	,,	164	—	—	—	BDL	—

BDL=Below detectable level.

TABLE 5

(METEOROLOGICAL DATA DURING THE EXPERIMENTAL PERIOD (1796 DAYS)

a-Temperature (°C)

Frequency distribution of different temperature ranges during the period of experimentation

Temp. Range	Occurrence (days) and per cent Max. Temp.	%	Min. temp.	%
-4-0	—	—	27	1.50
1-5	—	—	302	16.82
6-10	—	—	300	16.70
11-15	7	0.39	214	11.92
16-20	139	7 74	226	12 53
21-25	309	17.20	499	27.78
26-30	260	14.48	10	0.56
31-35	531	29.57	—	—
36-40	368	20.49	—	—
41-45	175	9.74	—	—
46-47	7	0 39	—	—
Total	1796	100.00	1796	100.00

Mean daily temperature : Max. 31.5°C; Min. 15.5°C

b-Relative humidity (%) :

Overall daily range : Morning 41-92; Evening 17-81

Overall daily Mean : Morning 61.9; Evening 47.1.

C-Rainfall (mm)

Period	Rainfall
July, 1973—June, 1974	272
July, 1974—June, 1975	269
July, 1975—June, 1976	514
July, 1976—June, 1977	830
July, 1977—May, 1978	469
Total	2354

A perusal of the data given in Tables 2 and 3 reveal that the aldrin residues resulting from continual applications (under field conditions) were rather negligible This can be seen from the data given in Table 2 where the residues corresponding to 1.87 kg/ha treatment 243 days after the 8th application were below detectable level while from higher doses, i. e., 3.75 kg and 5.62 kg the figures were .07 and 0.36 ppm, respectively. Similarly, residues after 9th and 10th applications were also very low. Considering the total amounts of aldrin added through 10 applications, i. e., 1.87, 37.5 and 56.2 kg a.i./ha the residue built-up to the extent of 0.20 to 0.53 ppm at the end of a 5 year experimental studies were negligible (Table 3).

The data on dissipation of aldrin from soil in pot-culture experiment @ 56 to 60% in 33-70 days (Table 4) and 44-55% in 174 days under field conditions (Table 3) showed that the loss was more rapid during initial stages than at later stages of insecticidal application. However, the loss of aldrin was slightly more from pot-culture experiment than field experiment. This probably was due to more plant population under field conditions which depressed the loss of aldrin through volatilization by giving a thorough coverage to the soil.

From the foregoing discussion it is evident that built-up of aldrin residues from continuous 10 applications was very low. The possible reasons of rapid loss of aldrin might have been (i) conversion to dieldrin, photo dieldrin and photoaldrin which could not be estimated because of lack of facilities (ii) extreme meteorological conditions (Table 5) in winter, summer as well as rainy seasons must have enhanced losses due to volatilization, hydrolysis and other chemical processes, (iii) time lapse between harvesting of wheat and sowing of moong crop during which land remained fallow and fully exposed to extremely hot and rainy conditions which were very conductive for degradation of pesticides, (iv) microbial degradation and (v) loss due to uptake by wheat as well as moong crops.

The results obtained in the present investigations seem to be in agreement with the findings of other workers, namely, Agnihotri *et al*, (1974C), Gupta *et al*, (1976) and Agnihotri *et al*, (1977), who reported that more than 80% aldrin and dieldrin residues dissipated from soils in 4–5 months and that aldrin got converted into dieldrin under tropical northern Indian conditions. Contrary to the above reports, dissipation of aldrin and dieldrin under temperate conditions was comparatively much slower. Edwards (1966) showed that it took about 3 years for aldrin and 8 years for dieldrin for 95% dissipation in soil under temperate conditions.

It can be concluded from the present investigations that continuous soil application of aldrin @ 1.87 and 3.75 kg a.i./ha for five years did not result in built-up of very high residues which could actually or potentially be harmful. The use of aldrin under tropical conditions of Haryana can, therefore, be recommended at large scale without any fear of health hazards.

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REFERENCES

Agnihotri, N. P., Pandey, S. Y. and Jain, H. K. 1974 C. Persistence of BHC and aldrin in soil and translocation in Moong and Lobia *Indian J. Entomol.* 36 : 261-68.

Agnihotri, N. P., Pandey, S. Y., Jain, H. K. and Srivastava, K. P. 1977. Persistence of aldrin, dieldrin, lindane, heptachlor and P, p'-DDT in soil. *J. Entomol. Res.* 1 : 89-91.

Danish, A. A. and Lidov, R. E. 1950. Colorimetric method for estimating small amounts of aldrin (Compound 118). *Anal. Chem.* 22 : 702-06.

Edwards, C. A. 1966. Insecticide residues in soils. *Residue Rev.* 13 : 83-132.

FAO/WHO 1972. Pesticide residues in food. *WHO Technical Report Series No.* 52 : 30.

Gupta, H. C. L., Kushwaha, K. S., Kavadia, V. S. and Srivastava, B. P. 1976. *Aldrin residues in soils and its translocation in maize and bajra raised on treated soil.* Proc. All India Symp. "Modern concepts of plant protection". University of Udaipur, Udaipur, p. 78-79.

Kathpal, T. S. and Dewan, R. S. 1975. An improved clean-up technique for the estimation of residues of endosulfan and endrin. *J. Assoc. Off. agric. Chem.* 58 : 1076-78.

O'Donnel, A. E., Neal, M. M., Weiss, F. T., Bann, T. M., Decine, T. J. and Lau, S. C. 1954. Chemical determination of aldrin in crop materials. *J. agric. Food. Chem.* 2 : 573-80.

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AVAILABLE MICRONUTRIENT STATUS AND THEIR RELATIONSHIP WITH SOME CHARACTERISTICS OF THE ARID BROWN SOILS OF HARYANA

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ABSTRACT

Two hundred soil samples were collected from 9 blocks of Rohtak district from arid brown soils. The relationship worked out between various physico-chemical characteristics and available micronutrients indicated that Zn had a positive relationship with P, Cu, Fe and O. C. Iron, Zn, Cu and Mn were negatively related with pH. Copper had a positive relationship with O. C., $CaCO_3$, Zn, Fe and Mn. Multiple regression equation showed that pH, E. C., O. C., $CaCO_3$, P, Fe and Mn accounted for 63% of variability of Cu. Iron had a positive relation with Zn, Mn, Cu and O. C. Like Cu, 53% of the Fe variability was explained by all these factors as observed from regression equation. Manganese was positively related with O. C., $CaCO_3$, Zn, Cu and Fe and 29% variability of Mn was explained by these factors. Soils were sufficient in Cu, Mn and Fe. Zinc was deficient in 89% soils and Zn application was a must for optimum yield.

The importance of micronutrients as plant nutrients is well established and responses in fruit and field crops are not unknown. There is no systematic survey of the micronutrient status of arid brown soils of Haryana, and the details of the soil factors which may limit crop yield is lacking. The present investigation was, therefore, planned to estimate the contents of different micronutrient cations; their relationship with some soil properties, and to delineate areas of their deficiency and sufficiency of arid brown soils of Haryana.

MATERIAL AND METHODS

Two hundred surface soil samples (0-15 cm depth) representing 9 blocks of district Rohtak were collected. The villages in a block were randomly selected and their number varied with the size of a block. The sites close to the roads were avoided and every precaution was taken while collecting the samples which were necessary for micronutrient research work.

The samples were air-dried and ground in a wooden pestle and mortar and sieved through a 2 mm stainless steel sieve. The samples were analysed for pH, E. C. (both in 1:2 soil : water), O. C. and $CaCO_3$ content by conventional methods as described by Jackson (1958). Available P was determined by Olsen *et al.* (1954) method. Available Zn, Cu, Mn and Fe were determined

with DTPA (pH 7.3) extractant according to the procedure of Lindsay and Norvell (1978). The micronutrient cations in the soil extracts were determined on AA-120 techtron atomic absorption spectrophotometer. Correlation studies of soil properties with the micronutrient cations were worked out statistically.

RESULTS AND DISCUSSION

Physico-chemical characteristics

Block-wise distribution of physico-chemical characteristics of the arid brown soils of Rohtak district along with their available Zn, Cu, Fe and Mn in the form of range and average values are presented in Table 1 and 2, respectively. A perusal of the data in table 1 show that the soil pH and E. C. varied from 7.3 to 9.4 and 0.10 to 11.00 with mean values of 8.1 and 0.89, respectively.

The organic carbon content in the soils under study ranged from 0.06 to 0.78% with a mean value of 0.30 per cent. In general, organic carbon content in most of these soils was low as a result of sparce vegetative cover and rapid oxidation of organic matter facilitated by the prevailing high temperature conditions.

The calcium carbonate content in these soils ranged from 0.10 to 7.20% with average value of 1.09 per cent. These soils were calcareous in nature. The block-wise categorization of samples indicated that average $CaCO_3$ content was higher in soils of Beri, Kalanaur and Meham blocks. The soils of these blocks being sedimentary had relative plenty of salts in their matrix.

The available P content varied from 4 to 82 kg/ha. with a mean value of 21 kg/ha. The available P status of Jhajjar, Salhawas, Kalanaur, Nahar and Rohtak blocks was low to medium and would require P fertilization for good crop yields.

Available Micronutrient Cations and their relationship

Zinc. The available soil Zn content ranged from 0.05 to 2.85 ppm with a mean value of 0.63 ppm. However, taking the critical limit of 1 ppm DTPA extractable Zn as suggested by Singh (1973) 89% of the soil samples fall in the category of deficient and would require Zn fertilization for the maximum economic yields of crops in arid brown soils of Rohtak district.

The average content of available Zn showed that the soils of Kalanaur, Rohtak, Sampla and Bahadurgarh were deficient; those of Meham, Nahar, Beri and Salhawas were marginal and soils of Jhajjar block were adequate in Zn.

From the simple correlation studies, it was observed that there existed a significant positive correlation of available soil Zn with P (0.18**), Cu (0.27**), Fe (0.36**) and Mn (0.25**). The close similarity of pH, EC, $CaCO_3$ and organic carbon content of the soils under study seems to be responsible for the observed lack of correlation between available Zn with these soil properties. These results are in consonance with the observation of Rai *et al.* (1972) and Vittal and Gangwar (1974).

To find out the partial contribution of soil P, Cu, Fe and Mn in the determination of available soil Zn, multiple regression equation was fitted, i.e.,

TABLE 1

Soil characteristics of different blocks of arid brown soils of Rohtak district

Block	No. of samples	Soil properties									
		pH		EC		O C.		$CaCO_3$ (%)		P(kg ha)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bahadurgarh	19	7.5—9.0	8.2	.10—6.00	1.14	.12—.51	.30	.20—2.20	.58	10—50	27
Beri	24	7.3—8.6	8.1	.14—5 50	.84	.21—.73	36	.50—7.20	1.85	4—74	25
Jhajjar	25	7.3—8.7	8.1	.21—2.20	.56	.15—.66	28	.20 - 2.00	.78	5—44	15
Kalanaur	12	8.1—8.6	8.4	.14—1.02	.29	.18—.36	.27	.20—3.70	1.76	15—32	20
Meham	18	7.6—8.4	8.0	.16—5.00	.61	.15—.55	.30	.20—5.20	1.36	7—82	24
Nahar	10	8.0—8.5	8.2	.17—.75	.27	.06—.36	.12	.20—3.70	.36	15—32	20
Rohtak	50	7.3—8.5	8.0	.17—4.00	.91	.12—78	.39	.20—5.20	.96	7—60	20
Salhawas	25	7.6—8.9	8.1	.12—3.25	.50	.06—.45	.18	.10—6.00	.90	9—30	18
Sampla	17	7.6—9.4	8.2	.21—11.00	2.51	.10—48	.29	.20—3 00	.79	10—63	27
Average		7.3—9.4	8.1	.10—11.00	.89	.06—.78	.30	.10—7.20	1.09	4—82	21

TABLE 2

Available Zn, Cu, Fe and Mn of different blocks of arid brown soils of Rohtak district

Block	No. of samples	Zn		Cu		Fe		Mn	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bahadurgarh	19	.05—.90	.52	.40—3.70	2 10	3.42—33.06	17.58	6—94	42
Beri	24	.20—1.40	.68	1.10 - 5.00	2.25	5.32—40.28	17 45	12—98	55
Jhajjar	25	.65—2 85	1.05	.40—3.40	1.40	6.08—41.80	17.37	17—68	36
Kalanaur	12	.15—.70	.33	.50—1.80	1.09	3.80—12 54	6.81	8—14	11
Meham	18	.15—1.35	.61	.90—2.90	1.86	6.40 - 45.42	20.59	26—98	81
Nahar	10	.40—1.10	.62	.20—1.30	.51	5.32—20 52	7.41	8—38	17
Rohtak	50	.50—2.10	.46	.45—6 70	1.90	3.80—39.00	15.77	8 - 98	38
Salhawas	25	.25—1.40	.77	.20—2.80	.92	3.42—35.72	14 95	6—80	19
Sampla	17	.10—1 40	.51	.80—3 90	1.94	5.32—34 20	13 90	11—90	37
Average		.05—2.85	.63	.20—6 70	1 66	3.42—45.42	15.51	6—98	38

Soil available Zn=.3423−.0054 pH+ .0111 E. C. − .5012 O. C.+.0153 $CaCO_3$ +. 002 P + 0.54 Cu + .0125** Fe + .001 Mn.

The above equation indicated that these factors played a significant role in the determination of available soil Zn as 16% of the variability in soil Zn was explained by these factors.

From comparative study of partial regression coefficient, only Fe showed significant contribution in the determination of Zn, while remaining factors showed non-significant contribution which implies that Fe was the major nutrient in these soil which influenced the available soil Zn value.

Copper. The available Cu content ranged from 0.20 to 6.70 ppm, with an average of 1.66 ppm. Lindsay and Norvell (1978) reported 0.2 ppm Cu (DTPA-extractable) as critical limit. Thus, soils of all the blocks of Rohtak district were adequate in Cu (Table 2) and there was no problem of Cu deficiency in these soils. A highly significant positive relationship (Table 3) between available Cu and O.C. (.70**), $CaCO_3$ (.34**), P (.36**), Zn (.27**), Fe (.60**) and Mn (.38**) suggested that all these soil factors affected the availability of Cu in the soils under investigation. But the influence of O. C. and Fe was much higher than that of other soil properties. The presence of organic matter seems to have increased the availability of Cu by supplying soluble complexing agents that reduced Cu fixation. No doubt, the content of O. C. was low in these soils, still the nature of metallo-organic complexes of Cu could be such that might have contributed a major portion of the available Cu pool in these soils. The results are in confirmity with those of Grewal *et al.* (1969).

The predictability of soil available Cu, as influenced by various factors studied is given by the regression equation :

Soil Cu = −2.059+.209 pH+.063 O.C.** +.068 $CaCO_3$+.088 P + .150 Zn + .024 Fe** + .004 Mn**.

These factors accounted for 63% of the variability in soil Cu covering to the simultaneous influence of these soil character. However, the partial regression co-efficient in the above equation indicates the dominant influence of organic matter and available Fe on Cu.

Iron. Available Fe was high in all soils (Table 2). It fluctuates between 3.42 to 45.52 ppm with an average of 15.51 ppm. All the soils were sufficient in Fe (Lindsay and Norvell, 1978). Simple correlation studies (Table 3) indicated a highly significant positive correlation wtih soil O. C. (.51**), P (.31**), Zn (.36**), Cu (.60**), and Mn (.49**) were observed. Pathak *et al.* (1979) also reported a positive relationship between O. C. and Fe. A significant positive relation of available Fe with O. C. (r=.51**) indicated that like Cu, the availability Fe in these soils was also influenced largely by the organic matter content. There was negative relationship between pH and Fe, Shukla *et al.* (1975) also reported similar results.

The combined influence of various soil characters on the predictability of available soil Fe is given in the regression equation :

TABLE 3

Coefficient of correlation ('r' values) between some pertinent properties and available Zn, Cu, Fe and Mn of arid brown soils of Rohtak district

Characteristics	pH	EC	O. C.	$CaCO_3$	P	Zn	Cu	Fe	Mn
				'r' values					
pH	*	—.218**	—.170**	.090	.007	—.002	—.028	—.091	—.031
E. C.	*	*	.088	.001	.079	.042	.126	—.025	.057
O. C.	*	*	*	.376**	.257**	.128	.701**	.507*	.209*
$CaCO_3$	*	*	*	*	.129	.082	.344**	.112	.136*
P	*	*	*	*	*	.181**	.365**	.309*	.079
Zn	*	*	*	*	*	*	.271**	.357	.254**
Cu	*	*	*	*	*	*	*	.602**	.383**
Fe	*	*	*	*	*	*	*	*	.487**
Mn	*	*	*	*	*	*	*	*	*

**Significant at 1 per cent level.

Soil Fe $= 8.196 - 1.017$ pH $- .864$ EC* $+$ 17.61 O. C.** $- 1.122$ $CaCO_3$** $+ .081$ P* $+ 4.005$ Zn** $+ 2.796$ Cu** $+ .093$ Mn**.

From the above equation, it was observed that these soil factors played a significant role in the determination of soil Fe as 53% of the variability in Fe was explained by these factors.

However, from comparative study of partial regression coefficient, O. C., Mn, Cu, Zn and P showed positive significant contribution and E. C. and $CaCO_3$ content exhibited negative significant contribution of determination of soil Fe.

Manganese. The available Mn content varied from 6 to 98 ppm with a mean value of 38.36 ppm. According to Lindsay and Norvell (1978) all the arid brown soils of Rohtak district were sufficient in available Mn.

From the simple correlation studies, it was found that there existed a significant positive correlation of available Mn with O. C. (.21**), $CaCO_3$ (.14*), Zn (.25**), Cu (.38**) and Fe (.49**). To find out the partial contribution of these soil characters in determining available Mn multiple regression equation was fitted, i.e., Available Mn $= 23.618 - .869$ pH $- 1.309$ E. C. $- 46.443$*, O. C. $- 2.237$ $CaCO_3 - .279$ P $+ 5.850$ Zn $+ 7.535$ Cu* $+$ 1.433 Fe**. From the above equation, it was observed that these soil factors played a significant role in the determination of available Mn as 29% of the variability in soil manganese by these factors.

From comparative study of partial regression coefficient, only Fe, Cu and organic matter exhibited significant contribution in determining Mn, while remaining soil factors showed non-significant contribution. But available Fe was the major soil factor influencing available soil Mn values.

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REFERENCES

Grewal, J. S., Bhumbla, D. R. and Randhawa, N. S. 1967. Available micronutrients status of Punjab, Haryana and Himachal Pradesh soils. *J. Indian Soc. Soil Sci.* 17 : 27-33.

Jackson, M. L. 1958. *Soil Chemical Analysis.* Prentice Hall Inc. Englewood Cliffs, N. J. (U.S.A).

Lindsay, W. L. and Norvell, W. A. 1978. Development of DTPA soil test for Zn, Fe, Mn and Cu. *Soil Sci. Soc. Amer. J.* 42 : 421-428.

Olsen, S. R., Watanabe, C. V., F. S. and Dean, L. A. 1954. *Estimation of available phosphorus in soils by extraction with* sodium bicarbonate. U.S.D.A. Cir. 939 : 1-19

Pathak, A. N., Tiwari, K. N. and Prasad, D. D. 1979. An appraisal of available and potentially available iron status of Alluvial soils of U. P. *J. Indian Soc. Soil Sci.* 27 : 191-193.

Rai, M. M., Pal, A. R., Chimania, B. P., Shitoley, D. B. and Vakil, P. 1972. Available micronutrient status of shallow black soils of M.P. *J. Indian Soc. Soil. Sci.* 20 : 129-134.

Singh, Ram Mehar 1973. M. Sc. Thesis, Haryana Agricultural University, Hissar.

Shukla, U. C., Gupta, B. L. and Singh, R. 1975. Available and potentially available forms of Fe and Mn in surface arid brown soils of Haryana. *J. Indian Soc. Soil. Sci.* 23 : 484-488.

Vittal, K. P. R. and Gangwar, M. S. 1974. Zinc in soil profiles of Nainital tarai. *J. Indian Soc. Soil Sci.* 22 : 151-155.

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DISTRIBUTION AND RELATIONSHIP OF MICRONUTRIENTS WITH SOIL PROPERTIES OF SOILS OF SOUTH WESTERN HARYANA

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ABSTRACT

Six soil profiles in south-western Haryana did not show any consistent trend in distribution of DTPA extractable Zn, Cu, Mn and Fe content, due to alluvial nature of soil. Available Zn and Cu was significantly correlated with organic carbon and clay. Organic carbon was found to be the main factor regulating Mn content in soil. Soil pH had negative relationship with the availability of Zn, Cu and Mn. There was significant positive correlation of Zn with Cu, Mn and Fe. Copper was significantly correlated with Mn and Fe.

The forecasting of micronutrient deficient areas can be improved considerably if important soil characteristics are considered with soil test values. Among these, soil texture, organic carbon, pH, $CaCO_3$ and available P possibly influence the distribution of micronutrient cations in soils. Thus, present investigation was undertaken with the following objectives ;

(i) To study the depth-wise distribution of Zn, Cu, Mn and Fe in soils; and

(ii) To work out the association of some soil properties with micronutrient cations.

MATERIAL AND METHODS

In order to correlate the relationship between soil properties and available micronutrients, 6 soil profiles were exposed in south western region of Haryana. The micronutrient cations and other soil properties were determined depth-wise. Sand, silt and clay were analysed by international pipette method, organic carbon by dichromate oxidation (Walkey and Black, 1934) and pH in 1 : 2 soil water suspension with Beckman pH meter, using glass electrode, $CaCO_3$ was determined by Puri's (1949) rapid titration method and E. C. by conductivity meter. Zinc, Cu, Mn and Fe were extracted as described by Lindsay and Norvell (1978) and determined on Atomic Absorption Spectrophotometer. The micronutrient content of different depths was correlated with pH, organic carbon and clay per cent. Soils were classified upto family level according to Soil Taxonomy, 1975.

RESULTS AND DISCUSSION

It is evident from data (Table 1) that pH ranged from 8.0 to 9.3, $CaCO_3$ ranged from 0 to 37.4 per cent. Organic

carbon was in the range of 0.03 to 0.49% and clay content varied between 2.6 and 59.2 per cent.

Distribution of micronutrient cations

It is apparent from data (Table 2) that distribution of micronutrients in various profiles did not follow any typical pattern. The results are contrary to the findings of Lal and Biswas (1974), who reported uniform distribution of Mn, Fe and Cu in old alluvial soils of Rajasthan. In present study, each profile had typical trend pertaining to micronutrient status with increasing depth, viz.,

(i) no consistent pattern of distribution for available zn;

(ii) available Cu in some profiles showed increasing tendency with depth, while in others the trend was reverse; and

(iii) whereas available Fe and Mn either decreased with depth or remained unaltered.

This irregular pattern of distribution might be related to alluvial nature of these soils. The variations in the properties of deposited material might have caused the inconsistent pattern of available micronutrients distribution.

Correlations

The R^2 value (Table 3) between available micronutrients and various soil properties indicated that available Zn was significantly and positively correlated with organic carbon and clay. This was due to the reason that in both components, Zn was present in the structural composition as well as on the exchange complex in the readily available form. The higher R^2 value with organic carbon against organic carbon and clay collectively was due to the fact that Zn content of soil organic fraction was more than that of inorganic fraction and on decomposition it contributed significant amount of Zn to the available pool of soil.

Available Zn was dominantly linked with organic Carbon. Mishra ane Pandey (1976) reported similar relationship in U. P. soils Available Cu was evenly influenced by organic carbon and clay. The predictability of Cu availability improved remarkably when organic matter and clay were considered together. Rai and Mishra (1967) recorded a significant positive correlation between organic matter and exchangeable Cu. Organic Carbon had a significant positive relationship with Mn and appeared to be the main factor regulating the available Mn in soils. Basu *et al*, (1964) reported that Mn from humic acid fraction of soil was released more quickly, consequently increasing the availability of Mn. The R^2 values increased when organic carbon and pH; and pH, organic carbon and clay were considered together.

Clay predominantly influenced the availability of Fe. The predictability of Fe availability improved considerably if pH, Organic Carbon and clay were taken together. Shukla *et al.* (1975) also reported a negative relationship between pH and available Fe and a positive relationship between organic carbon and available Fe. None of the micronutrient Cation had significantly correlation with per cent $CaCo_3$ ($\angle$.08). A similar relationship was also observed by Singh and Ram (1975) and Mishra Pandey (1976).

TABLE 1

Physico-chemical characteristics of different soil profile of south-western Haryana

Depth (cm)	pH (1:2)	EC (mmhos/ cm 1:2)	$CaCO_3$ (%)	O.C	Sand	Silt	Clay
					(%)		
1	2	3	4	5	6	7	8
			Kirtan				
			(Typic Camborthid)				
0—20	8.3	0.35	7.5	0.29	74.0	13.6	12.4
20—40	8.6	0.22	12.5	0.20	55.4	29.8	14.8
40—65	8.6	0.20	13.8	0.15	62.4	22.6	16.0
65—105	8.5	0.28	12.7	0.10	51.6	32.6	15.8
105—135	8.4	0 45	17.8	0.08	40.0	38.0	22.0
135—160	8.3	0.95	15.4	0.07	54 4	17.6	28.0
160—185	8.0	1.90	9.0	0.04	52.0	18.0	30.0
			Mirkan				
			(Tpyic Torriorthent				
0—30	8.3	0.30	6.1	0.33	64.8	20.6	14.6
30—60	8.5	0.22	14.0	0.23	52.8	27.2	20.0
60—85	8 6	0.25	15.1	0.14	55.0	26·3	18.7
85—105	8.6	0.25	14 0	0.12	74.6	7.6	17.8
105—125	8.6	0.30	9.3	0.18	53.6	26.6	19.8
			Hansi				
			(Typic Ustochrepts)				
0—15	8.1	0.30	10.4	0.49	37.4	16.0	46.2
15—30	8.4	0.20	4.1	0.25	40.4	13.6	46.0
30—45	8.1	0.25	3.2	0.18	38.2	9.4	42.4
45—60	8.4	0.22	2.0	0.18	39.6	10.2	50.2
60—75	8.1	0.30	3.3	0.15	37.4	3.4	59.2
75—90	8.7	0.40	2.3	0.16	52.4	26.2	21.4
90—105	8.5	0.55	2.3	0.14	65.0	18.4	16.6
			Mirzapur				
			(Typic Ustifluents)				
0—15	9.0	0.35	7.21	0.13	75.2	13.4	11.4
15—30	8.8	0.40	5 6	0.22	74.4	14.8	10.8
30—60	8.8	0.20	5.2	0.06	73.2	13.8	13.0
60—90	8.2	0.32	3.1	0.21	79 0	9.2	11.8
90—120	8.7	0.20	5.1	0.06	83.6	11.2	5.2
120—150	8.7	0.25	4.7	0.07	79.8	15.8	6.4
150—180	9.3	0.50	27.5	0.10	40.8	40.4	18.8
			Balsamand cultivated				
			(Typic Torripsamments)				
0—10	8.6	0.10	0.0	0.03	94.6	2.8	2.6
10—30	8.5	0.11	0.0	0.06	94.2	2.8	3.0
30—87	8.5	0.16	1.9	0.05	95.4	0.6	4.0
87—122	8.4	0.17	2.5	0.07	94.8	2.0	3.2
122—143	8.4	0.18	5.6	0.07	93.6	3.4	3.0
143—172	8.5	0.16	4.4	0.06	92.4	2.0	5.6
			Balsamand				
			(Typic Palcorthid)				
0—16	8.4	0.14	2.2	0.13	88.4	4.0	7.6
16—40	8.2	0.18	3.6	0.15	86.2	7.4	6.4
40—63	8.2	0.23	11.1	0.16	80.0	9.0	11.0
63—82	8.1	0.21	30.5	0.16	81.2	8.2	10.6
82—138	8.4	0.22	37.4	0.08	82.6	8.0	9.4
138—170	8.5	0.21	33.0	0.07	83.2	9.1	7.4

TABLE 2

Distribution of DTPA extractable micronutrients in soils of south-west Haryana

Depth (cm)	Zinc	Copper	Manganese	Iron
		(ppm)		
(1)	(2)	(3)	(4)	(5)
		Kirtan (Typic Camborthids)		
0—20	0.56	1.00	9.08	1.19
20—40	0.24	1.00	2.40	0.85
40—65	2.40	0.90	1.68	1.02
65—105	0.40	2.10	1.92	1.70
105—135	0.84	3.50	3.12	1.70
135—160	1.44	3.50	3.12	1.70
160—185	0.36	1.00	1.44	1.19
		Mirkan (Typic Torriorthent)		
0—30	0.64	1.70	5.52	1.70
30—60	0.84	1.50	3.60	1.36
60—85	0.72	1.60	2.88	1.02
85—105	0.48	0.90	1.44	0.85
105—125	2.92	6.60	4.80	1.02
		Hansi (Typic Ustochrepts)		
0—15	2.88	6.30	6.24	16.66
15—30	1.20	3.60	3.60	5.78
30—45	0.56	2.10	2.64	4.42
45—60	1.40	3.60	3.60	4.08
60—75	3.04	6.80	5.04	4.08
75—90	0.48	2.00	2.40	4.42
90—105	0.68	2.60	2.64	4.08
		Mirzapur (Typic Ustifluents)		
0—15	2.56	5.60	4.56	1.02
15—30	1.60	3.40	5.04	1.02
30—60	1.72	3.80	2.88	1.19
60—90	4.05	6·00	7.68	5.44
60—120	1.96	4.00	3.12	1.02
120—150	1.64	4.10	3.12	0.85
150—180	0.80	1.70	2.40	1.70
		Balsamand (Cultivated) (Typic Torripsamment)		
0—10	0.32	0.20	2.04	0.68
10—30	0.20	0.25	2.16	0.68
30—87	0.32	0.50	2.40	0.68
87—122	0.44	0.80	2.64	0.68
122—143	0.40	0.70	2.64	0.68
143—172	0.36	0.45	1.68	0.51
		Balsamand (Typic Paleorthid)		
0—16	0.48	0.70	4.80	0.85
16—40	0.92	1.90	3.60	0.68
40—63	1.40	2.80	4.08	0.85
63—82	1.00	2.10	3.60	0.85
82—138	0.26	0.60	2.28	0.85
138—170	1.32	2.50	2.88	0.68

TABLE 3

Relationship of available micronutrient elements with pH, O. C. and clay individually and in combination

Element	pH	Organic Carbon	Clay	pH and organic carbon	pH and Clay	Organic Carbon and Clay	pH, organic carbon and Clay
Zinc	0.002	0.25**	0.12**	0.23**	0.13**	0.24**	0.28**
Copper	0.005	0 28**	0.27**	0.29**	0.29**	0.42**	0.43**
Manganese	0.07	0.32**	0.04	0.35**	0.09	0.32**	0.37**
Iron	0.10 **	0.19**	.0.40**	0.41**	0.41**	0.45**	0.57**

**denotes significant at 5% level of significance.

The R^2 values demonstrated that available micronutrients were by and large, regulated by organic carbon and clay. None of the micronutrients under study was correlated to pH of the soil except Fe. This might be due to the narrow range of pH of these soils. The dependence of available content, irrespective of the micronutrient cations, with some common soil properties was confirmed by the highly significant positive correlations among the various micronutrients as indicated below :

Element	*'r'*
Zn–Cu	0.89**
Zn–Mn	0.56**
Zn–Fe	0.45**
Cu–Mn	0.55**
Cu–Fe	0.53**
Mn–Fe	0.39**

To illustrate further the relationship between available micronutrients, clay and organic carbon following three profiles were selected.

1. **Mirkan** (Typic Torriorthent) : In these soils large variations in organic carbon content of different depths were observed.
2. **Hansi** (Typic Ustochrepts) : The various depths of this profile varied markedly in their clay content.
3. **Balsamand** (Typic Torripsamments) : Neither clay nor organic carbon was high in various depths of this profile. Their distribution was also more or less consistent.

The wide variation in the distribution of clay and organic matter contents of different depths improved strinkingly the correlation between the available micronutrients and soil properties (Table 4). These data additionally confirmed the close association between available micronutrients, clay and organic carbon. In sharp contrast to other profiles the available micronutrients were negatively correlated with pH in these three profiles. The negative relationship of Cu, Fe, and Zn with pH was also reported by Misra and Pandey (1976) and Singh and Ram (1975).

Available micronutrient contents and clay percent of different depth were mapped (Fig. 1). These figure

TABLE 4

Correlation between available micronutrients and soil properties of 3 selected profiles

Element	'r' value		
	O. C.	Clay	pH
Zinc	0.72**	0.64*	0.45**
Copper	0.73**	0.73**	0.46**
Manganese	0.71**	0.53**	0 58**
Iron	0.38	0.62**	0.56**

**significant at 5%

revealed that in Mirkan profile the distribution of available Zn closely followed the organic carbon content. The influence of clay was negligible. On the contrary the available Zn at various depth of Hansi profile was influenced profoundly by clay percent and organic carbon had only a marginal effect. In contrast, the available Zn at various depths of Balsamand profiles was low and its distribution was more or less consistent. This behaviour was parallel to the low organic carbon and clay content of this profile and their even distribution at various depths. The fluctuations in the contents of Fe, Cu and Mn were more or less similar to zinc.

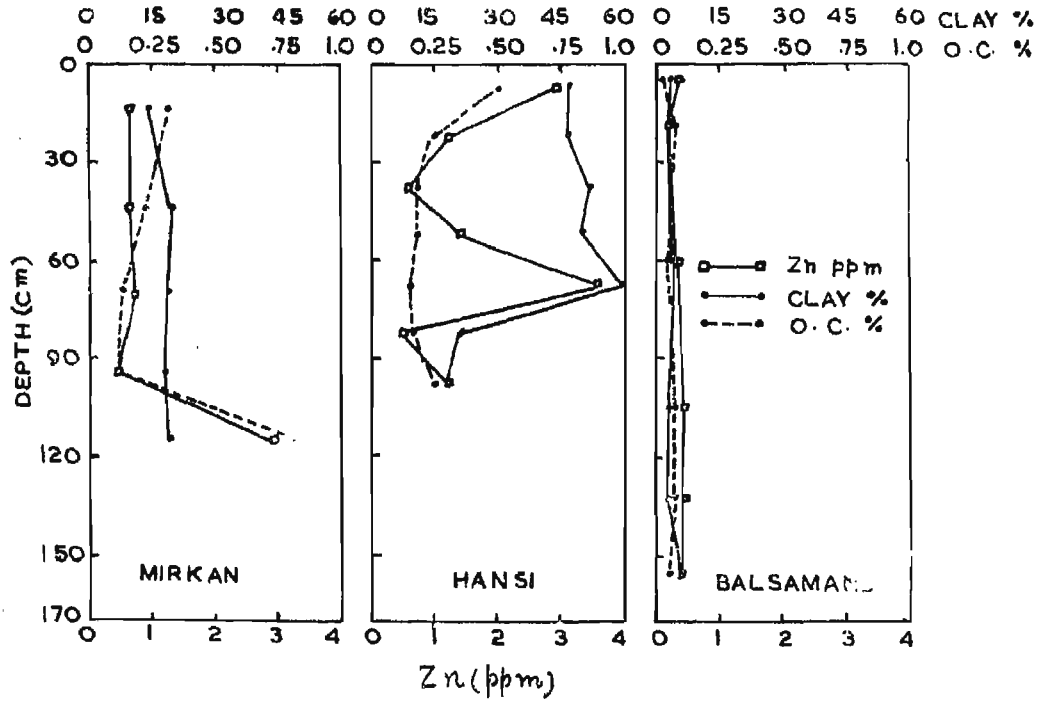


FIG. 1 DISTRIBUTION OF AVAILABLE Zn IN THREE PROFILES AS RELATED TO ORGANIC CARBON (%) AND CLAY (%)

These results clearly demonstrated the dominant role played by organic carbon and clay in the distribution of available micronutrients. The pH also appeared to influence the available micronutrients though to a lesser extent. This anomaly was perhaps brought about by the narrow pH range and smaller number of samples.

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REFERENCES

Basu, A. N, Mukherjee, D. C and Mukherjee S. K. 1964. Interaction between Humic acid Fraction of soil and trace element cations. *J. Indian Soc. soil sci.* 12 : (iii) 311-318.

Fateh Lal and Biswas, T. D. 1974. Factors affecting the distribution and availability of micronutrient elements in major soil groups of Rajasthan II soil profiles. *J. Indian soc. soil sci.* 22 (4) 333-346.

Lindsay, W. L. and Morvell, W. A. 1978 Development of DTPA Soil test for Zn, Fe, Mn and Cu. *soil soc. sci. Amer. J.* 42 : 421-428.

Misra, S. C. and Pandey, G. 1976. Zinc in saline alkali soils of Uttar Pradesh. *J. Indian soc. soil. sci.* 24 (3) : 336-338.

Puri, A. N. 1949 *soils their physics and chemistry*, Rein hold Publishing Corp. New york.

Rai, M. M. and Mishra, M. K. 1967. Available Copper in Madhya Pradesh soils. *J. Indian soc. soil sci.* 15 : (1) 49-51.

Singh, S. and Patti Ram 1975. Distribution of Fe in Paddy soils of southern U. P. *J. Indian soc. soil sci.* 23 (2) : 253-255.

Shukla, U. C. Gupta, B. L. and Raghubir Singh 1975. Available and potentially available form of iron and manganese in Surface arid brown soils of Haryana. *J. Indian soc. soil sci.* 23 (2) 484-488.

Soil taxonomy 1975. *A basic system of soil classification for making and interpreting soil surveys.* U. S. D. A. Agri. Hand book No. 436.

Walkley, A. and Black, C. A 1934. An examination of the method for the determination of soil organic matter and proposed modification of the chromic acid titration method. *Soil sci.* 37 : 29-38.

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STUDIES ON THE EFFECT OF POST-HARVEST TREATMENTS ON STORAGE BEHAVIOUR OF GUAVA (*PSIDIUM GUAJAVA* L.) CV. SARDAR (L 49)

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ABSTRACT

Post-harvest applications of waxing, potassium permanganate and potassium metabisulphite were given to study their effect on storage behaviour of Sardar cultivar of guava. Prolonged storage caused loss in fruit weight, shrivelling, browning, rotting and decreased firmness with reduced vitamin C content of the fruits. These degradative changes were significantly slow in treated fruits. The best treatment to check browning and rotting was potassium metabisulphite which was followed by potassium permanganate and waxing. These treatments maintained firmness and taste for longer period but delayed development of ground colour, per cent T. S. S., acidity and total sugars increased up to second day of storage and thereafter decreased. Waxing and potassium permanganate retained quality compa atively for longer period.

Guava is one of the important subtropical fruits. Of the two crops in a year under arid conditions, growers have to depend mainly on rainy season crop because of improper ripening of fruits during winter. Rainy season fruits are poor in taste and keeping quality. Thus, there is lot of wastage of fruits during storage and transit. Therefore, it was thought worthwhile to try some postharvest treatments to increase shelf life of rainy season guava fruits.

MATERIAL AND METHODS

The experiment was conducted at the experimental orchard in Haryana Agricultural University, Hissar, during the year 1977-78 on Sardar (L49) cultivar of guava.

Fruits were harvested when these changed colour from deep green to light green. Uniform fruits were selected and washed under running tap water. Two hundred and twenty fruits constituted the sample under each treatment.

The following post-harvest treatments were tried :

(1) **Waxing.** The fruits were dipped for one minute in 12% fungicidal wax emulsion obtained from CFTRI, Mysore. The waxed fruits were kept under fan for some time to dry the wax and were stored at room temperature in polythene bags.

(2) **Potassium permanganate.** Potassium permanganate in a small muslin cloth bag was put inside the

polythene bags to absorb ethylene gas. 10 grams of potassium permanganate was used per kg of fruit.

(3) **Potassium metabisulphite.** The chemical in a muslin cloth bag was put inside the polythene bag to absorb ethylene gas. Ten grams of chemical was used for one kilogram of fruit.

(4) **Control.** Fruits were packed in polythene bag without any treatment for storage at room temperature.

The polythene bags were opened after every two days for recording various observations. Initial data were recorded on the date of harvest. On each sampling date 20 fruits constituted the sample.

The data with respect to weight loss were recorded by weighing 20 fruits at each sampling date. For colour development U. S. D. A. colour chart, as reported by Magness *et al.*, (1928), was used which consisted of four colours, viz., green, yellowish green, greenish yellow and yellow. Fruit firmness was assessed by thumb pressing method where four units were considered, viz, hard, medium hard, medium soft and soft. Browning, shrivelling and rotting percentages were calculated by counting the number of fruits affected. Estimation of chemical characters was done by methods as described by Tej Pal *et al.*; (1979). Organoleptic rating was done by allotting marks form 1-4 to the corresponding excellent, very good, good and poor eating quality of fruits.

RESULTS AND DISCUSSION

Physical Characters

The data in respect of physical characters at different storage intervals as affected by various post-harvest treatments are given in Table 1.

The perusal of data indicates that weight loss increased with increase in duration of storage and per cent loss in weight was reduced by different post-harvest treatments. The loss in weight was significantly low in case of treated fruits than control. Within the treatments, the best results were obtained by fruits stored in bags containing potassium permanganate followed by potassium metabisulphite and waxing. The control fruits were completely spoiled on the 6th day of storage, whereas treated fruits remained fit for human consumption upto 8 days in case of potassium permanganate and waxing. The superiority of potassium permanganate could be due to its effect on removal of ethylene which in turn reduced the rate of respiration and hence, they had less degradative changes (Scott *et al.*, 1974). Potassium metabisulphite might have been effective because of fungicidal action of sulphur content in it and its ethylene absorbing ability. Waxed fruits had better taste than under potassium metabisulphite because the waxing reduced the respiration and evapo-transpiration (Trout *et al.*, 1953).

The development of yellow ground colour was rapid in control fruits as well as in potassium metabisulphite, whereas it was slowed down by potassium permanganate and waxing upto 8th day of storage because of reduced ethylene production and other degradative changes. Similarly, all the treatments except control, were effective in retaining the fruit firmness. The best results were obtained when the fruits were stored with potassium permanganate followed by waxing. The potassium metabisul-

TABLE 1

Effect of post-harvest treatments on physical characters of guava fruits during storage cv. Sardar (L 49)

Character	Days in storage	Treatment				C. D. at 5%
		Waxing	Potassium permanganate	Potassium metabisulphite	Control	
1	2	3	4	5	6	7
Loss in weight (%)	0	0	0	0	0	N.S.
	2	3.12	0.12	5.03	5.68	1.19
	4	7.32	1.25	5.51	12.57	0.80
	6	11.70	2.76	5.64	18.67*	5.16
	8	16.81	3.26	5.91	—	1.63
	10	19.94	5.04	6.05	—	1.09
Colour Development Index**	0	2.00	2.00	2.00	2.00	—
	2	2.00	2.00	4.00	3.00	—
	4	2.00	2.00	4.00	4.00	—
	6	2.00	2.66	4.00	4.00*	—
	8	2.00	2.66	4.00	—	—
	10	3.33	3.66	4.00	—	—
Firmness index***	0	1.33	1.33	1.33	1.33	—
	2	1.33	1.33	3.00	2.00	—
	4	1.33	1.66	3.66	2.33	—
	6	1.33	1.66	3.66	4.00	—
	8	2.00	2.33	3.66	—	—
	10	3.00	2.66	3.66	—	—
Browning (%)	0	0(0.50)	0(0.50)	0(0.50)	0(0.50)	N.S.
	2	0(0.50)	0(0.50)	0(0.50)	56.66(48.84)	(2.70)
	4	20.00(26.07)	10.00(15.16)	0(0.50)	100(90.00)	(12.40)
	6	36.66(37.22)	13.33(17.38)	13.33(21.14)	100(90.00)	(14.14)
	8	90.00(75.00)	56.66(48.84)	13.33(21.14)	—	(16.06)
	10	100(90.00)	100(90.00)	20.00(26.07)	—	(8.53)
Rotting (%)	0	0(0.50)	0(0.50)	0(0.50)	0(0.50)	N.S.
	2	0(0.50)	0(0.50)	0(0.50)	10.00(18.43)	N. S.
	4	0(0.50)	0(0.50)	0(0.50)	33.33(35.01)	(5.94)
	6	6.66(12.45)	10.00(15.16)	3.33(6.47)	100.00(90.00)	(18.17)
	8	36.66(37.22)	30.00(33.21)	10.00(18.43)	—	(10.27)
	10	80.00(63.93)	83.33(70.07)	13.33(21.14)	—	(18.48)
Shrivelling (%)	0	0(0.50)	0(0.50)	0(0.50)	0(0.50)	N.S.
	2	0(0.50)	0(0.50)	0(0.50)	56.66(48.84)	(2.70)
	4	20.00(26.07)	10.00(15.16)	0(0.50)	100(90.00)	(12.40)
	6	36.66(37.22)	13.33(17.38)	13.33(21.14)	100(90.00)	(14.14)
	8	90.00(75.00)	56.66(48.84)	13.33(21.14)	—	(16.06)
	10	100(90.00)	100(90.00)	20.00(26.07)	—	(8.33)

Values in Parenthesis are angular transformations.

*However all the fruits spoiled and not fit for consumption.

**The lower the colour value, the greener the fruit.

***The lower the value, the firmer the fruit.

phite did not retain the fruit firmness because of degradative changes brought about by its sulphur content. These results are in agreement with the findings of scott *et al* (1974), Magness and Diehl (1924), Trout and Hale (1953) and Hulme (1958).

It is clear from the data that the browning was significantly controlled by potassium metabisulphite followed by potassium permanganate and waxing. These results are in agreement with Scott *et al.*, (1974) in banana. Browning was also low in fruits under waxing and metabisulphite treatments on account of reduction in ethylene production, respiration rate and effect of sulphur content.

It is evident from the data that per cent rotting and shrivelling were significantly reduced in treated fruits as completely to control. The most effective treatment was potassium metabisulphite. It was also seen that control fruits were spoiled completely on 6th day of storage, whereas treated fruits had very low incidence of rotting on this day of storage. More than half the fruits under control shrivelled on the 2nd day of storage while treated fruit had no shrivelling even up to 4th day under potassium metabisulphite. Potassium permanganate and waxing were also effective because of reduced rate of respiration (Scott *et al* 1974).

Chemical Characters

The data recorded for chemical characters are presented in Table. 2

The data indicated that total soluble solids (T.S.S.) increased upto second day in the fruits and thereafter decreased irrespective of the treatments. Similar rise and fall in T. S. S was also reported by Bassily (1968) in peach fruits. At all the storage intervals, the waxed fruits had higher T.S.S. than others. The initial rise in T.S.S. might be due to the conversion of starch into sugars while the later decrease was due to consumption of sugar for respiration during storage. Similarly, per cent acidity also increased upto second day and then decreased. Since the juice became concentrated on account of loss of moisture during storage, the increase in per cent acidity was obvious. In latter part of storage the reduction might be due to utilization of acids in respiration. Garg and Ram (1974) also found similar behavour in guava. However, no significant differences were observed within the treatments at all the storage intervals.

The ascorbic acid content went on decreasing with increase in duration of storage irrespective of the treatments. The decrease in ascorbic acid content with duration of storage might be due to oxidation of ascorbic acid to dehydroascorbic acid.

It is clear from the data that total sugars increased upto second day of storage and then decreased with the increase in duration of storage irrespective of the treatments. However, no significant difference was observed within treatments. The organoleptic rating was also more in treated fruits as compared to control. There was deterioration in the taste after second day of storage even in treated fruits. However, it was slower in treated fruits with potassium permanganate and waxing. This could be attributed to low degradative process during storage under these treatments.

TABLE 2

Effect of post-harvest treatment on the chemical characters of guava fruits during storage cv. Sardar (L49)

Character	Days of Storage	Treatments				C.D. at 5%
		Waxing	Potassium permanganate	Potassium metabisulphite	Control	
1	2	3	4	5	6	7
T.S.S. (%)	0	11.40	11.40	11.40	11.40	N S.
	2	13.60	12.13	11.43	11.46	2.13
	4	12.73	10.80	8.93	10.86	2.24
	6	10.46	8.70	8.20	—	N.S.
	8	9.80	7.53	7.40	—	N.S.
	10	8.90	7.46	7.53	—	N S.
Acidity (%)	0	0 672	0.572	0.572	0.572	N S.
	2	0.704	0.660	0.674	0.660	N.S.
	4	0.674	0.616	0.616	0.645	N.S.
	6	0 674	0.557	0 616	—	N.S.
	8	0.557	0.528	0.613	—	N.S.
	10	0.528	0.616	0.616	—	N.S.
Assorbic acid mg/100 g	0	123.70	123.70	123.70	123.70	N.S.
	2	115.40	109.90	121.90	115.40	N.S.
	4	112.30	95.63	91.00	99.30	N.S.
	6	84.20	75.76	91.52	—	N.S.
	8	82.13	70.30	73.80	—	N.S.
	10	63.80	60.70	73.03	—	N.S.
Total Sugars (%)	0	6.90	6.90	6.90	6.90	N.S.
	2	9.58	8.27	9.47	8.92	N.S.
	4	9.58	8.10	8.05	8.85	N.S.
	6	8.85	7.73	7.81	—	N.S.
	8	8.09	6.94	6.94	—	N.S.
	10	5.68	4.50	6.94	—	N.S.
Organoleptic rating*	0	2.50	2.50	2.50	2.50	—
	2	2.40	2.50	2.00	2.30	—
	4	2.10	2.20	1.50	1.50	—
	6	2.10	2.10	1.10	1.40	—
	8	1.20	2.30	1.00	—	—
	10	1.10	1.70	0.50	—	—

*The more the value, the tastier the fruit.

From the above study, it could be inferred that shelf life of summer season guava fruits could be increased by storing them with potassium permanganate and waxing without much deterioration in quality. However, in case of potassium metabisulphite, there is a need to find out some better method of storage to check deterioration in taste. By waxing the guava fruits, their shelf life could be increased by about 6 days in ordinary storage and thereby huge wastage of rainy season guava could be checked effectively.

REFERENCES

Bassily, S. 1968. Studies on the storage of "Meet Ghamr" peaches. *Agri. Res. Rev. Cairo.* 46 : 92-106.

Garg, R. C. and Ram, H. B. 1974. A note on the effect of post harvest treatments with growth regulators on ripening and storage behaviour of guava *(Psidium guajava L.). Prog. Hort.* 6 : 53-57.

Hulme, A. C. 1958. Effect of certain waxing treatments at time of harvest upon the subsequent storage quality of Grims Golden and Golden Delicious apple. *Proc. Amer. Soc. Hort. Sci.* : 440-446.

Magness, J. R. and Diehl, H. C. 1924. Physiological studies in apple during storage. *J. Agric. Res.* 27 : 1-35.

Magness, J. R., Diehl, H. C. and Haller, M. H. 1928. Picking maturity of apple in relation to storage *USDA Tech. Bull.* 1448.

Scott, JK. J., Glasson, M. C. and Roberts, E. A. 1974 Potassium permanganate as an ethylene absorbent in polythene bags to delay the ripening of banana during. Storage, *Aust. J. Exp. Agric. Anim. Hush.* 10 : 237.

Tej Pal, Yamdagni, R. and Jindal, P. C, 1979. Effect of pre-harvest spray of different chemicals on storage losses in grapes cv Perlette. *Haryana Agric. Univ. J. Res.* 4 : 235-240.

Trout, S. A. and Hale, E. G. 1953. Extending storage life of apple by use of skin coating. *Agric. Gaz. NSW.* 68 : 64-65.

RESEARCH NOTE

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OUTBREAK OF ARMYWORM, *MYTHIMNA SEPARATA* (WALKER) ON PADDY CROP IN HARYANA

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The armyworm, *Mythimna separata* (Walker) *Noctuidae : Lepidoptera*) is a well known pest of various graminaceous crops all over the world. It was considered to be a serious pest of paddy by Fletcher(1917). Narayanan(1953) reported it as a sporadic pest, damaging leaves and ear heads from most of the rice growing tracts of India. Army worm has been reported of regular occurrence on paddy in Madhya Pradesh since 1966. During 1968-69 and 1969-70, the pest appeared in epidemic forms, specially on high yielding varieties, threatening paddy cultivation in the State (Gargav and Katiyar, 1972). Katiyar and Patel (1969) reported the grain losses of 16.41 q/ha of the paddy due to army worms.

During *Kharif* 1978, the heavy infestation of armyworm was first reported from Haryana in the last week of september from a village known as Khizrabad, situated about 30 km away from Jagadhari (Haryana) on the Jagadhari-Paunta Sahib road. Later, within a period of one month, the pest spread in an epidemic form in most of the paddy growing areas of Jagadhari tehsil and caused very heavy damage to the maturing paddy crop by cutting the panicles and feeding on leaves.

Infestation of the pest was more severe in areas where paddy crop ramained submerged under flood water for 2-3 days which occured due to very heavy rain in the last week of August, 1978. The pest also assumed serious proportions in those fields where water logging persisted for longer time and the fields had dried about a fortnight before the maturity of paddy crop. Further, heavy infestation was confined mostly to high yielding varieties, specially in those fields which were luxuriant in growth and had heavy tillering. Such crops being thick due to heavy plant population, provided very good shelter for the hiding of caterpillars of army worms. The caterpillars were hiding in the plant hills at the base or slightly above the ground level. In severely infested areas, 1-6 or even more larvae/pupae were present almost in every hill. During night, caterpillars moved out of their hiding places and caused severe damage by cutting panicles of the ears of green as well as maturing paddy crop. The pest was not observed cutting complete ear heads as reported by Narayanan (1953). The damage was observed to be many folds more than the actual consumption by the caterpillars. In this way the pest had inflicted very heavy damage to the yield of paddy crop. In some of the badly infested areas, grain loss from 10 to 30% had been estimated. Besides this direct loss, most of the farmers in the heavily infes-

ted areas harvested their crops even before the full ripenning of grain due to fear of this pest. Such pre-mature harvesting of crops produced large number of chaffy grains which adversely affected the yield of crop and fetched poor market price. It was interesting to note that none of the paddy fields under *Basmati* variety was observed to be infested by this pest.

Several species of birds like, cattle egret (*Bubicus ibis*), common mynah (*Acridotheres tristris*), crow (*Carvus splendens*), black drongo (*Dicrurus macrocercus*) and the bluejay (*Coracias benghalensis*) were attracted towards the harvested paddy crop. They picked up most of the larvae and pupae hiding in the stubbles of the paddy crop and provided very good control of the pest. Almost similar observations of picking of larvae and pupae of army worm by birds were also made by Awasthy and Chaudhary (1965) during April-May, 1963, in the irrigated sugarcane fields.

Serious infestation of this pest on sugarcane crop in the areas of Jagadhari and Radaur had been reported since 1964 (Chaudhary and Ramzan 1967), but the available information reveals that this was the first serious outbreak of army worm on the paddy crop in Haryana State.

REFERENCES

Awasthy, P. N. and Chaudhary, J. P. 1965. Biology and control of army worm *Pseudoletia unipuncta* Haw. *Indian Sugarcane Journal.* 10 (4) : 249-251.

Fletcher, T. B. 1917. Sugarcane, paddy and other cereals, grasses and fodder crops. *Rept. Proc. 2nd ent. Meet. Pusa.* 137-209.

Chaudhary, J. P. and Ramzan, M. 1967. Army worm a menace to sugarcane. *Prog. farming.* 4 (2) : 7-8.

Gargav, V. P. and Katiyar, O. P. 1972. Effect of time of application of insecticides on grain losses due to paddy army worms. *Indian J. Entomol.* 34 (1) : 57-59.

Katiyar, O. P. and Patel, R. K. 1969. A note on estimation of grain losses to paddy by army worm. *Int. Rice. Comm. Newl.,* 18 (3) : 26-27.

Naryanan, E. S. 1953. Some major insect pests of rice and their control. *Indian Farm.* 3 (5) : 8-13.

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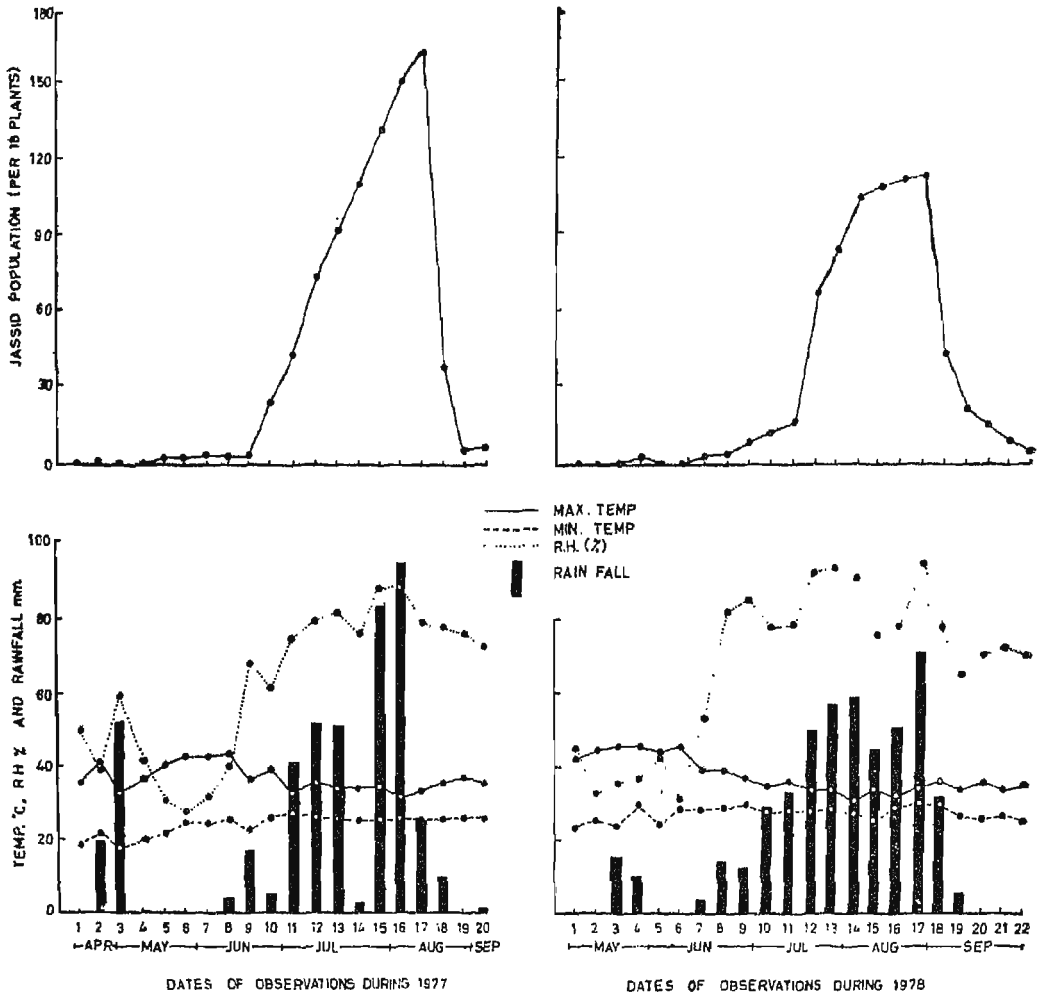
SOME OBSERVATIONS ON FIELD POPULATION OF *EMPOASCA KERRI* PRUTHI, A JASSID PEST ON MUNG BEAN CROP IN HARYANA

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(Received : March 13, 1979)

The jassid, *Empoasca kerri* Pruthi is a serious pest of many *Kharif* pulses like mungbean, urdbean, cowpea and pigeonpea, causing considerable damage both to the growth as well as to the yield of crops. Therefore, for finding out an approximate time for conducting suitable control measures of the pest in the agroclimatic conditions prevailing in Haryana, studies on the field population of this pest were carried out at the Farm of the Haryana Agricultural University, Hissar. For this purpose, four crops of mungbean were sown almost at monthly interval, starting from the 3rd week of March during the years 1977 and 1978. Observations on these crops were initiated when they became about a month old. The experiments were replicated three times with plot size and row to row distance being 10 m×10 m and 30 cm, respectively. In each plot, 6 plants were randomly selected and tagged in order to record all the observations on them only. The record of jassid population was started from the last week of April or first week of May, which continued upto last week of September. Only nymphal stages were taken into consideration for recording pest population. Jassids population/18 plants recorded at weekly intervals along with weekly average of maximum and minimum temperature, mean relative humidity and total weekly rainfall have been presented in Fig. 1.

The data summarized in Fig. 1. show that during 1977, the population of jassid remained low ranging 0-4 jassids/18 plants upto the middle of June when average maximum and minimum temperature ranged from 32.2 to 43.4°C and 17.5 to 25.3°C and mean relative humidity from 27 to 50 per cent. With slight decrease in atmospheric temperature and increase in the relative humidity due to onset of monsoon rains after middle of June the jassid population started increasing and the maximum activity of the pest was recorded from middle of July to middle of the August when maximum and minimum temperature ranged from 31.3 to 34.4°C and 25.2 to 26.2°C, respectively, and mean relative humidity from 79 to 88%, with total weekly rainfall from 3.2 to 94.0 mm. After middle of the August, the population started declining, which might be due to slight increase in atmospheric temperature, decrease in the relative humidity or also due to the maturity of crop.



Almost similar trend in increase or decrease of jassid population was recorded during 1978 (Fig. 1) also as the population ranging from 0-3 jassids/18 plants was recorded upto middle of the June. Later on however, with the onset of monsoon in the last week of June, there was increase in the relative humidity and slight decrease in the atmospheric temperature. With the result, the jassid population started increasing and the maximum activity of the pest was recorded from last week of July to end of the August. After August, the jassid population started declining.

The findings of the present experiment on the relations between meterological factors and the population have been corroborated by the works of other authors. Singh and Singh (1978) found that population of jassid on pigeonpea crop which appeared at early

stage of crop continued to build up and attains its peak during August and September. Almost similar build up of population was also recorded in case of *Emrasca biguttala biguttala* (Ishida), when populations of this jassid was recorded on cotton at Ludhiana (Punjab) during 1965 and 1966 (Atwal *et al.* 1969). This indicates that most of the jassid occuring during *Kharif* season prefer moderate temperature, high humidity and uniformly distributed rain fall from July to September for their quick multiplication.

ACKNOWLEDGEMENT

The authors are grateful to Dr. S. Lal, Senior Scientist (pulses) Department of Plant Breeding, Haryana Agricultural University, Hissar for providing necessary facilities.

REFERENCES

Atwal, A. S., Chaudhary, J. P. and Sohi, B. S. 1969. Effect of temperature and humidity on the development and population of cotton jassid, *Emposca devastans* Distant. *J. Res.* (*Punjab agric. Univ.*) **6**: 225-261.

Singh, R. N. and Singh, K. M. 1978. Incidence of insect pests in early varieties of red gram, *Cajanus cajan* (L.). *Indian J. Entomol* **40** : 229-244.

Haryana agric. Univ. J. Res., Vol. X, No 2, pp. 253—256 (June 1980)

PRODUCTION OF ACID PROTEASES BY A MUTANT (N_3) OF *ASPERGILLUS NIGER*

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(Received : February 1, 1980; Revised : April 18, 1980)

Fungi such as *Aspergillus niger, A. awamori, A. saitoi* and *Mucor pusillus* have been shown in the past to produce acid proteases as the major component of the protease system (Yoshida, 1956; Somkuti and Babel, 1968). Mutagenic agents such as ultraviolet rays, nitrous acid and nitrosoguanidine have also been used to induce mutations with improved protease productivity (Brotskaya, 1961; Leighteon and Stock, 1970). Acid proteases are in great demand for use in digesting aids (Pharmaceutical), stabilization of beer, food industries etc. The present investigation was, therefore, undertaken to develop a strain producing only acid proteases with improved productivity and to develop know how to utilize efficiently the easily available agricultural produce. Isolation of a mutant and standardization of cultural conditions for maximum acid protease production by this mutant have been reported here.

Induction and Isolation of Mutants

Fungal spores (10^7/ml) from 5 day old cultures were mutagenized for 40 min. with nitrous acid by the method of Siddiqi (1962). Survivors were transferred to tris-phosphate buffer (pH 7.0) to stop the reaction, plated on a medium containing skim milk (2%, W/V), glucose (1%, W/V), neopeptone (Difco, 1%, W/V) agar plates and incubated at 37°C for 5 days. Suspected mutants (based on zone of protein hydrolysis or visual change in morphology) were rescreened for acid protease production and subsequently maintained on PDA slants. Preliminary fermentation tests with selected mutants were carried by the submerged culture method in the medium containing 4% wheat flour and 0.1% ammonium nitrate in distilled water, and sterilized at 15 lbs p.s.i. for 20 min. The inoculum for fermentation studies consisted of 5×10^6 to 1×10^7 spores/ml suspended in water containing Tween 80 (1/10,000) and inoculated one ml inoculum in 250 ml Erlenmeyer flasks containing 50 ml medium. The extracts were assayed at different pH values (Table 1). One mutant showing highest acid protease activity and no activity in alkaline range was selected for further work.

Enzyme was assayed by measuring rate of hydrolysis of casein according to the method described by Oleniacz and Pisano (1968). However, instead of 6% casein and 0.1 M-Phosphate saline buffer of pH 7.4, 2% casein and buffer of different pH as KCl–HCl, pH

TABLE 1

Screening of mutants

Isolate No.	Protease activity at different pH*				
	2.0	4.0	6.0	8.0	10.0
Parent strain	52.6	—	24.1	19.3	10.4
N_1	43.6	—	—	15.6	—
N_2	42.8	—	—	26.9	11.7
N_3	69.7	—	2.3	—	—
N_4	24.3	—	44.2	—	—
N_5	19.3	—	39.2	—	—
N_6	—	—	40.2	—	—
N_7	37.8	—	15.1	—	—

*Protease activity is expressed as units/ml of extract.

2.0 (Clark and Lubs 1917), citratephosphate, pH 2.5 to 7.0 (McIlvaine, 1921), phosphate buffer, pH 8.0 (Sorensen, 1909) were used. One enzyme unit is defined as that amount of enzyme producing an increase of one micromole of acid soluble tyrosine in the substrates per min. at 40°C.

Selection of Media

The mutant was grown on 4% flour of moong *(phaseolus aureaus)*, mash *(P. mungo)*, gram *(Cicer arietinum)*, masur *(Lens culinaris medic)*, soybean *(Glycine max)*. barley *(Hordeum vulgare)*, and wheat *(Triticum aestivum)* and 0.1% ammonium nitrate in distilled water. The samples were withdrawn and assayed for enzyme activity at different time of incubation (Fig. 1). The maximum enzyme activity was obtained in medium containing wheat flour followed by barley (65.5 and 62.1 units/ml, respectively). In other media, the value for acid protease activity ranged between 15.13 and 42.13 units/ml. The low activity was observed on medium containing moong. The maximum enzyme activity was generally observed between 108 to 120 hr. of incubation.

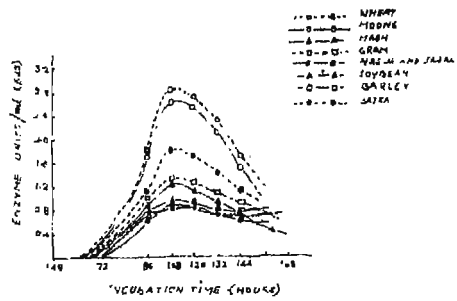


Fig 1 PROTEASE PRODUCTION ON DIFFERENT MEDIA

Large Scale Production of Snzyme

A 25 l stainless steel fermentor (Emenvee laboratory formentor) was used. Fifteen litres of medium containing wheat flour (5%) and 0.1% ammonium nitrate (Singh, 1972) was prepared in the fermentation vessel and sterilized at 15 lbs p.s.i. for 20 min. After cooling it was inoculated with 48 hr. old inoculum at 5% level. The temperature of fermentation was maintained at 35±1°C (Singh, 1972) by circulating hot water surrounding the fermentor. The aeration rate was adjusted to 2 l of air/min. and agitation speed was 450 rpm. Samples were withdrawn after 24 hr interval and were assayed for acid protease activity (Fig. 2). Maximum activity (54.8 units/

ml) was observed after 120 hr. However, the enzyme yield was lower than in shake flasks. It can, therefore, be concluded that acid protease production in the fermentor was slow as well as low than in the shake flasks. The low yield of acid protease in the fermentor might be due to the fact that the volume was more and, therefore, lower aeration and agitation which adversely effect protease production.

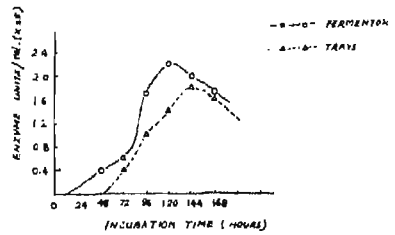


Fig 2 PRODUCTION OF ACID PROTEASES IN FERMENTOR AND TRAYS

Tray Method

50 g of wheat bran was mixed with 100 ml of citrate phosphate buffer, pH 3.0 containing 0.1% ammonium nitrate (Singh 1972) and spread in the aluminium tray (9"×6") and sterilized at 15 lbs for 20 min. on consecutive days, 5 ml spore suspension (10^6 to 10^7) cells/ml) was uniformly sprayed and mixed aseptically. The trays were incubated at 35°C, 10 ml sterile water was sprayed at 48 hr interval over the bran to maintain appropriate moisture. The enzyme was extracted from the semisolid medium with distilled water (18.5 ml/g of the material) the enzyme activity was determined in the enzyme extract (Fig. 2). The maximum enzyme activity was observed after 144 hr. growth. However, the development of activity was still slower than that of the fermentor and in shake flasks. Semisolid medium was not suitable for acid protease production by this mutant.

According to these observations, the mutant isolated was superior to the parent strain and gave only acid protease activity. Cereals were most suitable for acid protease yield.

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REFERENCES

Brotskaya, S. Z. 1961. The effect of various doses of U. V. radiation on the generation of *Aspergillus* mutants that produce active protease. *Trudy Inst. Mikrobiol. Akad. Nank. USSR.* 10 : 120-128.

Clark, W. M. and Lubs, H. A. 1917. The colorimetric determination of hydrogen ion concentration and its applications in Bacteriology. *J. Bacteriol.* 2 : 1.

Ichishima, Eiji, Yasuhiro, G., Teruo, W., and Fumihike, Y. 1963. Studies on the proteolytic enzymes of black Aspergilli IX. Effect of agitation and aeration on submerged production of acid protease. *Agril. Biol. Chem. (Tokyo),* **27** (4) : 302-309.

Leighteon, T. J. and Stock, J. J. 1970. Isolation and preliminary characterization of developmental mutants from *Microsporum gypseum. J. Bacteriol* 104 (2) : 834-838.

McIlvaine, T. C. 1921. *Preparation of Buffers.* "In Methods in Enzymology". Vol. 1 New York. p. 138-146.

Oleniacz, W. S., and Pisano, M. A. 1968. Proteinase production by a species of *Cephalosporium. Applied Microbiol.* 16 : 90-96.

Siddiqi, O. H. 1962. Mutagenic action of nitrous acid on *Aspergillus nidulans. Genetic. Res.* 3 : 303-314.

Singh, D. P. 1972. Production of Acid Proteases by Fungi. Ph.D. Dissertation submitted to Haryana Agricultural University, Hissar.

Somkuti, G. A. and Babel, F. J. 1968. Acid protease synthesis by *Mucor pusillus* in chemically defined media *J. Bacteriol.* 95 (4) : 1415-1418.

Sorensen, S. P. L. 1909. *Preparation of Buffers,* "In Methods in Enzymology" Vol. I New York, p. 138-146.

Tipograf, D. Y. and Petina, T. A. 1966. Growth conditions of *Aspergillus candidus* strain 11 and its enzyme complex. Friklandnaya Biochem. *Mikrobiol* 2 (4) : 417-424.

Yoshida, F. 1956. Production of proteolytic enzymes by Aspergillus species. *Agril. Biol. Chem.* 28 (10) : 734-739.

Haryana agric. Univ. J. Res., Vol. X, No. 2, pp. 257 (June 1980)

INCIDENCE OF TUNDU ON WEED PLANTS

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Tundu (Yellow spike disease) is caused by the bacterium *Corynebacterium tritici* in association with the seedgall nematode *Anguina tritici*. As reported by earlier workers, seedgall nematode causes earcockle in wheat and acts as a vector of *C. tritici* which is responsible for causing *tundu*.

During the research work on screening wheat germplasm for resistance to *A. tritici* at Entomology Farm, Haryana Agricultural University, Hissar, weed plants belonging to the family Graminae, namely, *Lolium temulentum* L., *Alopecurus monspeliensis* L. and *Phalaris minor* Retz. were found to be infected with *tundu*. At the vegetative phase there were no symptoms of crinkling and twisting of leaves but at the reproductive phase symptoms of *tundu* developed very conspicuously.

These plants appear to have not been reported earlier as hosts of this nematode from India and abroad. Bhatti *et. al.* (1978) observed concomitant incidence of *tundu* and earcockle on many varieties/lines of barley.

REFERENCE

Bhatti, D. S., Dahiya, R. S. and Dhawan, S. C. 1978. New record of *tundu* and earcockle incidence in barley. *Nematologica* 24 : 331-332.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 2, pp. 258—260 (June 1980)

CONTAMINATION OF COTTON LEAVES WITH 2, 4-D HERBICIDE RESIDUES

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(Received : October 26, 1979; Revised : December 15, 1979)

Cotton *(Gossypium* spp*)* is very important cash crop of Haryana and its adjoining States. The crop being vulnerable to a variety of insect-pests throughout its growing period, intensive plant protection measures are taken including the use of systemic and contact insecticides belonging to organophosphate and organochlorine groups, respectively. However, in spite of the best plant protection measures adopted, malformation of cotton leaves has been observed for the last 5-6 years in various parts of Haryana State. The leaf malformation in farmers' field was identical with the toxicity sysptoms of 2, 4-D (2, 4-Dichlorophenoxyacetic acid) herbicide observed under supervised trial where its spray application was given @ .025 Kg a, i/ha. It is interesting to note that although 2, 4-D is seldom recommended for controlling weeds in cotton, the leaf malformation was observed in a fairly large number of farmers' fields.

In order to confirm whether the malformation could possibly be due to 2, 4-D residues, samples of affected cotton leaves were collected from different parts of the State during 1977 and 1978 *kharif* seasons. The leaves were chopped into small pieces of $\frac{1}{2}$ to 1 c and representative samples varying from 25 to 50 g were extracted with acetone by shaking on rotary shaker for about 1.5 hours. The acetone extracts were processed, derivatised with butoxyethanol and analysed by gas liquid chromatography using Electron Capture Detector and glass columns packed with 3% OV-1 on chromosorb-W. Other conditions of chromatography were : injector block temperature 200°C, column temperature 190°C, detector temperature 270°C and N_2 carrier gas flow 80 ml/mn. All analytical details were followed as per given by Meagher (1966) except that clean-up after derivatisation was carried out by using mixture of florisil (80-100 mesh) and Nuchar-C-190N (3:1) in place of florisil alone. The results obtained are given in Table 1.

A perusal of the data reveals that 7 out of 11 samples contained 2, 4-D residues varying from 0.06 to 1.6 ppm,

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TABLE 1

Residues of 2, 4-D in/on cotton leaves

Sr. No.	Source of sample i.e. village	Variety of cotton	Amount of 2-4-D found (ppm)	Year of sample collection
1.	Shishwal	BN	0.23	1977
2.	—do—	BN	1.60	1977
3.	—do—	BN	ND	1977
4.	—do—	BN	0.32	1977
5.	—do—	BN	ND	1977
6.	—do—	BN	0.53	1977
7.	Keriwale	320F	ND	1977
8.	—do—	BN	0.27	1977
9.	Ghotra	BN	0.10	1977
10.	H. A. U. Farm, Hissar	BN	0.06	1978
11.	—do—	BN	ND	1978
12.	2, 4-D treatment @ .025 Kg a, i/ha HAU, Hissar	BN	0.25	1978

BN : Bikaneri Narma ND : Non-detectable

whereas the leaf samples collected from the field treated with 2, 4-D @ .025 kg a, i/ha contained residues to the extent of 0.25 ppm 10 days after spraying. Presence of 2, 4-D residues in/on cotton leaves of affected plants confirmed the doubt that malformation was because of contamination with 2, 4-D residues and also as low as 0.06 ppm of the herbicide could cause ill effects on the growth of cotton plants.

The possible sources of herbicidal contamination could be (1) use of the sprayer contaminated with 2, 4-D employed earlier on previous wheat crop where application of 2, 4-D is given to control dicot weeds; (2) use of fertilisers and plant protection chemicals which might have got contaminated with 2, 4-D during storage because these are invariably stored in the same godown by pesticide depot holders as well as farmers; (3) translocation of 2, 4-D residues from the soil where 2, 4-D was used in previous season; and (4) drifting of 2, 4-D sprays from the adjoining fields.

In the light of the above studies, the following recommendations can be made to the cotton growers :

1. The use of sprayers which had been used earlier for 2, 4-D should be avoided. If due to certain limitations the same sprayer is to be employed for spraying insecticides/fungicides on cotton, it should be dipped in a solution of washing soda (5-10 gm/10 litres of water) and washed thoroughly before keeping it for next season. A thorough washing immediately before its use for spraying on cotton is also advised.

2. Storage of 2, 4-D with other plant protection chemicals and fertilisers should strictly be avoided.

3. Application of 2, 4-D in those fields where cotton is to be sown in next *kharif* season should be made as per recommended dose during *rabi* season to avoid carry over of residues to the next crop.

4. The use of 2, 4-D in the fields adjoining to cotton should be avoided in order to check drifting of 2, 4-D on cotton plants.

ACKNOWLEDGEMENTS

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REFERENCE

Meagher, W.R. 1966. Determination of 2, 4-D and 2—(2, 4, 5-Trichlorophenoxy) propionic acid in citrus by electron capture Gas Chromatography. *J. Agric. Food Chem.* 14 : 374.

VETERINARY AND ANIMAL SCIENCES

Haryana agric. Univ. J Res., Vol. X, No. 2, pp. 261–266 (June 1980)

HISTOLOGICAL AND HISTOCHEMICAL STUDIES ON THE EXCURRENT DUCT SYSTEM OF TESTIS OF BUFFALO

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ABSTRACT

The excurrent duct system of testis was studied in prepubertal and adult buffalo bulls. The transition zone was lined with Sertoli cells. The latter alongwith certain cells of spermatogenic series formed plugs which projected into the receptacles. The plugs demonstrated PAS positive granules and fat droplets of varying sizes. The excurrent duct system was lined with flattened to simple cuboidal epithelium which demonstrated PAS positive and sudanophilic reaction at its luminal border.

The excurrent duct system of the testis is a system of epithelium lined passage-ways which convey the male germ cells from the site of their production to the ductuli efferentis testis (Dym, 1977). Although, the histology of testis and efferent duct system has been studied in buffalo at different ages (Dhingra and Goyal, 1975; Goyal and Dhingra, 1973a, 1973b; 1974; 1975a, 1975b, Guraya and Bilaspuri, 1976a 1976b; Sharma, 1977), yet the role of excurrent duct system in reproductive biology is in no way less important than other components of testis. Different segments of this system contribute substantially towards the semen production (Tuck *et. al.* 1970; Setchell and Waites, 1972). Specific reports on the excurrent duct system are meager in this animal. This paper describes the histological and histochemical details of all the segments of the excurrent duct system of testis in prepubertal and adult buffalo bulls.

MATERIAL AND METHODS

These studies were based on five prepubertal and five adult buffalo bulls. Small pieces of testicular tissue from the area of the mediastinum testis were collected in different fixatives for general histological studies (Luna, 1968) and special histochemical studies, i.e., McManus method for glycogen (PAS), Best's carmine method for glycogen, Sudan black B method for fats, osmium textroxide method for fats, acid mucopolysachharide stain (Luna, 1968), calcium cobalt method for alkaline phosphatase and lead method for acid phosphatase (Thompson, 1966).

RESULTS AND DISCUSSION

The excurrent duct system of testis was divided arbitrarily into receptacles, straight tubules and rete tubules. The seminiferous tubules tapered as they approached the straight tubules and the

spermatogenic cells were gradually replaced by Sertoli cells in the transition zone (Fig. 1). Perey *et al.*, (1961) reported that the intermediate zone (transition zone) in rat, was lined exclusively by Sertoli cells. The Sertoli cells of the transition zone were aligned on a PAS positive basement membrane and demonstrated PAS positive glycogen granules and fat granules of 2 to 5 μm in diameter. Glycogen has often been reported in Sertoli cells and spermatogonia (Cavazo and Melampy, 1954; Nicander, 1957).

Receptacles. The receptacles were the dilated ends of the straight tubules and received the tapered ends of the seminiferous tubules (Figs. 1, 2, 3, 4). These were lined with a single layer of flattened to simple cuboidal cells and dustlike particles of fats in the PAS positive luminal border of the epithelium were present (Fig. 5). The epithelium rested on a PAS positive basement membrane. Plugs consisted mostly of Sertoli cells and also other cells of spermatogenic series were seen occluding the connection between the seminiferous tubules and the excurrent duct system of testis. The Sertoli cells of the plugs contained PAS positive granules and fat droplets (Fig. 2, 3, 4) of varying sizes (1–5 μm). Similar plugs have been described in rabbit (Dhingra and Barnwal, 1977). Marin-Padilla (1964) and Kormano (1977) reported narrow channels in the transition zones of monkey and rat. Well organized channels were occ sionally observed in the plugs (Fig. 4) guarding the junctional area in the buffalo. Asymmetry of the plug might be responsible for the lack of visible channels in some tubules in light microscopic sections. Similar observations have been made by Kormano (1974).

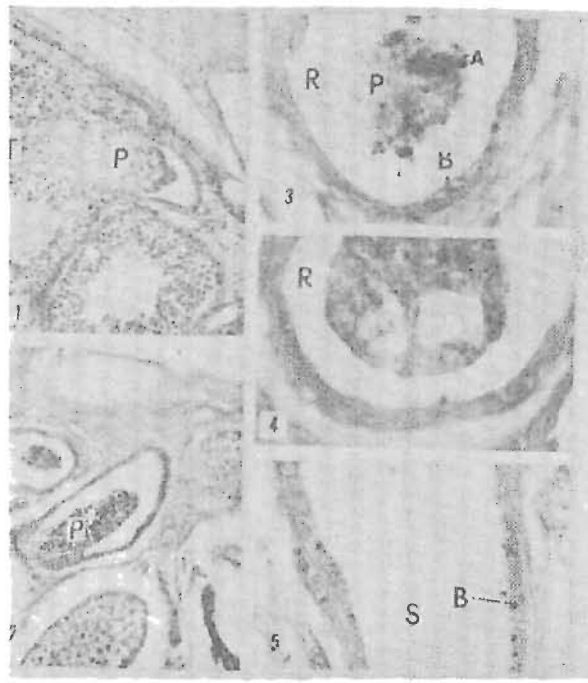


Fig. 1 An oblique section showing the transition zone (T) of buffalo testis. The plug (P), consisting mostly of Sertoli cells, projects into the receptacle. HE×100.

Fig. 2 An oblique section showing plug (P) in a receptacle of adult buffalo testis. The fat droplets of varying sizes are seen in the plug. Small fat droplets can be seen in the luminal border of the receptacle. Osmium tetroxide× 100.

Fig. 3 A part of the plug (P) and receptacle (R) of buffalo testis are enlarged in order to demonstrate varying sizes of fat droplets (A) in the plug. The epithelium lining the receptacle is simple squamous/simple low cuboidal and small fat droplets (B) can be seen in the luminal border of the receptacle. Osmium tetroxide×400.

Fig. 4 A cross section of the plug and receptacle (R) of buffalo testis showing fat droplets and channels in the plug. The epithelium of the receptacle also demonstrates fat droplets in its luminal border. Osmium tetroxide×400.

Fig. 5 A part of the straight tubule (Receptacle) of buffalo testis enlarged to show small droplets of fat (B) in the epithelium lining the straight tubule (S). Osmium tetroxide×400.

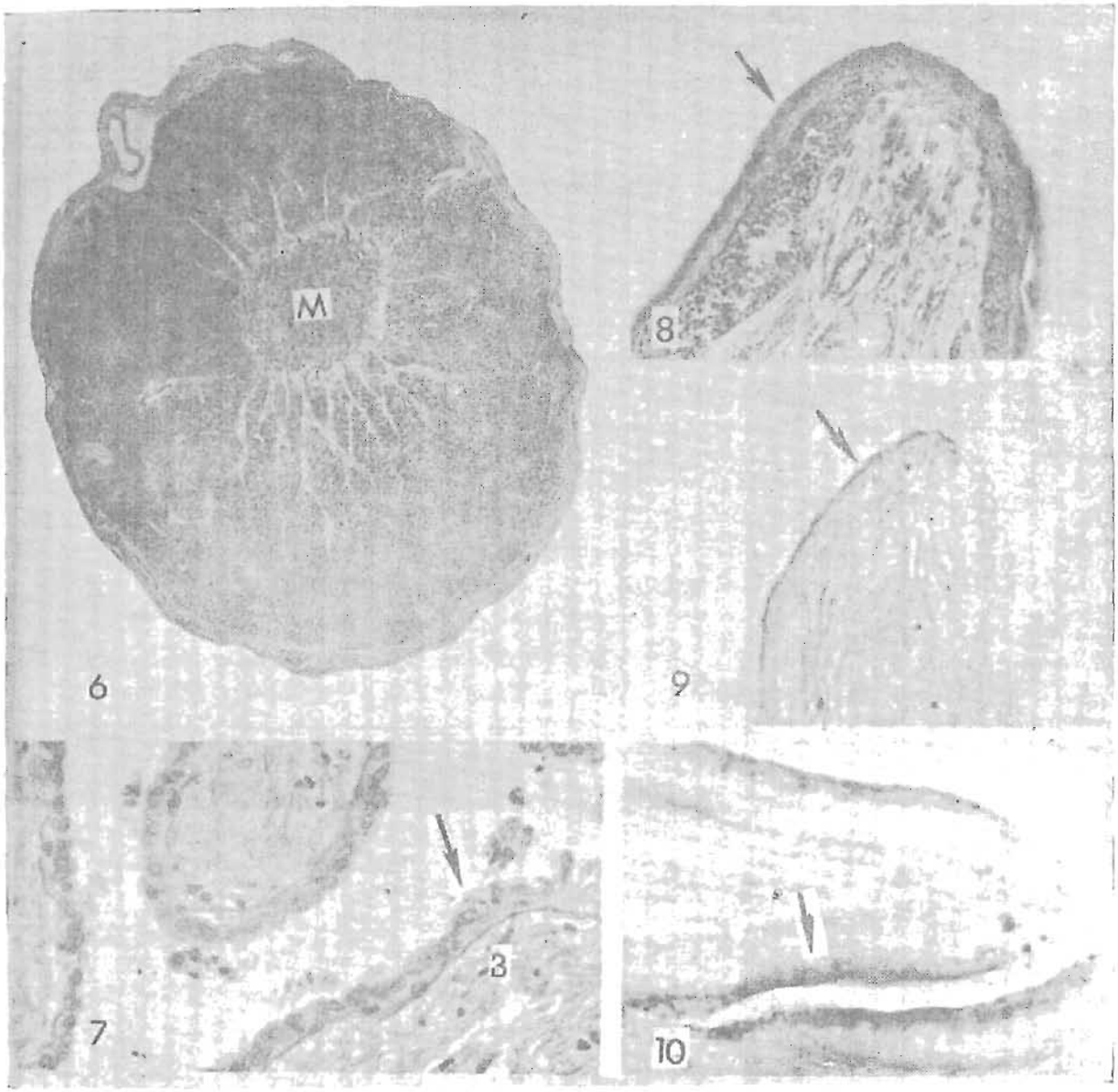


Fig. 6 The mediastinum testis (M) of buffalo is situated axially in the testicular pasenchyma and contains the rete testis. Haematoxylin × 4.

Fig. 7 Simple cuboidal epithelium with basal cells supported on a PAS positive basement membrane (B) lines the rete testis of buffalo. Small PAS positive granules were also seen in the luminal border (Arrow). PAS-haematoxylin × 400.

Fig. 8 Alkaline phosphatase positive reaction is evident at the luminal border of the rete epithelium (Arrow) of buffalo. Calcium Cobalt method for alkaline phosphatase × 400.

Fig. 9 The luminal border of the rete epithelium of buffalo demonstrates acid mucopolysachharide (Arrow). Acid mucopolysachharide stain × 400.

Fig. 10 The rete epithelium of buffalo shows irregular distribution of fats (arrow). Nile blue sulphate stain × 1000.

Straight tubules. The main segment of the straight tubule consisted of flattened to low simple cuboidal epithelium and demonstrated similar PAS and lipid reactions as that of the receptacle (Fig. 5). This segment, in man (Warwick and Williams, 1973) and other domestic animals (Dellmann and Wrobel, 1976; Nickel *et. al.*, 1973) is lined by a similar type of epithelium. However, Sertoli cells lining this segment have also been reported in man (Glenister, 1976). Schiff positive granules of glycogen have been demonstrated in the epithelium of straight tubules of man (Montagna, 1952), Camel (Singh, 1970) and guinea pig (Fawcett and Dym, 1974). However, rat, monkey and ram contained little or no intraepithelial glycogen (Dym, 1972, 1974). The epithelium of the rat tubuli recti is higher cuboidal than the remaining rete cavity (Leeson, 1961). No significant differences between the tubuli recti and rete epithelium have also been reported in rat (Vitale-Calpe and Aoki, 1969) and man (Bustos-Obregon and Holstein 1975, 1976).

Rete testis. The rete testis segment of the excurrent duct system was axially situated in the mediastenum testis of buffalo (Fig. 6) as has been reported earlier in buffalo calf (Goyal and Dhingra, 1973c; Dhingra, 1977). It consisted of system of highly complicated passageways which were lined with pseudostratified columnar epithelium in prepubertal animals and the epithelium assumed simple cuboidal epithelium with basal cells in adult animals. The epithelium rested on a PAS positive membrane (Fig. 7). The postnatal stages of buffalo upto 30 weeks of age have been reported to carry simple cuboidal to pseudostratified columnar epithelium in the rete testis (Goyal and Dhingra, 1973c). The luminal border was positive for PAS reaction (Fig. 7), alkaline phosphatase reaction (Fig. 8) and light acid mucopolysachharide reaction (Fig. 9). Fat droplets of varying sizes ranging from 1 to 3 µm in diameter were seen scattered at random in the rete epithelium (Fig. 10). Similar schiff positive, alkaline phosphotase and acid mucopolysachharide reactions have been reported in buffalo calves (Goyal and Dhingra, 1973c). Glycogen has been reported in the rete testis of hamster (Fauquet and Guha, 1969), guinea pig (Fawcett and Dym, 1974) and man (Bustos-Obregon and Holstein, 1975). Leeson (1962) reported brush border on the luminal surface of the rete epithelium and assigned it the function of fluid transport. It was suggested that the rete epithelium was secretory (Renzoni, 1957; Setchell, 1974) and contributed about 90% of the total fluid secretion in rat (Tuck *et. al.*, 1970; Levine and Marsh, 1971; Setchell and Waites, 1972).

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REFERENCES

Bustos-Obregon, J. E. and Holstein, A. F. 1975. Ultrastructure of the human rete testis. *Fertil. Steril* 26 : 200.

Bustos-Obregon, J. E. and Holstein, A. F. 1976. The rete testis in man : Ultrastructural aspects. *Cell tissue Res*, 175 : 1.

Cavazo, L. F. and Melampy, R. M. 1954. A comparative study of the periodic acid reactive carbohydrates in vertebrate testis. *Am. J. Anat.* 95 : 467-495.

Dellmann, H. D. and Wrobel, K. H. 1976. Male Reproduction System. In *"Textbook of Veterinary Histology"* (H. D. Dellmann and E. M. Brown eds.) PP. 293-317 Philadelphia : Lea and Febiger.

Dhingra, L. D. 1977. Mediastinum Testis. In *"The Testis IV"* (A. D. Johnson and W. R. Gomes eds). PP 451-460, New York : Academic Press.

Dhingra, L. D. and Goyal, H. O. 1975. A study on the different types of spermatogonia in buffalo. *Acta anat.* 93 : 219-227.

Dhingra, L. D. and Barnwal, A. K. 1977. Histological studies of the testicular efferent duct system of rabbit. *Haryana agric. Univ. J. Res.* Vol., 7 : 73-80.

Dym, M. 1972. The mammalian rete testis. *Anat. Rec.*, 172 : 304 (Abstr.).

Dym, M. 1974. The fine structure of the monkey Sertoli cells in the transitional zone at the junction of the seminiferous tubules with the Tubuli Recti. *Am. J. Anat.*, 140 : 1-26.

Dym, M. 1977. *The male reproductive system in "Histology"* (L. Weiss and R. O. Greep eds.), 4th edn. PP. 979-1038. New York : McGraw-Hill Book Company.

Fawcett, D. W. and Dym, M. 1974. A glycogen-rich segment of the tubuli recti and proximal portion of the rete testis in the guinea pig. *J. Reprod. Fertil.* 38 : 401-409.

Fauquet, J. P. and Guha, S. 1969. Glycogen, phosphorylase and glycogen synthetase in hamster testis during postnatal development. *J. Reprod. Fertil.* 19 : 455.

Glenister, T. W. 1976. Urogenital system. In *"Textbook of Human Anatomy.* 2nd ed. (W. J. Hamilton ed.) P. 468. London : The MacMillans Press Ltd.

Goyal, H. O. and Dhingra, L. D. 1973a. Postnatal study on the histochemistry of testis in buffalo *(Bubalus bubalis)* from birth to one year. *Acta anat.*, 84 : 150-160.

Goyal, H. O. and Dhingra, L. D. 1973b. A study on the postnatal histology of the testis in buffalo. From birth of one year. *Acta anat.* 84 : 237-250.

Goyal, H. O. and Dhingra, L. D. 1973c. Postnatal study on the histology and histochemistry of mediastinum testis in buffalo *(Bubalus bubalis)*.—from birth to one year. *Acta anat.* 86 : 65-70.

Goyal, H. O. and Dhingra, L. D. 1974. Histochemical study on the postnatal distribution of alkaline phosphatase in the epididymis of buffalo *(Bubalus bubalis)*.—from birth of one and a half year. *Acta anat.* 88 : 574-579.

Goyal, H. O. and Dhingra, L. D. 1975a. Postnatal study on the histochemistry of epididymis in buffalo *(Bubalus bubalis) Acta anat.* 93 : 151-160.

Goyal, H. O. and Dhingra, L. D. 1975b. Postnatal study on the histology and histochemistry of ductuli efferentis testis in buffalo *(Bubalus bubalis)*—from birth to one and a half year. *Acta anat.* 93 : 573-582

Guraya, S. S. and Bilaspuri, G. S. 1976a. Stages of seminiferous epithelial cycle in the buffalo *(Bos bubalis) Ann. Biol. Anim. Biochim. Biophys.* 16 : 137-144.

Guraya, S. S. and Bilaspuri, G. S. 1976b. Spermatogenic cells of the buffalo *(Bos bubalis)* testis *Indian J. Anim. Sci.* 46 : 388-396.

Kormano, M. 1974. Untersuchungen uber den bau und die funktion der wand des intratestikularen kanalchemsystem. Verh. Anat. Ges. Versamml. 68th, 1973, P. 193 (Cited Kormano, 1977).

Kormano, M. 1977. The rete testis. In "Testis IV" (A. D. Johnson and W. R. Gomes Eds). PP 461-479, New York : Academic Press.

Leeson, T. S. 1962. Electron microscopy of the rete testis of rat. *Anat. Rec.* 144 : 57-61.

Levine, N. and Marsh, D. J. 1971. Micropuncture Studies of the electrochemical aspect of the fluid and electrolyte transport in individual seminiferous tubules, the epididymis and the vas deferens in rats. *J. Physiol.* (London) 213 : 557.

Luna, L. G. (ed), 1968. Manual of histologic staining methods of the Armed forces Institute of Pathology. 3rd edn, PP. 36, 79, 87, 143-145, 157-58, New York : McGraw Hill Book Company.

Marin-Padilla, M. 1964. The mesonephric testicular connection in man and some mammals. *Anat. Rec.* 138 : 1-7.

Montagna, W. 1952. The distribution of lipids, glycogen and phosphatase in the human testis. *Fertil. Steril.* 3 : 27-32.

Nicander, L. 1957. A histological study on the glycogen in the testis of domestic and laboratory animals with special reference to the variation during spermetogenic cycle. *Acta Morphol. Neerl.-Scand*, 1 : 233-240.

Nickel, R., Schummer, A. and Seiferle, E. 1973. The viscera of the domestic mammals (Translated and revised by W. O. Sack) PP. 305. 307. 340 : Berlin : Verlag Paul Parey.

Perey, B., Clermont, Y. and Leblond, C. P. 1961. The wave of seminiferous epithelium in the rat. *Am. J. Anat.* 108 : 47-77.

Renzoni, A. 1957. Secretory epithelium of the rete testis in bull. Atti. Della Societa. *Italians Della Scienze Veterinarie.* 10 : 502-505.

Setchell, B. P. 1974. Secretions of the testis and epididymis. *J. Reprod. Fertil.* 37 : 165.

Setchell, B. P. and Waites, G. M. H. 1972. The effects of local heating of the testis on the flow and composition of rete testis fluid in the rat with some observation on the effect of age and unilateral castration. *J. Reprod. Fertil.* 30 : 225.

Sharma, A. 1977. Studies on the process of spermatogenesis and epididymal sperm reserve in water buffalo *(Bubalus bubalis)* M. V. Sc. thesis. Haryana Agril. University, Hissar.

Singh, U. B. 1970. Gross histology and certain histochemical observations on the testis and poll gland of camel *(Camelus dromedarius)* during different phases of sexual cycle. Ph. D. thesis. University of Udaipur, India.

Thompson, S. W. 1966. Selected Histochemical and Histological methods. PP 629-30, 639. Charles C. Thomas, U.S.A.

Trotter, D. M. 1959. Histological observations of the genitalia of immature, the castrated and mature bovine male. *Am. J. Vet. Res.*, 20 : 213-222.

Tuck, R. R., Setchell, B. P., Waites, G. M. H. and young, J. A. 1970. The composition of the fluid collected by micropuncture and catheterization from the seminiferous tubules and rete testis of rat. *Eur. J. Physiol.* 318 : 225.

Vitale-Calpe, R. and Aoki, A 1969. Fine structure of the intratesticular excretory pathway in the guinea pig. *Z. Anat. Entwicklungsgesch.* 129 : 135-153.

Warwick, R. and Williams, P. L. (Eds.). 1973. *Gray's Anatomy* 35th edn. PP 1337-1341. Edinburgh : Longman.

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PARANASAL SINUSES OF BUFFALO *(BUBALUS BUBALIS)*

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ABSTRACT

The paranasal sinuses and the associated ethmoidal sinuses were studied in buffalo calves and adult buffaloes by gross anatomical dissections. The morphology of maxillary, palatine, lacrimal, frontal, sphenoidal and ethmoidal sinuses was recorded. The size and extent of the maxillary, palatine and lacrimal sinuses varied greatly in young and adult animals. Frontal sinus was the largest amongst the paranasal sinuses. Sphenoidal sinus which had been reported to be absent in buffalo calves was recorded constantly present in adult buffaloes. The ethmoidal sinuses were enclosed in the substance of the ethmoturbinates. The dorsal conchal sinus, enclosed in the dorsal nasal concha (Endoturbinate-I) communicated with the rostrolateral compartment of the frontal sinus. The middle conchal sinus was enclosed in the middle nasal concha (Endoturbinate-II) and communicated with the ethmoidal meatuses. The ethmoidal air cells were recorded in the rostroventral part of the ethmoidal labyrinth.

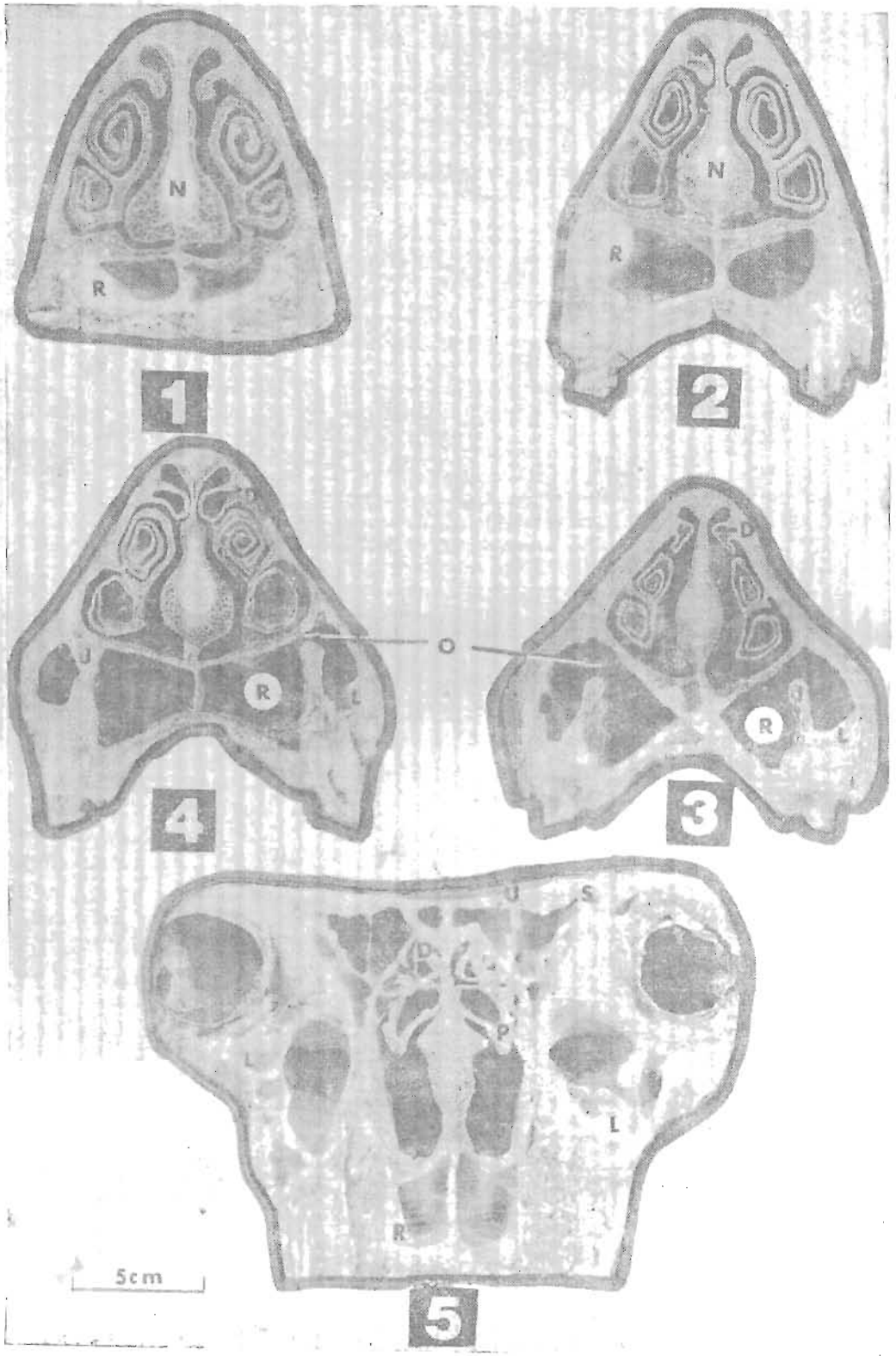
Paranasal sinuses are the excavations in the bones of the skull and are the extentions of the nasal cavity. The affections of the sinuses need surgical manipulations. Hence, their exact morphology in young and adult buffaloes is required. Blanton and Biggs (1969) reviewed the paranasal sinuses of most of the mammals with the exception of buffalo which took very little notice of the comparative anatomists because of its limited distribution in Asia. Only recently, the tempo of research on buffalo anatomy has gained momentum because of its rich contributions in Indian economy. Saigal and Khatra (1977) dealt with the paranasal sinuses of adult buffalo. However, a few of salient features in young and adult buffaloes needed further investigations.

MATERIAL AND METHODS

The studies were conducted on 10 male buffalo calves (1-2 years old age) and 10 adult buffaloes of either sex (4 to 10 years of age). The animals were embalmed and their heads were sawed off the cadavers at the atlanto-axial articulation. Five heads each from the young and the adult animals were macerated in running tap water. The following treatments were given both to the macerated skulls :

(A) Midsagittal and parasagittal sections were cut in two specimens each from the young and adult buffaloes.

(B) Cross sections of two specimens each from the young and adult buffaloes were cut at the following fixed anato-


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mical levels : 1. incisive papilla, 2. fifth transverse ruga of the hard palate, 3. tenth transverse ruga of the hard palate, 4. rostal to first premolar tooth, 5. between first and second premolar teeth, 6. between second and third premolar teeth, 7. between third premolar tooth and first molar tooth, 8. between first and second molar teeth, 9. between second and third molar teeth, 10.caudal to third molar tooth, 11. lateral canthus of the eye, 12. anterior border of the base of the horn, 13. middle of the base of the horn, and 14. posterior border of the base of the horn.

(C) The remaining macerated specimens from the young and adult buffaloes were sculptured according to the method of Saigal and Khatra (1977).

The unmacerated specimens were treated as under :

a. Midsagittal and parasagittal sections were cut in two specimens each from the young and adult buffaloes.

b. Cross sections of the remaining six specimens from the young and adult buffaloes were cut at the above mentioned fixed anatomical levels.

Anglicised terminology from Nomina Anatomica Veterinaria (1973) has been used.

RESULTS AND DISCUSSION

The paranasal sinuses were the extentions of the nasal cavity into malar *(Os zygomaticum)*, maxillary, lacrimal *(Os lacrimale)*, palatine *(Os palatinum)*, frontal *(Os frontale)* parietal *(Os parietale)*, occipital *(Os occipitale)*, and sphenoid *(Os sphenoidale)* bones. The ethmoidal sinuses were excavated in the ethmoidal labyrinth *(Labyrinthus ethmoidalis)*. The maxillary sinus, palatine sinus, lacrimal sinus, frontal sinus, sphenoidal sinus and ethmoidal sinus were recognized in buffalo.

Maxillary Sinus

The maxillary sinus *(Sinus maxillaris)* was chiefly situated in the maxillary bone (Figs. 3-6). It extended dorsocaudally into the malar and lacrimal bones in the adult buffalo, however, in buffalo calves it extended into the maxilla and lacrimal bone only (Fig 9). The zygomatic process of the malar bone did not show any excavation in young calves. Maxillary sinus morphology in adult buffalo is similar to that of goat (Dhingra and Singh,

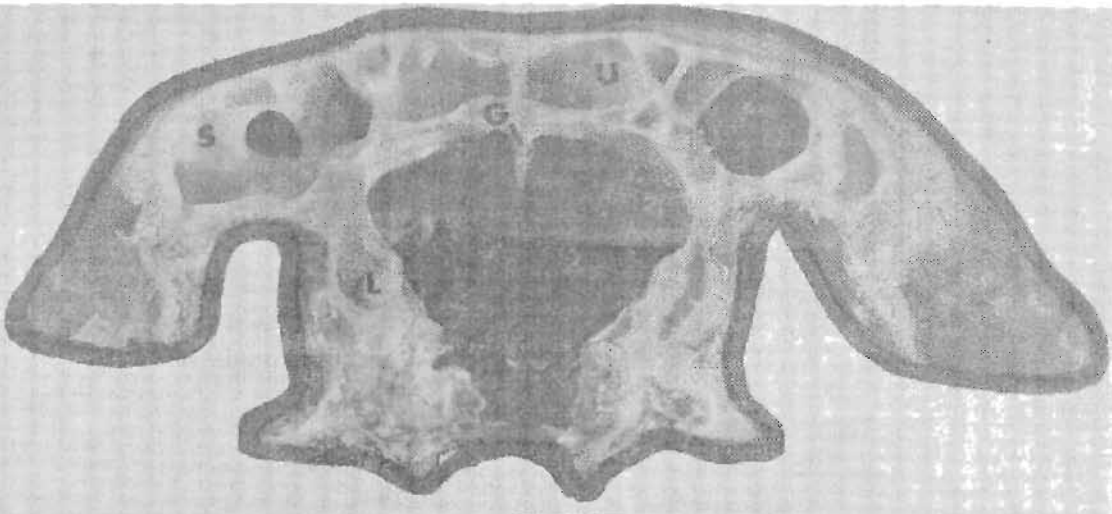
Fig. 1. Cross section of the head of buffalo at the level of rostral border of the first premolar tooth showing rostral limit of the palatine sinus.

Fig. 2. Cross section of the head of buffalo at the level between first and second premolar teeth. Note the median septum of palatine sinus increasing in height caudally.

Fig. 3. Cross section of the head of buffalo at the level between third premolar tooth and first molar tooth showing communication (arrow) pointing at maxillopalatine opening between maxillary sinus and palatine sinus.

Fig. 4. Cross section of the head of buffalo at the level between second and third molar teeth showing maxillopalatine opening.

Fig. 5. Cross section of the head of buffalo at the level of the lateral canthus of the eye showing the middle conchal sinus, rostromedial segment of caudal compartment of frontal sinus, postorbital diverticulum.



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1971), bovines, ovines (Sisson; 1975) and it is in agreement with Saigal and Khatra (1977). In adult buffalo, the sinus measured 15–20 cm in length and extended rostrally upto the level of the second premolar tooth. Caudally it extended 5–8 cm caudal to the level of the third molar tooth. Topographically its rostral limit lay 1.5—2.5 cm rostral to the facial tuberosity *(Tuber faciale)* and its caudal limit was marked by the supraorbital foramen *(Foramen supraorbitale)* or the junction of temporal process *(Processus temporalis)* and frontal process *(Processus frontalis)* of the malar bone. In buffalo calves, it measured 8–10 cm in length and extended rostrally to the level of the junction of the first and second premolar teeth and caudally to 1 cm rostral to the level of the supraorbital foramen. Saigal and Khatra (1977) described its extension from the level of the second cheek tooth to the lacrimal bulla. In bovines (McLeod, 1958; Sisson, 1975) the sinus extends from infraorbital foramen to the lacrimal bulla.

The roof of the maxillary sinus of adult buffalo was formed partly by the floor of the nasal cavity and partly by the floor of the lacrimal sinus. The caudal extention of the sinus was a thin papyraceous bony bulla which projected into the orbital fossa. The floor of the sinus was uneven due to the projections of the roots of the molar teeth. The lateral wall was formed by the maxillary bone and malar bone. It presented a diverticulum starting at the level of third molar tooth and extending into the body and temporal process of the malar bone upto the level of temporo-zygomatic suture *(Sutura temporozygomatica)*. The medial wall was contributed partly by the internal maxillary lamina and partly by the lacrimal bone and nasolacrimal canal *(Canalis nasolacrimalis)*. It was deficient dorsally from the level of third premolar tooth to third molar tooth and formed the maxillopalatine opening *(Apertura maxillopalatine)* (Figs. 3, 4). Caudal to third molar tooth it extended into a dilated pyramidal shaped lacrimal bulla *(Bulla lacrimalis)*. In buffalo calves, the roof was formed caudally by the floor of the nasolacrimal canal and rostrally by the sloping lateral wall of the maxillary and malar bones. The diverticulum of the maxillary sinus in the malar bone was absent and caudally it terminated in a cone shaped papyraceous extention. The floor was uneven and projections of second and third premolar teeth, and first molar tooth were present. According to Saigal and Khatra (1977) the medial wall is formed by an osseous septum. In ox, the lateral wall is formed by the outer table of the maxilla, lacrimal and malar bones, the medial wall by an imperfect plate of bone spring from the alveolar border and its floor shows projections of last three or four cheek teeth (Raghavan, 1964). In ovine, the sinus lies between medial and lateral plates of maxilla and zygomatic

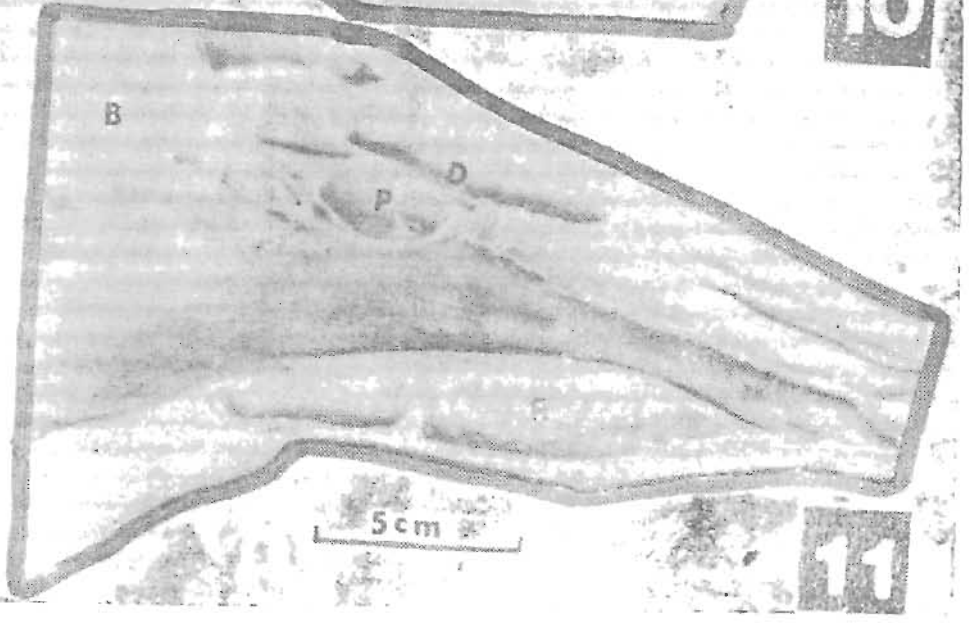
Fig. 6. Cross section of the head of buffalo at the level of the anterior border of the horn showing rostromedial segment of caudal compartment of frontal sinus, postorbital diverticulum, caudal extent of maxillary sinus.

Fig. 7. Cross section of the head of buffalo at the middle of the base of the horn showing cornual diverticulum.

Fig. 8. Cross section of the head of buffalo at the posterior border of the base of the horn showing cranial fossa, cornual diverticulum and nuchal diverticulum.


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bone and is further subdivided by the infraorbital canal into medial and lateral chambers (Sisson, 1975). In adult buffalo, the maxillary sinus communicated with the palatine sinus *(Sinus palatinus)* and middle nasal meatus *(Meatus nasi medius)* through maxillopalatine opening (Figs. 3, 4) and nasomaxillary aperture *(Apertura nasomaxillaris)*, respectivelly. The maxillopalatine opening lay over the free margin of the infraorbital canal *(Canalis infraorbitalis)* and extended between third premolar to third molar tooth measuring 8–10 cm in length. The nasomaxillary opening lay in the caudal part of the main segment of the middle nasal meatus (Dhingra and Kumar, 1978). In adult animals the opening measured 2.4–3.5 cm and it lay at the level of the third molar tooth. The communicating passage between the nasomaxillary opening and the maxillary sinus, occupied a narrow space bounded medially by the lateral wall of the nasal chamber and laterally by the medial wall of the rostrolateral compartment of frontal *(Sinus frontalis rostralis lateralis)* and lacrimal sinuses *(Sinus lacrimalis)*. In buffalo calf, the maxillopalatine aperture measured 4.5–5.5 cm and extended between second premolar to first molar teeth. The nasomaxillary opening measured 1–2 cm in length and lay at the level of first molar tooth. The maxillopalatine opening in bovines (McLeod, 1958; Raghavan, 1964; Sisson, 1975), goat (Dhingra and Singh, 1971) and in buffalo (Saigal and Khatra, 1977) is similar to our findings except in case of ovine the medial chamber communicates with the palatine sinus at the level of last cheek tooth (Sisson, 1975). The nasomaxillary opening in buffalo (Saigal and Khatra, 1977) is not distinguishable due to its continuity with the defect in the roof of the palatine sinus, whereas in ox (Sisson, 1975) the much narrower opening lies dorsal to the maxillopalatine aperture and in sheep and goat (Hare, 1975) the opening lies in the dorsal passage of the middle nasal meatus caudally.

Palatine Sinus

The palatine sinus was an excavation in the palatine bone and palatine process *(Processus palatinus)* of the maxilla (Figs. 1-5, 10, 11). The sinus was excavated equally in the above two bones in adult buffalo, whereas in buffalo calves, its two third part was enclosed in the palatine process of maxilla and one third in the horizontal part *(Lamina horizontalis)* of the palatine bone. Its length measured 20-25 cm in adult and 12-15 cm in young animal. The sinuses of either side were separated completely by a median bony septum *(Septum sinuum palatinorum)*. In adult buffalo, it extended rostrally 2.5-4.5 cm rostral to the first premolar tooth at the level of tenth to eleventh transverse rugae *(Rugae palatinae)* of the hard palate and 8-9 cm caudal to the third molar tooth caudally. However, in buffalo calves

Fig. 9. Dorsal surface view of the skull of buffalo calf sculptured to expose the sinus frontalis rostralis, rostromedial segment of caudal compartment of frontal sinus, postorbital diverticulum and lacrimal sinus.

Fig. 10. Midsagittal section of macerated skull of the buffalo showing the dorsal conchal sinus and middle conchal sinus.

Fig. 11. Parasagittal section of the head of buffalo calf showing the dorsal conchal sinus, middle conchal sinus and palatine sinus.

the rostral limit of the sinus lay 2.5-3.5 cm rostral to the level of infraorbital foramen *(Foramen infraorbitale)* and its caudal extent lay 1.5-2 cm caudal to the level of the first molar tooth. The sinus presented a small caudodorsal diverticulum directed towards rostral margin of the sphenopalatine foramen *(Foramen sphenopalatinum)*. The palatine sinus increased in size rostrocaudally upto the level of the third molar tooth and it diminished in size caudally. According to Saigal and Khatra (1977) the rostral, two third of the sinus, lies within the maxilla and caudal one third within the os palatinum in adult buffalo which is similar to our findings in buffalo calves. They further reported that its rostral extent was located upto middle of the region of diastema and its caudal extent upto spina nasalis caudalis. In other domestic ruminants (McLeod, 1958; Raghavan, 1964; Sisson, 1975), the rostral extent is similar to our findings. However, its caudal extent in bovines lies at the posterior border of the palate (McLeod, 1958, Sisson, 1975). The roof of the palatine sinus, caudal to the third molar tooth was formed by the floor of the nasopharyngeal meatus and choana and rostrally by the floor of the nasal cavity excepting a deficient area extending from the rostral border of the first molar to the caudal border of the second molar teeth in adults and at the level of third permolar tooth in calves. The deficiency in roof was covered by mucous memberane in fresh specimen. The large oval gap just in the region of apertura maxillopalatina is also reported in buffalo (Saigal and Khatra, 1977). In bovines, the palatine sinus communicates with the nasal cavity through a large oval (McLeod, 1958) or a short narrow opening (Raghavan, 1964); whereas, in other domestic ruminants, there is a large defect in the roof of the sinus closed by two layers of mucous membrane (Sisson, 1975). The floor of the palatine sinus was formed by the horizontal plate of palatine bone upto the level of second molar tooth and rostral to this level by the palatine process of maxilla. The lateral wall of the palatine sinus was partially deficient dorsally, from the level of the third premolar to third molar teeth in adult buffalo and from second premolar to first molar teeth in buffalo calf, whereas the ventral portion of the deficient lateral wall was formed by the internal maxillary lamina which contained infraorbital canal in its free margin. The lateral wall was complete caudally from the level of the third molar tooth to the level of the lateral canthus of the eye and was formed by the perpendicular lamina *(Lamina perpendicularis)* of the palatine bone. Rostral to the third premolar tooth the lateral wall was complete and was formed partly by the internal maxillary lamina upto the level of the first premolar tooth and further rostrad by the ventral border of maxilla. In buffalo calf, the lateral wall was deficient dorsally from the level of the second premolar to first molar teeth. A bony median septum separated the two palatine sinuses completely and was attached dorsally to the floor of the nasal cavity at the level of median nasal septum *(Septum nasai)* and ventrally to the horizontal part of the palatine bone and palatine process of the maxilla (Figs. 1-5). The medial wall, in its rostral part, measured 1.5 cm in height (Fig 1) and it incressed gradually to reach a maximum height of 4 cm caudally (Fig. 5). It presented incomplete osseous septae directed towards the lateral wall

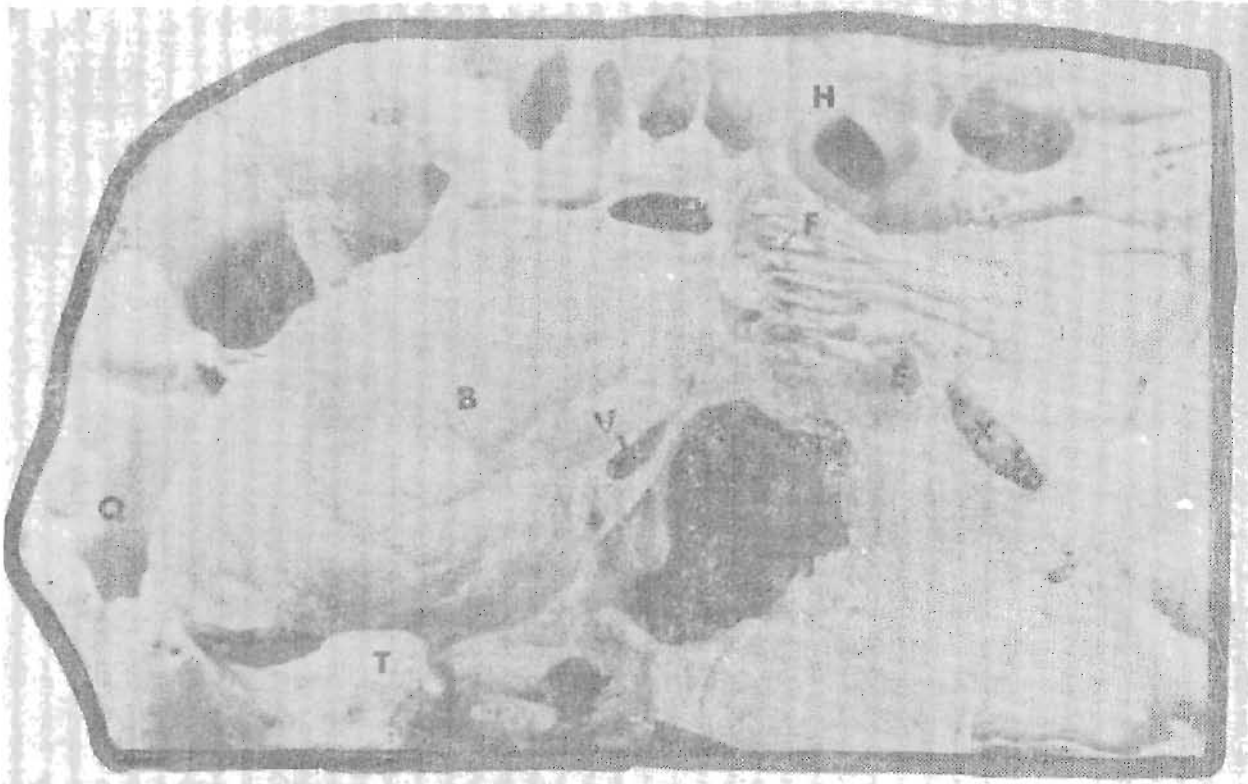
(Fig. 11). The bony palatine canal *(Canalis palatinus)*, in adult buffalo, traversed the sinus obliquely ascending from the anterior palatine foramen *(Foramen palatinum rostrale)* situated at the level of second molar tooth, to the posterior palatine foramen *(Foramen palatinum caudale)* situated at the level of the caudal border of the third molar tooth. The canal was deficient in its dorsal wall at the level of third molar tooth. In buffalo calf, the palatine canal lay in its entire length at the level of first molar tooth. According to Saigal and Khatra (1977) the palatine canal is almost open throughout its course dorsally in buffalo. In ox, it passes obliquely without any communication through the upper part of the sinus (Raghavan, 1964) or it passes obliquely through the caudal part of the palatine sinus (Sisson, 1975). The maxillo-palatine opening in buffalo has been discussed earlier in the description of the maxillary sinus.

Lacrimal Sinus

The lacrimal sinus was an excavation in the lacrimal bone and a part of the adjoining frontal bone in the adult buffalo, whereas in buffalo calf, it was present only in the lacrimal bone (Fig 9) It measured 2-3 cm and 6-8 cm in length in young and adult buffaloes, respectively. It extended rostrally upto the level of the second molar tooth and caudally upto the level of the frontal process of the malar bone in adult buffalo, whereas in young subjects, it extended rostrally upto the anterior margin of the orbit and caudally upto first molar tooth. According to Saigal and Khatra (1977) the caudal extent of the sinus lies 3-5 cm caudal to the margo Infraorbitalis which is similar to our finding except for difference in anatomical landmarks as margo infraorbitalis is formed by the frontal process of the malar bone. The caudal extent in bovine (McLeod, 1958) is similar to that of buffalo. In adult buffalo, the roof of the lacrimal sinus lay at the floor of the rostrolateral compartment of the frontal sinus, where an aperture at the level of the caudal border of third molar tooth provided a communication between the two sinuses. The floor was formed by the caudal extension of roof of the maxillary sinus, and an aperture at the level of third molar tooth provided communication with maxillary sinus. The medial wall was formed by the orbital part of the frontal bone which separated lacrimal sinus from the ethmoidal labyrinth and nasomaxillary fissure *(Fissura nasomaxillaris)*. Rostrally the lateral wall was formed by nasolacrimal canal and caudally by orbital part of lacrimal and frontal bones. The lateral wall was separated from the caudal extention of the maxillary sinus. According to Saigal and Khatra (1977) the lacrimal sinus in buffalo is bounded rostrolaterally, caudolaterally and medially by facial, orbial and nasal parts of lacrimal bone, respectively. They further reported that its roof was formed by the frontal bone. The communication of the lacrimal sinus with the maxillary sinus has also been reported in buffalo (Saigal and Khatra, 1977), and ruminants (Sisson, 1975). McLeod (1958) thought it to be an extention of the maxillary sinus in bovines.

Frontal Sinus

The frontal sinus was largest of the paranasal sinuses (Figs. 5-9, 12, 13). It was excavated in the frontal, parietal and occipital bones in the adult buffalo.



12



5 cm

13

Its excavation was confined to the frontal bone in buffalo calf. Saigal and Khatra (1977) reported its excavations in the interparietals of adult buffalo in addition to the bones reported in this study. Since the interparietals are primitively paired and lose their identity by fusing with the parietals and supraoccipital bones before or shortly after birth (unpublished observations), it was not possible to confirm their being excavated in the young and adult animals. Similar observations have been made in bovines (McLeod, 1958; Raghavan, 1964; Sisson, 1975). The frontal sinus was present in the bones forming the roof of the cranial cavity *(Cavum cranii)*, upper half of the temporal fossa *(Fossa temporalis)* and a part of the roof of the nasal cavity in adult buffalo, whereas in buffalo calf the rostral part of the roof of the cranial cavity and nasal cavity (Fig. 9) housed it. In adult buffalo the rostral extent was marked 1–1.5 cm caudal to frontonasal suture *(Sutura frontonasalis)* and the caudal limit lay at the level of the external occipital protuberance *(Protuberentia occipitalis externa)*. In buffalo calf the rostral limit lay at the level of the first molar tooth and caudal limit lay 4-5 cm caudal to supraorbital foramen. The frontal sinus extended laterally into the lateral margins of the frontal bone and caudolaterally into the cornual diverticulum (Figs. 7, 8) in adult buffalo. In buffalo calf, the lateral extent lay at the upper margin of the orbit restricted medial to the supraorbital foramen and caudolaterally at the root of the cornual process *(Processus cornualis)*. Medially the frontal sinus was separated completely from its counterpart by a bony median sagittal septum *(Septum sinuum frontalium)* in young and adult animals. According to Saigal and Khatra (1977) the rostral extent of the frontal sinus lie at the level of margo infraorbitalis and its caudal extent is in agreement to our findings in buffalo. The frontal sinus in adult buffalo was further subdivided into a rostral compartment *(Sinus frontalis rostralis)* and caudal compartment *(Sinus frontalis caudalis)* by a transverse oblique bony septum which arose medially from the median sagittal septum at the level of the cribriform plate *(Lamina cribrosa)* of the ethmoid bone *(Os ethmoidale)*. The rostral compartment was further divided by incomplete parasagittal bony septae into sinus frontalis rostralis lateralis. The caudal compartment of frontal sinus which lay caudal to the transverse oblique septum was further divided by another caudal oblique transverse septum into rostromedial segment and the main compartment. The latter was the largest of all the compartments and contained postorbital, nuchal and cornual diverticula (Figs. 6-8, 12). The main segment of the caudal compartment of the frontal sinus in buffalo calf was divided into a small medial and a large lateral compartment (Fig 9). The other diverticula of this sinus, as have been described above were absent in buffalo calf. Saigal and Khatra (1977) reported an additional

Fig. 12. Parasagittal section of the macerated skull of buffalo showing the sphenoidal sinus, ethmoidal air cell and nuchal diverticulum forming the posterior wall of the cranial fossa.

Fig. 13. Parasagittal section of the macerated skull of the buffalo showing ethmoidal air cell, dorsal conchal sinus, middle conchal sinus and ethmoidal meatuses.

sinus frontalis rostralis intermedius in the rostral compartment. The frontal sinus is divided into numerous diverticula by ridges and partial septae in ox (Raghavan, 1964). Sisson (1975) stated, that in bovines it was divided into one major caudal frontal sinus and four minor rostral frontal sinuses. Rostromedial compartment of the frontal sinus in its caudal portion formed the roof of the ethmoidal labyrinth in adult buffalo. It was narrow and much smaller rostrally and formed the caudal part of the roof of the dorsal nasal meatus *(Meatus nasi dorsalis)* caudally, it became wider and extended upto the level of the cribriform plate of the ethmoid bone. Its rostral limit lay 1-2 cm caudal to the level of the frontonasal suture. The roof of the sinus was formed by the outer table *(Facies externa)* of the frontal bone, its medial wall by the median sagittal septum and its lateral wall by the parasagittal incomplete bony septa which facilitated its communication with the rostrolateral compartment of frontal sinus. It contained an opening in its ventrolateral part at the level of the lateral canthus of the eye through which it communicated with the ethmoidal meatuses. Similar communication has been described by Saigal and Khatra (1977), whereas in bovines (Sisson, 1975) the rostral frontal sinuses communicate with the ethmoidal meatuses and in macerated specimen, with the sinus of the dorsal nasal concha and lacrimal part of the maxillary sinus, the rostrolateral compartment of the frontal sinus and caudolaterally with the main caudal compartment of the frontal sinus. The ethmoidal labyrinth lay at the floor of the sinus rostrally and one to two small foramina 2-4 cm rostral to supraorbital foramen provided communication with the sinus of the dorsal nasal concha *(Sinus conchae dorsalis)*. In buffalo calf, the rostral limit lay at the caudal border of the second molar tooth. The floor and medial wall of the sinus separated it rostromedially from the ethmoidal labyrinth, and rostrolaterally its lateral wall separated it from the lacrimal sinus and nasolacrimal canal. It communicated caudomedially with the rostromedial compartment of the frontal sinus, rostromedial segment of caudal compartment of the frontal sinus and caudolaterally with the postorbital diverticulum of the caudal compartment of frontal sinus. The sinus of the dorsal nasal concha communicated through one to two foramina at the level of the second molar tooth. Saigal and Khatra (1977) reported that the rostral limit of the rostrolateral compartment lies at the junction of the facial crest and orbital margin. They further reported that its floor had 5-6 or more foramina through which it communicated with the dorsal conchal sinus. The caudomedial and caudolateral communications of the sinus described by them are in agreement with this report. The rostromedial segment of the caudal compartment in adult buffalo communicated rostrally with the rostrolateral compartment of the frontal sinus and caudally the partial transverse oblique septum separated it from the main segment of frontal sinus. Its medial wall was formed by the median sagittal septum which separated it from its fellow on the opposite side. It continued into main caudal segment of the caudal compartment of frontal sinus, and formed the roof of the anterior cranial fossa *(Fossa cranii rostralis)* in its rostral part. It communicated rostrally, with the rostromedial and rostrolateral compartments of frontal sinus. Laterally the sinus was separated from the postorbital

diverticulum by a parasagittal septum. Its floor, in its rostral part was formed by the orbital part of the frontal bone. This sinus is named as sinus frontalis caudalis pars rostromedialis in adult buffalo (Saigal and Khatra, 1977). They have further reported that it is irregular in shape and communicates rostrocaudally with the sinus frontalis caudolateralis in its postorbital diverticulm. The main segment of the caudal compartment of frontal sinus in adult buffalo was very extensive. It was mainly excavated in the frontal bone and extended caudally into the supraoccipital part of the occipital bone and laterally into the parietal bones. A transverse oblique septum demarcated the postorbital diverticulum in the rostrolateral part of the sinus and a parasagittal septum demarcated caudomedially placed nuchal diverticulum and caudolaterally placed cornual diverticulum (Figs. 7, 8). The postorbital diverticulum was related to the upper margin of the orbit and was associated rostrally with the rostrolateral and rostromedial compartments, medially the rostromedial segment of the caudal compartment, caudomedially the nuchal diverticulum and caudolaterally the cornual diverticulum. It lay over the posterior wall of the orbital fossa. The supraorbital canal *(Canalis supraorbitalis)* traversed through the cavity of the sinus without any communication with the postorbital diverticulum. At the level of the optic foramen it communicated with the sphenoidal sinus. The nuchal diverticulum was a caudolateral extention of the main segment of caudal compartment of frontal sinus and it was separated from the postorbital diverticulum and nuchal diverticulum by bony septae. The cornual diverticulum was divided into small diverticula by the incomplete bony septae arranged in varying directional places. The diverticulum extended upto one third the length of the cornual process of the frontal bone (Figs. 7, 8). In buffalo calf, the caudal compartment of the frontal sinus showed comparatively much larger postorbital diverticulum. It extended rostrally upto the level of postglenoid process *(Processus retroarticularis)* of the temporal bone. The nuchal and cornual diverticula were absent. The postorbital diverticulum communicated rostromedially with the rostrolateral compartment of the frontal sinus and supraorbital canal lay outside the sinus on the lateral extent of the upper rim of the orbit. The roof and posterior wall of the orbital fossa was formed by the postorbital diverticulum. The main segment of the caudal compartment has been described as sinus frontalis caudalis pars caudolateralis in buffalo (Saigal and Khatra, 1977). This report on its diverticula and their extent is similar to the present observation. The caudal compartment of the frontal sinus in bovines (Sisson, 1975) communicates rostrally at its floor with the ethmoidal meatus, whereas no such communication was noticed in young or adult buffalo.

Sphenoidal Sinus

The sphenoidal sinus *(Sinus sphenoidalis)* was excavated mainly in the wings of the presphenoid bone *(Os presphenoidale)* and it extended partly into the adjacent portion of body of the bone (Fig. 12). In adult buffalo, it measured 1.5–2.5 cm in length. Its roof was related to the floor of the cranial fossa rostral to the level of optic foramen and its floor was related to the roof of the orbitorotundum foramen. It extended rostrally upto the level of the ethmoidal crest

(Crista ethmoidalis) or slightly rostral to the optic foramen where it communicated with the postorbital diverticulum of the frontal sinus through an opening, apertura sinus sphenoidalis. Its caudal limit was at the level of the rostral clinoid process *(Processus clinoideus rostralis)* of the sphenoid bone. The sphenoidal sinus was absent in buffalo calves. It has been reported to be absent in adult buffalo (Saigal and Khatra, 1977). In ox (Raghavan, 1964), the sphenoidal sinus is present in the wing of the presphenoid bone which is in agreement to our findings, whereas in ovine, it occupied the ventral part of the presphenoid bone (Sisson, 1975). The communication of the sphenoidal sinus with the ethmoidal meatuses has been reported in ox (Raghavan, 1964) and ovines (Sisson, 1975), whereas no such communication was detected in buffalo.

Ethmoidal Sinuses

The ethmoidal sinuses were closely associated with the paranasal sinuses in buffalo. These were spaces enclosed in the substance of the endoturbinates *(Endoturbinalia)* and ectoturbinates *(Ectoturbinalia)* of the ethmoidal labyrinth. They included ethmoidal sinuses and ethmoidal air cells. The dorsal conchal sinus and the middle conchal sinus *(Sinus conchae mediae)* were quite large excavations of the ethmoturbinates *(Ethmoturbinalia)* and, therefore, warranted description alongwith paranasal sinuses. The dorsal conchal sinus, excavated in the dorsal nasal concha *(Concha nasalis dorsalis)* (Figs. 3-5, 10, 11) measured 20-22 cm in length in adult buffalo and 10-12 cm in buffalo calf. In adult animal, it extended rostrally upto the second premolar tooth level and caudally upto the level of the cribriform plate of the ethmoid bone. In buffalo calf, it extended from second molar to first premolar teeth level. The sinus became narrower as it was traced rostrally. Dorsally it was related to the nasal *(Os nasale)* and frontal bones through the dorsal nasal meatus (Fig. 10) and ventrally it was related to the dorsal limb and main segment of the middle nasal meatus. It communicated with the rostrolateral compartment of the frontal sinus through 1-2 foramina. The excavation in the dorsal nasal concha has also been reported in bovines (Raghavan, 1964; Sisson, 1975). In ovines (Sisson, 1975), the sinus communicated with the middle nasal meatus at the level of the last cheek tooth and the bony septum between the cavity of the concha and frontal sinus was incomplete in dried skulls (May, 1970).

The sinus of the middle nasal concha was the next largest sinus amongst ethmoidal sinuses (Figs. 5, 10, 11, 13). It was excavated in the middle nasal concha *(Concha nasalis media)* measuring 8-10 cm in length in adult animal and 5 5-6.5 cm in buffalo calf. It extended caudorostrally from cribriform plate of the ethmoid bone to the rostral border of the the third molar tooth in adult animal, whereas in buffalo calf, its rostral limit lay at the first molar tooth. It was separated dorsally from the dorsal nasal concha by the dorsal limb of the middle nasal meatus and ventrally it was separated from the ventral nasal concha *(Concha nasalis ventralis)* by the ventral limb of the middle nasal meatus. The ethmoidal sinus drained into ethmoidal meatuses. The ethmoidal air cells numbering 2-3 in adult animal (Figs. 12, 13) and only one in buffalo calf, were seen in a parasagittal section lying at the rostroventral part of the ethmoidal

labyrinth. They communicated with the ethmoidal meatuses. Similar ethmoidal cells *(Paraethmoidal sinuses of Loeffler,* 1959*)* have been described by Hillman (1975) in pig as excavations in the bones surrounding the ethmoidal labyrinth.

REFERENCES

Blanton, P. L. and Biggs, N. L. 1969. Eighteen hundred years of controversy. The paranasal sinuses. *Am. J. Anat.* **124 :** 135-148.

Dhingra, L. D. and Kumar, S. 1978. Nasal cavity of buffalo *(Bubalus bubalis), Haryana agric. Univ. J. Res.,* 8 : 107-119.

Dhingra, L. D. and Singh, Y. 1971. Paranasal sinuses of the goat. *Haryana agric. Univ. J. Res,* 1 : 31-39.

Hare, W. C. D. 1975. Ruminant respiratory system. In : Getty, R. ed., 1975. Sisson and Grossman's *the Anatomy of the Domestic Animals* 5th ed., Vol. 1, pp 919. Philadelphia : W. B. Saunders Co.

Hillman, D. J. 1975. Porcine Osteology, Skull. In : Getty, R. ed., 1975. Sisson and Grossman's *the Anatomy of the Domestic Animals.* 5th ed., Vol. 2, pp 1250-1252.

Loeffler, K. 1959. The topography of the nasal cavity and the paranasal sinuses in the pig. *Deutsche tierartl. Woch.* 66 : 237-242 and : 270-273.

May, N.D.S. 1970. *The Anatomy of the Sheep.* 3rd ed., Univ. Queensland Press, Australia.

McLeod, W. M. 1958. *Bovine Anatomy.* 2nd ed, (Revised by Trotter, D. M., and Lumb, J. W.) pp 4 and 8. Minneapolis: Burgess Publishing Co.

Nomina Anatomica Vaterinaria. 1973. Including changes adopted by the International Committee on Veterinary Anatomical Nomenclature in 1975. 2nd ed. Vienna: World Association of Veterinary Anatomists.

Raghavan, D., ed. 1964. *Anatomy of the Ox.* pp 77, 82-84. New Delhi : Indian Council of Agricultural Research.

Saigal, R. P. and Khatra, G. S. 1977. Paranasal Sinuses of adult buffalo *(Bubalus bubalis). Anat. Anz.* 141 : 6-18.

Sisson, S. 1975. Ruminant Osteology. In : Getty, R. ed., 1975. Sisson and Grossman's *the Anatomy of the Domestic Animals.* 5th ed., Vol. 1, pp 768., 772-774. 783., 785-786. (Edited by Ellenport, C. R. and reviewed by Hillman, D. J.) Philadelphia : W. B. Saunders Co.

Abbreviations used in the illustrations

A	Cornual diverticulum
B	Cranial fossa
C	Dorsal nasal meatus
D	Dorsal conchal sinus
E	Ethmoidal air cell
F	Ethmoidal meatuses
G	Falx cerebri
H	Frontal sinus

I Sinus frontalis rostralis

J Infraorbital canal

K Lacrimal sinus

L Maxillary sinus

M Middle nasal meatus

N Median nasal septum

O Maxillopalatine opening

P Middle conchal sinus

Q Nuchal diverticulum

R Palatine sinus

S Postorbital diverticulum

T Petrous temporal bone

U Rostromedial segment of caudal compartment of frontal sinus

V Spenoidal sinus

W Supraorbital foramen

X Sphenopalatine foramen

Y Ventral nasal concha

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UTILIZATION OF AGRO-INDUSTRIAL BYPRODUCTS BY LIVESTOCK AND POULTRY

II EFFECT OF HIGHER LEVELS OF PEA WASTE ON THE PERFORMANCE OF BROILER CHICKS

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ABSTRACT

Diets containing 0, 10, 15 and 20% dehydrated pea waste were fed to 96 day-old broiler chicks divided into eight groups of 12 each for a period of 10 weeks of age. Individual body weight and group feed consumption were recorded at weekly intervals. Data of carcass characteristics were obtained at 10 weeks of age.

Inclusion of pea waste at 20% level in the diet resulted in significantly ($P < 0.05$) higher body weight gain with better feed efficiency than other treatments. The yield of edible meat was also significantly ($P < 0.05$) higher in broiler fed ration containing 20% pea waste. It saved Rs. 0.56 to produce a kg of dressed carcass in comparison to control.

Earlier studies on broiler chicks (Khirwar *et al.*, 1979) fed diets containing malt sprout and dehydrated pea waste indicated that inclusion of pea waste upto 10% in the diet significantly increased performance and lowered the cost. The present experiment was aimed to explore the possibility of further increasing the level of inclusion in broiler rations.

MATERIAL AND METHODS

Ninety-six day-old Arbor Acre Commercial broiler chicks, vaccinated for fowl pox and marex disease, were reared in electrically heated battery brooder and maintained on a standard mash for one week. Subsequently, these chicks were wing banded and randomly distributed into 8 groups of 12 each on the basis of uniform body weight. Each dietary treatment was randomly allotted to two groups.

Four test diets (Table 1) were formulated by incorporating dehydrated pea waste (PW), at 0, 10, 15 and 20% levels. The levels of protein, energy and crude fibre in the diets were within the limits prescribed by ISI (1967) for broiler rations. Calorie, protein ratio of each diet was approximately 130-135 : 1. Feed and water were available *ad lib.* throughout the experimental period of 10 weeks. Individual body weight and group feed intake were recorded at weekly intervals.

TABLE 1

Composition of the experimental rations

Ingredients (%)	Levels of pea waste (PW) %			
	0* (T_1)	10 (T_2)	15 (T_3)	20 (T_4)
Constant mash**	64.0	64.0	64.0	64.0
Rice polish	25.0	21.0	11.0	6.0
Molasses	5.0	5.0	10.0	10.0
G. N. Cake	6.0	—	—	—
Pea waste (dehydrated)	—	10.0	15.0	20.0
Calculated composition (as fed basis)				
Crude protein (%)	20.61	20.19	20.40	21.06
M. E. (Kcal/kg)	2843	2837	2807	2807

* Vitablend (Glaxo) was added to supplement Vit. A, B_2 and D_3 @ 25g and Bifuran @ 40g as a coccidiostat per 100 kg diet.

** Constant mash cantained maize 35.0; fish meal 8.0; maize gluten meal 17.5; poultry mindif 2.5 and limestone 1.0 parts.

At the end of 10 weeks all the chicks were slaughtered for carcass evaluation. Feed was withdrawn 24 hr. prior to killing, but a free supply of drinking water was made available. Each bird was weighed (empty live weight), killed and dressed carcasses were weighed after hand picking of feathers and removing the shanks by cutting at the hock joint. Eviscerated weights were recorded after removal of crop, gullet and trachea.

The chemical composition of feed ingredients was determined by A. O. A. C. (1970) methods. The data were analysed statistically (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Mean live weight of chicks at start of the experiment, 8 and 10 weeks are presented in Table 2. At 8 weeks of age, maximum body weights were recorded in T_4 followed by T_3, T_2 and T_1, respectively. Statistical analysis of the data revealed that treatment T_1 and T_2 did not differ significantly from each other but treatment T_3 had significantly ($P<0.05$) higher body weight than T_1 and T_2. However, treatment T_4 had significantly ($P<0.05$) higher live weights compared to all the other treatments. At 10 weeks of age, the live weights of chicks under treatment T_1, T_2 and T_3 did not differ significantly amongst each other while significantly ($P<0.05$) higher live weights were recorded in chicks fed diet containing 20% PW (T_4). However, inclusion of dehydrated pea waste at any level of inclusion showed an improvement in the performance of chicks both at 8 and 10 weeks of age. Highest feed consumption was recorded in treatment T_4, followed by treatment T_3, T_1 and T_2 while body weight gains were highest in treatment T_4, followed by treatment T_3, T_2 and T_1, respectively, at 8 weeks of age.

At 10 weeks of age also, higher feed consumption was recorded in treatment T_4. The chicks receiving diets containing 10 and 15% PW (T_2 and T_3) consumed almost similar amount of feed but more compared to control one. Chicks receiving diets containing PW utilized the feed

TABLE 2

Performance of chicks on pea waste diets

Particulars	Levels of pea waste (%)			
	0 (T_1)	10 (T_2)	15 (T_3)	20 (T_4)
	1—8 weeks			
Av. initial body weight (g)	42.29±1.85[a]	42.29±1.65[a]	42.08±1.83[a]	42.08±1.44[a]
Av. final body weight (g)	710.75±39.59[a]	800.87±34.07[a]	927.08±33.92[b]	1021.82±23.59[c]
Av. body weight gain (g)	668.46	758.58	885.00	979.74
Av. feed consumed (g)	1957.00	1778.00	1970.00	2137.00
Feed : gain (FCR)	2.93	2.34	2.23	2.18
Cost/kg gain (Rs.)	3.20	2.36	2.26	2.23
	1—10 weeks			
Av. final body weight (g)	1011.50±45.53[a]	1113.48±35.74[a]	1105.91±56.60[a]	1347.73±45.02[b]
Av. body weight gain (g)	969.21	1071.19	1063.83	1305.65
Av. feed consumed (g)	2784.00	3052.00	3029.00	3434.00
Feed : gain (FCR)	2.87	2.85	2.84	2.63
Cost/kg gain (Rs)	3.04	2.88	2.87	2.69

± indicates standard error of mean.

The figures having same superscript are not statistically different from each other.

TABLE 3

Carcass yield, dressing percentage and economics at 10 weeks of age

Parameters	Levels of pea waste %			
	0 (T_1)	10 (T_2)	15 (T_3)	20 (T_4)
Empty live weight (g)	955.50±43.31	1048.26±34 31	1055.91±53 51	1269.54±44 31
Dressed weight (g)	673.00±30.21[a]	740.86±95 34[a]	758.18±39.06[a]	910.68±33 64[b]
Eviscerated weight (g)	547.50±26.36[a]	606.95±22.14[a]	623.64±35.32[a]	770 90±32.26[b]
Dressing percentage	70.49±0.38[a]	70.67±0.32[a]	71.80±0.36[a]	71.73±0 34[a]
Feed cost/kg dressed carcass (Rs)	4.31	4.07	4.00	3.75

± indicates standard error of mean.

The figures having same superscript are not statistically different from each other.

more efficiently as compared to reference diet. However, higher efficiency of utilization was recorded at 20% level of inclusion both at 8 and 10 weeks of age. The efficiency of utilization is well indicated when expressed on FCR basis (Table 2). Improved performance of chicks on PW diets over reference diet might be due to the better amino acid make up of pea waste. Moran *et al.* (1968) reported that peas contained high amount of lysine and favourable amino acid balance for chicks. Khirwar *et al.* (1979) also reported an improvement in the efficiency of feed utilization when pea waste was incorporated at 10% level.

The data pertaining to carcass yield, dressing percentage and cost/kg carcasses at 10 weeks of age have been presented in Table 3. The yield of dressed and eviscerated carcasses were significantly ($P<0.05$) higher in treatment T_4 (20% PW) when compared to 0,10 and 15% levels of inclusion. While treatment T_3, T_2 and T_1 did not differ significantly amongst each other with respect to dressed and eviscerated weights. Inspite of the significantly different dressed carcass yield, the dressing percentage did not differ significantly in all the treatments indicating that different levels of PW did not influence the proportion of edible meat in the carcass.

ECONOMICS

At 8 weeks of age the cost of feed per kg gain was Rs. 3.20, 2.36, 2.26 and 2.23 in treatment T_1, T_2, T_3, and T_4, respectively. The corresponding figures at 10 weeks were Rs. 3.04, 2.88, 2.87 and 2.69; respectively (Table 2). These figures indicated that with the advance in age the feed cost/kg gain also increased in treatments containing pea waste while a slight reduction in feed cost was observed in control (T_1). This was due to improvement in FCR during last two weeks under treatment T_1 (control). When the figures of feed cost/kg gain were compared with the findings reported earlier *(Khirwar et al.*, 1979) it was found that the cost/kg gain was less in all the groups, at both the ages, under the conditions of the present experiment. The feed cost/kg dressed carcass (Table 3) was highest in control (T_1) followed by treatment T_2, T_3 and T_4, respectively. Inclusion of pea waste at 10, 15 and 20% levels resulted in a net saving of Rs. 0.24, 0.31 and 0 56/ kg dressed carcasses, respectively, over the control.

REFERENCES

A. O. A. C. 1970. *Official Methods of Analysis* (11th Edn.) Washington, D. C. Association of Official Agricultural Chemist.

I S I 1967. *Indian Standard Speciftcation for Broiler feeds IS : 4018.* Indian Standard Institution, New Delhi.

Khirwar, S. S., Paliwal, V. K. and Pradhan, K. 1979. Utilization of agro-industrial by-products by livestock and poultry. I Effect of malt sprout and pea waste on broiler chicks. *Haryana agric. Univ. J. Res.* 10 : 101-109.

Moran, E. T. Jr., Summers, J. D. and Jones, G. E. 1968. Field peas as a major dietary protein source for the growing chick and laying hen with emphasis on high temperature steam pelleting as a practical means of improving nutritional value. *Can. J. Anim. Sci.* 48 : 47-56.

Snedecor, G. W. and Cochran, W. G. 1967. *Statistical Methods* (6th edn.). The Iowa State Univ. Press, U. S. A.

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STUDIES ON THE PERFORMANCE OF COMMERCIAL BROILER STRAINS UNDER 3×3 DIALLEL CROSSING. II. GROWTH, MORTALITY, EFFECT OF SEX, AND FEATHERING*

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ABSTRACT

Three commercial broiler strains, procured from different sources, were crossed in a 3×3 diallel to study the growth, effect of sex, effect of feathering and mortality at different stages of growth upto 12 weeks.

Significant differences were observed among the 9 genetic groups for body weight from day old to 6 weeks of age. Maternal effects were found to persists upto 2 weeks of age. Male chicks were significantly heavier than female chicks at 2 weeks of age and later on. Early feathering chicks grew significantly faster than the late feathering chicks upto 6 weeks of age. The mortality ranged between 2 to 11% in different genetic groups.

No evidence of heterosis was observed in any of these crosses for the broiler traits studied at market age except mortality.

It may be concluded that crossing of the available broiler stocks may not be of any use except in case of mortality where there is some evidence of heterosis. It may be possible to improve these stocks further through Intrapopulation Selection or modified approach of Recurrent Reciprocal Selection.

Economic viability of broiler industry depends upon the availability of efficient broiler stock. Among the elite broiler strains, high estimates of heritability have been calculated for such traits as body weight and eviscerated weight; and inter crossing of such strains has yielded what we may call *profit heterosis* (Smith, 1964 : Moav, 1966 *a*, *b*). Dev and Singh (1970) reported that commercial broiler stocks could be used as foundation for selection experiments and crossed for economic exploitation. In the present study, an attempt was made to study the possibility of obtaining 'heterosis' in some broiler traits by crossing commercial strains.

MATERIAL AND METHODS

A totat of 350 day old straight-run chicks were purchased from three diff-

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erent commercial hatcheries and were designated as BH_1, BH_3 and BH_4. The cockerels weighing more than 2 kg and pullets weighing more than 1.5 kg at 12 weeks of age were retained for breeding and these strains were crossed in all possible combinations in a 3×3 diallel to produce 3 parental types and 6 cross groups, including the reciprocal crosses. Each group was produced from 5 cockerels randomly allotted to 24 pullets. The eggs collected during a period of 10 days were incubated and the chicks hatched out were wing banded and vaccinated against Ranikhet Disease (F1). The chicks were reared groupwise under optimum managemental conditions of feeding with a ration containing 22% protein.

The number of chicks hatched were recorded groupwise. The body weight of each chick was recorded at biweekly intervals upto the age of 12 weeks. To maintain uniformity in the number of chicks in each genotype, some chicks were culled at random at 8 weeks of age from those groups where large numbers were available.

The feather score of each chick was recorded at 10 days of age. The chick having well developed tail and wing feathers were classified as early feathering and those having no tail feathers as late feathering. The sex indentification was done at 8 weeks of age and the chicks died before this age were excluded from the analysis. Mortality was recorded groupwise upto 12 weeks of age expressed as percentage of the initial number of chicks in each group.

The means alongwith their standard errors, were worked out for each genetic group according to sex and according to feather score at biweekly intervals upto 12 weeks.

The number of chicks in various genetic groups were unequal, therefore, the analysis of variance of weighted means was done to test the differences among genetic groups, between sexes, between featherings and interactions between group×sex, group×feathering, sex×feathering and group×sex×feathering for growth using the following mathematical model, where all the main effects were considered as fixed.

$Y_{ijkl}=\mu+G_i+S_j+F_k+(GS)_{ij}+(GF)_{ik}+(SF)_{jk}+(GSF)_{ijk}+e_{ijkl}$ Where,

- Y_{ijkl} is lth chick of kth type of feathering, jth sex and ith genetic group.
- μ is the overall mean.
- G_i is the effect of ith genetic group (i=1.....9).
- S_j is the effect of jth sex (j=1, 2).
- F_k is the effect of kth type of feathering (k=1, 2).
- $(GS)_{ij}$ is the interaction between ith genetic group and jth sex.
- $(GF)_{ik}$ is the interaction between ith genetic group and kth type of feathering.
- $(SF)_{jk}$ is the interaction between jth sex and kth type of feathering.
- $(GSF)_{ijk}$ is the interaction among the ith genetic group, jth sex and kth type of feathering
- e_{ijkl} is the residual effect peculiar to the ijklth chick and assumed to be NID $(0, 6^2)$.

The interaction variances were tested by residual variance and found to be non-significant. The main effects were then tested against the pooled residual variance. Duncan's Multiple Range test

was used to compare the means. Heterosis was worked out as the superiority of crosses over their parental types.

RESULTS AND DISCUSSION

Growth

The averages alongwith their standard errors for body weight in different genetic groups from day old to 12 weeks of age, are presented in Table 1 and the results of analysis of variance for testing the differences among various genetic groups, between sexes, and between featherings are presented in Table 3. Percent superiority of crosses over their straightbreds and the results of mean seperation test are also presented in Table 1. The differences among the 9 genetic groups were found to be significant in body weight from day old to 7th weeks of age. No such differences were observed from 8 to 12 weeks of age. On an average, the chicks produced by BH_1 dams were heavier than those produced by BH_3 and BH_4 dams upto 2 weeks of age which indicated the existence of maternal effect upto this age. No evidence of heterosis were observed in the present study for body weight at broiler age. Aggarwal *et. al.* (1975 b) reported, from diallel mating systems in poultry, that the maternal effects were evident for body weight at earlier ages but gradually declined with advancing age. They also reported that, for 8 and 10 weeks body weight, maternal effects were not significant. In several studies, evidence of heterosis has been recorded and consistent expression has been recorded for periods ranging from 8 to 10 weeks (Nordskog and Ghostley, 1954; Aggarwal *et. al.* 1975 a; and Pati *et. al.* 1975) and 12 weeks (Kumar *et. al.* 1971; Singh and Chhabra, 1974). However, there is an overwhelming evidence to show that non-additive gene effects are not important, and may be ignored, for growth of broilers (Goodman *et. al.*, 1957; Kan *et. al.*, 1959; Dev and Singh 1970). In the present study also, there seems to be no advantage of crossing commercial broiler strains as no heterosis was observed.

Effect of sex

Differences of male and female chicks for average body weight at different ages of growth (pooled over genetic groups) are presented in Table 2. The average body weight of males was higher than the females except at day old where the differences were not significant Table 3. From 2 weeks of age, the males of all the genetic groups were found to grew significantly faster than the females and the difference between the two sexes increased with increasing age. At 12 weeks of age, the average body weight (pooled over genetic groups) of cockerels was 369.92 gms more than the pullets. The higher rate of growth in cockerels compared to pullets is a universal phenomenon and of only academic interest here. There are several workers who reported similar trends (Mathur and Ahmed, 1968; Dev and Sharma, 1972; Wahid *et. al.*, 1974)

Effect of feathering

The averages for body weight of early feathering and late feathering chicks (pooled over genetic groups) at different ages are also presented in Table 2. The frequency of early feathering observed at 10 days of age in all the genetic groups was higher than the frequency of late feathering. The early feathering chicks of all the genetic groups weighed significantly heavier than

TABLE 1

Average alongwith standard errors and per cent superiority of crosses for body weight (gms) at various ages in different genetic groups of broilers

Genetic group	Body weights (Gms) at						
	Day old	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks
$BH_1 \times BH_1$	a 46.97±0.46 (65)	a 127.76±2.84 (65)	ab 330.38±9.31 (65)	bc 644.46±12.15 (65)	a 1068.15±17.75 (65)	ab 1572.00±27.89 (60)	a 2073.60±59.24 (50)
$BH_3 \times BH_1$	ab 45.90±0.54 (52)	a 122.88±2.82 (52)	bc 312.40±9.93 (52)	abc 647.01±15.92 (52)	a 1070.48±20.46 (52)	ab 1560.00±32.82 (48)	a 2023.41±58.36 (41)
$BH_4 \times BH_1$	b 45.00±0.44 (59)	a 121.94±2.64 (59)	abc 325.50±7.71 (59)	ab 653.05±13.08 (59)	a 1088.89±24.19 (59)	ab 1550.43±26.86 (58)	a 2078.30±40.66 (53)
$BH_1 \times BH_3$	c 41.72±0.30 (65)	a 124.92±3.15 (65)	abc 325.92±7.82 (65)	bc 629.84±11.86 (65)	a 1067.38±16.45 (65)	b 1514.84±22 81 (65)	a 2019.82±34 08 (58)
$BH_3 \times BH_3$	d 39.97±0.38 (100)	b 107.10±1.70 (100)	c 308.80±5.19 (100)	c 622.10± 9.74 (100)	a 1077.05±21.30 (100)	a 1597.26±24.77 (73)	a 2111.27±51.68 (59)
$BH_4 \times BH_3$	de 39.10±0.35 (97)	a 121.59±2.05 (97)	ab 330.41±5.23 (97)	a 680.87±10.57 (97)	a 1084.17±22.08 (97)	a 1600.85±27.97 (70)	a 2105.64±36.74 (62)
$BH_1 \times BH_4$	c 41.87±0.35 (94)	a 127.59±2.15 (94)	abc 322.39±5.56 (94)	ab 652.12±10.59 (94)	a 1112.23±16.84 (94)	ab 1546.00±22.69 (65)	a 2061.20±60.25 (58)
$BH_3 \times BH_4$	de 39.67±0.36 (90)	a 127.11±1.81 (90)	a 336.11±5.64 (90)	a 680.66±10.91 (90)	a 1105.16±13.49 (90)	ab 1535.63±28.80 (63)	a 2016.66±42.53 (57)
$BH_4 \times BH_4$	e 38.96±0.33 (104)	c 113.99±1.74 (104)	c 310.04±5.31 (104)	bc 646.53± 9.14 (104)	a 1113.50±12.49 (104)	ab 1529.53±21.01 (76)	a 2030.00±27.36 (70)

Overall	41.53±0.16 (726)	120.16±0.77 (726)	322.09±2.17 (726)	651.59± 3.78 (726)	1090.09± 6.22 (726)	1556.62±10.99 (578)	2058.37±15.11 (508)
Crosses of	Per cent superiority crosses						
BH_1 with BH_3	0.70	5.50	−0.10	0.80	−0.40	−2.90	−3.40
BH_1 with BH_4	1.00	0.70	1.20	1.00	0.90	−0.10	0.80
BH_3 with BH_4	−0.20	12.30	7.70	7.20	−0.050	0.30	−1.10

The average superscript with various letters differed significantly (P∠0.05) within parenthesis are the number of chicks.

TABLE 2

Effect of sex and feathering on the body weight (gms) of broilers at different ages

Age	SEX			FEATHERING		
	Male	Female	Difference	Early	Late	Difference
Day old	41.39±0.24 (360)	41.67±0.25 (366)	−0.28	42.45±0.20 (435)	40.15±0.25 (291)	2.30*
2 weeks	122.01±1.08 (360)	118.34±1.11 (366)	3.67*	124.78±0.97 (435)	113.26±1.17 (291)	11.52*
4 weeks	333.23±3.17 (360)	311.13±2.87 (366)	22.10*	333.05±2.77 (435)	305.70±3.28 (291)	27.35*
6 weeks	684.30±6.75 (366)	619.42±4.64 (366)	64 88*	662.35±4.90 (435)	635.51±5.84 (291)	26.80*
8 weeks	1144.62±8.35 (366)	1036.44±8.32 (366)	108.19*	1092.79±8.48 (435)	1086.06±8.98 (291)	6.73
10 weeks	1681.64±11.23 (283)	1436.69±12.13 (295)	244.95*	1568.89±15.58 (356)	1536.95±14 56 (222)	31.94
12 weeks	2252.80±21.55 (241)	1882.88±15.49 (267)	369.92*	2063.38±18.21 (309)	2050.60±26.30 (199)	12.79

*Significant at 5% level (P∠0.05).

TABLE 3

Analysis of Variance for Body Weight at different age

Source of variation	D. F.	MEAN SQUARES						
		Day old	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks
Among genetic groups.	8	682**	3946**	8519**	35522**	28607	59844	78566
Between sexes	1	13	2441*	88658**	763940**	2124357**	8666208**	17332971**
Between feathering.	1	925**	23127**	130453**	125614**	7892	139412	19767
Residual		11 (715)	367 (715)	3092 (715)	8915 (715)	25244 (715)	54718 (567)	82127 (497)

* Significant at 5 percent level ($P < 0.05$).

** Significant at 1 percent level ($P < 0.01$).

Within parenthesis are the residual degrees of freedom.

the late feathering chicks from day old to 6 weeks of age. From 8 weeks to 12 weeks of age although the early feathering chicks were heavier but this superiority was followed to be statistically non-significant. From the result obtained in the present study, it was observed that feathering affects growth during early life as the differences between early and late feathering were found to be significant upto 6 weeks of age. This is in close agreement with the reports of Hurry and Nordskog (1953), Saeki and Katsuragi (1961), and Kumar and Acharya (1975). However, a number of workers have reported no influence of early and late feathering on growth (Godfrey and Farnsworth, 1952; Sheridan and McDonald, 1963). The influence of the sex-linked early feathering gene on body growth is not yet entirely clear. It might probably be due to genetic or physiological linkage between early feathering and rapid growth. The possession of well covered body at early stages would favour the growth since the chicks were generally subjected to low temperature during growth period. Warren and Payne (1945) found higher body weight at 12 weeks of age in early feathering New Hampshire chicks as compared with late feathering ones. The difference was not great but it was consistant for 8 different lots of birds. On the other hand, Godfrey and Farnsworth (1952) were unable to demonstrate any relationship between the sex-linked early feather gene and growth to 10 weeks of age. They concluded that the action of the k gene took place in the feather follicle and was not concerned with general body growth.

Mortality

Mortality (per cent) in each genetic group upto 6, 7 8, 9, 10, 11 and 12 weeks of age and heterosis for mortality upto these ages are presented in Tables 4. Upto 6, 7 and 8 weeks of age, lowest mortality (1.78%) was observed for BH_4

TABLE 4

Percent mortality at different age in various genetic groups and the percent superiority of crosses in broilers

Genetic groups	Mortality (%) upto						
	6 weeks	7 weeks	8 weeks	9 weeks	10 weeks	11 weeks	12 weeks
$BH_1 \times BH_1$	9.87	9 87	9.87	9.87	11.11	11.11	11.11
$BH_3 \times BH_1$	10.00	10.00	10.00	10.00	10.00	10.00	10.00
$BH_4 \times BH_1$	6.15	6.15	6.15	6.15	6.15	6.15	6.15
$BH_1 \times BH_3$	6.84	6.84	6.84	6.84	6.84	6.84	6.84
$BH_3 \times BH_3$	4.62	4.62	4.62	4.62	5 55	5.55	5.55
$BH_4 \times BH_3$	1.96	1.96	1.96	1.96	1 96	1.96	1.96
$BH_1 \times BH_4$	4.04	4.04	5.05	5.05	5.05	5.05	5.05
$BH_3 \times BH_4$	3.96	4.95	4.95	4.95	4.95	4.95	4.95
$BH_4 \times BH_4$	1.78	1.78	1.78	2.67	4.46	4.46	4.46
Overall	4.99	5.11	5.24	5.36	5.86	5.86	5.86
Crosses of	Per cent superiority of crosses						
BH_1 with BH_3	16.2	16.2	16.2	16.2	1.0	1.0	1.0
BH_1 with BH_4	−12.5	−12.5	−3.8	−10.6	−28 0	−28.0	−28.0
BH_3 with BH_4	−7.5	7.9	−3.9	−5.2	−30.9	−30.9	−30.9

straightbred chicks. However, the per cent mortality upto 9, 10, 11 and 12 weeks of age was the lowest for $BH_4 \times BH_3$ crosses chicks. The highest mortality (10.00%) upto 9 weeks of age was observed for $BH_3 \times BH_1$ crosses chicks and upto 10, 11 and 12 weeks it was highest for BH_1 straightbred chicks The overall per cent mortality (pooled over genetic groups) was 4.99, 5.11, 5.24, 5.36 add 5.86 upto 6, 7, 8, 9 and 10 weeks, respectively. No chicks died after 10 weeks of age. The mortality observed in the present study agrees well with the reports of Dev and Sharma (1972), Pati *et al.* (1975), and Kumar *et al* (1975) for various broiler stocks. However, these values were higher than those reported in the final reports of Random Sample Test (Annonymous, 1977). This might be due to more favourable climatic conditions at Hessarghatta.

The heterosis for survivability exhibited by the crosses of BH_1 with BH_4 ranged from 3.8 to 28% at every stage. The crosses of BH_3 and BH_4 also had 4 to 31% less mortality in comparison to their contemporary straitbreds except during 6 to 8 weeks of age, when the straightbreds had less mortality. Heterosis in survivability was also reported by King and Buckner (1952), Merritt and Gowe (1960), Singh and Chhabra (1974) and Pati *et al.* (1975) for various broiler stocks.

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REFERENCES

Aggarwal, C. K., Mohapatra, S. C., Sinha, S. P., Ahuja, S. D. and Sharma, P. N. 1975 a. Evaluation of pure-breds and cross-breds for broiler traits. *Indian J. Poult. Sci.* 10 : 170-171.

Aggarwal, C. K., Mohapatra, S. P., Sinha, S. P., Sharma, P. N and Ahuja, S. D. 1975 b. General and specific cobining abilities, maternal and sex-linked effects as estimated from diallel mating systems in poultry. *Indian J. Poult. Sci.* 10 : 173-174.

Annonymous 1977. Repott of Fifth Random Sample Test for broilers at Hessarghatta, Bangalore, *Poult. Guide* 14 (3) : 35-39.

Dev, D. S. and Singh, B. 1970. Importance of heterosis for broiler qualities in some commercial chicken stocks. *Indian J. Anim. Prod.* 1 : 144-146.

Dev, D. S. and Sharma, M. L. 1972. Comparision of some broiler chicken stocks for meat production. *J Res. Punjab Agric. Univ.* 9 : 219-223.

Godfrey, G. F. and Farnsworth, G. M. 1952. Relation of the sex-linked rapid feathering gene to chick growth and mortality. *Poult. Sci.* 31 : 65-68.

Goodman, B. L., Grimes, J. F. and Jaap, R. G. 1957. Repeatability estimates of genetic variance within two closed flock strains (Abstract). *Poult. Sci.* 36 : 1121.

Hurry, H. F. and Nordskog, A. W. (1953). A genetic analysis of chick feathering and its influence on growth rate. *Poult. Sci.* 32 : 18-25.

Kan, J., Krueger, W. R. and Quinsenberry, W. H. 1959. Non-additive gene effects of six broiler traits as studied from a series of diallel matings. *Poult. Sci.* 38 : 972-983.

King, S. C. and Bruckner, J. H. 1952. A comparative analysis of purebred and crossbred poultry. *Poult. Sci.* 31 : 1030-1036.

Kumar, J., Acharya, R. M. and Tamhan, S. S. 1971. Collection and evaluation of native fowl germ plasm. 10. Carcass yield and carcass quality of indigenous breeds, exotic breeds and their reciprocal crosses. *Indian J. Anim. Sci.* 41 : 1138-1143.

Kumar, J. and Acharya, R. M. 1975. Effect of feathering on the performance of Desi, White Leghorn and Rhode Island Red Chickens. *Indian J. Anim. Sci.* 45 : 660-663.

Kumar, J., Singh R. P., Balaine, D. S. and Sharma, R. K. 1975. Evaluation of some commercial broiler chickens. *Haryana Agric. Univ. J. Res.* 5 : 75-89.

Mathur, C. R. and Ahmed, M. T. 1968. A study of processing losses and meat yields of broilers at 10 weeks of age *Indian Vet. J.* 45 : 1033-1037.

Merritt, E. S. and Gowe, R. S. 1960. Combining ability among breeds and strains of meat type fowl. *Can. J. Genet. Cytol.* 2 : 286-294.

Moav, R. 1966 a. Specialised sire and dame lines. 1. Economic evaluation of crossbreds. *Anim. Prod.* 8 : 193-202.

1966 b. Specialised sire and dam lines. II. The choice of the most profitable parental combination when component traits are genetically additive. *Anim. Prod.* 8 : 203-221.

Nordskog, A. W. and Ghostley, F. J. 1954. Heterosis in Poultry. 1. Strain crossing and crossbreeding compared with closed flock breeding. *Poult. Sci.* 33 : 704-715.

Pati, S. K., Mohapatra, S. C., Sinha, S. P., Aggarwal, S. K. and Mehta, N. T. 1975 Comparison of pure-bred, Strain and breed crosses for broiler traits. *Indian J. Poult. Sci.* 10 : 142-148.

Saeki, Y. and Katsuragi, T. 1961. Effect of early and late feathering gene on growth in New Hampshires, Leghorn and their crossbreds. *Poult. Sci.* 40 : 1612-1616.

Sheridan, A. K. and McDonald, M. W. 1963. The relationship between feathering and body weight in broiler chickens. *Poult. Sci.* 42 : 1468–1471.

Singh, R. P. and Chhabra, A. D. 1974. Studies on performance of pure-breds and reciprocal crossbreds obtained through 3×3 diallal crossing of New Hampshire, Australorp and White Cornish breeds of poultry. 1. Growth, mortality and carcase yield and quality. *Haryana Agric. Univ. J. Res.* 4 : 61-68.

Smith, C. 1964. The use of specialised sire and dam lines in selection for meat production. *Anim. Prod.* 6 : 337.

Wahid, A., Mukherjee, T. K. and Jalaludin, S. 1974. The influence of breed and sex on live performance, dressing and yield of meat from 12 week old broilers, *Poult. Sci.* 53 : 1511-1519.

Warren, D. C. and Payne, L. F. 1945. Influence of feathering gene upon a chick's growth rate. *Poult. Sci.* 24 : 191-192.

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COMPARATIVE EFFICACY OF SOME ACARICIDES IN THE CONTROL OF SARCOPTIC MANGE IN CAMELS

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ABSTRACT

Controlled acaricidal trials on camels revealed that sarcoptic mange, an obstinate skin disease, could be effectively treated with Sevin 0.5% or Sumithion 0.5% spraying. This method of treatment was found to be much cheaper and less laborious than the conventional methods adopted for treating the disease. The significance of these findings has been discussed.

Sarcoptic mange is a highly contagious skin disease of camel and is of common occurrence throughout the state of Rajasthan (Rathore and Lodha, 1973) and in the Punjab (Sen and Fletcher, 1962). Datt *et al.* (1978) studied the incidence and intensity of mange in livestock at Hissar and reported an incidence as high as 19 02% in camels as compared to other species of domestic animals.

Intense pruritus is a characteristic symptom of the disease and this causes the animals to scratch and gnaw the affected parts. Constant scratching prevents the animal to eat The animals become weak and emaciated and are rendered unfit for work. Thus, the disease is of great economic importance.

A large number of insecticides have been in use for the control of sarcoptic mange in camels. Some of the earliest were sulphur in oil, a mixture of kerosine oil and used engine oil etc. However, after the advent of dichloro-diphenyl trichloro ethane (D. D. T.), a number of insecticides of the chlorinated hydrocarbon group like D. D. T., benzene hexachloride (B. H. C.), chlordane, etc. have also been made use of. Comparatively recent insecticides to be used are Neguvon, Malathion and Sumithion, all of which belong to the group of organophosphorus compounds. Sevin is the most recent insecticide to be introduced and belongs to the carbamate group of insecticides.

The earlier insecticides have been used either as a "pour-on" or dusts; but these techniques of treatment suffered from one common drawback of being very laborious and time consuming, especially when treating the disease on a herd basis.

In view of the above, it was decided to try a new technique of application, i.e.,

spraying. The present study was undertaken to assess the efficacy of newer insecticides for its treatment as the disease is posing a great problem for the camel owners and field veterinarians of this state.

MATERIALS & METHODS

During the present investigation, the authors attended several outbreaks of skin disease in camels in the villages of Sirsana, Bagla, Kirrhan, Modhakhera, Rawalwas, Kalwas (Dist. Hissar) and Kaluana (Dist. Sirsa). A total of 271 cases of sarcoptic manage in camels were examined but only those animals showing identical clinical symptoms and the presence of mites were included in these trials.

To obtain the scrapings, a scalpel was dipped in mineral oil and used to scrape vigorously a small area of an infected site. Material obtained by the scraping was transferred to a microslide and examined microscopically at 100x magnification. A record was kept of the mites found. The insecticides used in this experiment were emulsifiable concentrates of D. D. T. 25 E. C. (B. L. Industries), Sumithion 25 E. C. (Rallis India Ltd.), Sevin 50 W. P. (Union Carbide) and B. H. C.

The actual concentrations of the insecticides used in the spraying operations are given in Table 1 and were formulated in accordance with the recommendations of the WHO Expert Committee on Insecticides (1970).

Three applications of the insecticides were made at weekly intervals on the mangy camels by spraying the emulsions with the Aspee Power Sprayer of the American Spring & Pressing Works Pvt. Ltd., Bombay. Spraying was done under pressure of 20 lbs psi. To ensure that each animal was throughly covered, camels were sprayed individually at the rate of 2-4 gallons per head depending upon the length of hair coat.

The camels were examined for ectoparasites before giving any treatment and divided into four groups for trials with different insecticides. Thereafter, 10 camels were selected at random from each group and examined on 7th and 14th day, after first spraying with insecticides, to determine initial kill of the mites. A fourth examination was made on 21st day.

The therapeutic efficacy of a drug was assessed by disappearance of symptoms (pruritus), lesions as well as mites and reappearance of normal hair coat.

RESULTS

The results of these field trials are summarized in Table 1. Comparative efficacy of the four insecticides reveals that at the concentrations sprayed, Sevin and Sumithion were superior than B.H.C. and D. D. T. With Sevin there was 60% recovery of mangy camels after the first spray, 80% after the second and 100% after the third. Similarly, with Sumithion there was 50, 70 and 100% recovery after the first, second and third sprayings, respectively. B. H. C. followed next with 40, 50 and 70% recovery, whereas D. D. T. was found to be more or less ineffective as it provided only 0 to 20% recovery after three sprayings with the insecticide. No apparent symptoms of toxicity were observed with these insecticides. The cost of a single spraying

TABLE 1

Field trials with Insecticides as sprays for the control of sarcoptic mange in camels

Insecticide & *formulation*	Concentration (%)	No. of animals sprayed	No. of animals examined (skin scrapings)	No. of animals found free of mites on day 7	14	21	Observations & remarks
Sevin 50 W. P. (carbaryl, 1-Naphthyl-methyl carbamate)	0.5	37	10	6	8	10	Scratching decreased after first spraying; Hair growth noticed after 2nd spray.
D. D. T. 25 E. C. (Dichloro-diphenyl 2, 2, 2 Trichloro-ethane)	0.025	29	10	0	2	2	Pruritus only slightly improved. Lesions did not heal.
Sumithion 25 E. C. (Fenitrothion)	0.5	42	10	5	7	10	Scratching decreased after first spraying; Hair growth noticed after 2nd spray.
B. H. C. (Benzene Hexa chloride)	0.25	31	10	4	5	7	Mild pruritus and moderate hair growth after 3rd spraying.

operation on a camel with Sumithion was found to be Rs. 2.92 and with Sevin Rs. 2.25 only.

DISCUSSION

Sevin and Sumithion were found to be the most effective and economical of the various insecticides tested, afforded good initial kill of mites and considerable residual effectiveness.

Sumithion has an offensive, pungent odour which is disliked by the animals and also causes symptoms of headache in the man entrusted with the spraying operations.

Sevin insecticide formulations do not readily penetrate healthy mammalian skin, as indicated by a LD_{50} greater than 4000 mg/kg of active ingredient, administered to female white rats (W.H.O. Experts Committee on Insecticides, Seventeenth Report, 1970).

As sarcoptes are burrowing mites, they remain in tunnels in the epidermis. Owing to the irritation thus caused, the infected parts are gnawed at by the camels, and some raw wounds result. Frequently in such cases, large areas of papules and vesicles are seen. As the disease continues the skin becomes greatly thickened. Insecticides, which normally do not penetrate healthy mammalian skin, are now able to penetrate due to the ravages caused by the mites; without causing any apparent toxic effects at the concentration used. This could be the probable reason for better results with Sevin and Sumithion.

B. H. C. and D. D. T. have been used in lower concentrations as they tend to be absorbed and deposited in body fat and may cause toxicity in weak animals (Radeleff *et al.*, 1955). The poor performance of these two insecticides could be attributed to the fact that the farmers of this area are know to use them quite commonly mixed in "Lassi" as a pour-on for the cure of this disease. Although resistance studies have not been conducted but it is quite possible that this particular strain of the parasite may have developed resistance against these chlorinated hydrocarbons.

A few safety restrictions recommended by U. S. D A. for the use of insecticides are :

(i) Do not spray in a confined non-ventilated area.

(ii) Avoid spraying or dipping animals in cold, stormy weather.

(iii) For using any insecticide, it should not come in contact with animal feed, water, milk, or milking equipment.

(iv) Avoid treating stressed or sick animals.

REFERENCES

Datt, S. C., Tika Ram, S. M. and Satija, K. C. 1978. Studies on the incidence of mange in livestock in Hissar (Haryana). *Haryana Veterinarian* **17** : 112-116.

Radeleff, R. D., Woodward, T. G. Nickerson, W. J. and Bushland, R. C. 1955. The acute toxicity of chlorinated hydrocarbon and organic phosphorus Insecticides to livestock U. S. D. A. *Tech. Bull.* No. 122.

Rathore, M. S. and Lodha, K. R. 1973. Observations on sarcoptic mange in camels (Camelus dromedarious) in Rajasthan. I. Incidence and intensity. *Indian Vet. J.* 50 : 1083–1088

Sen, S. K. and Fletcher T. B. 1962. Veterinary Entomology and Acarology for India. ICAR. p. 527.

WHO Expert Committee on Insecticides, Seventeenth Report. 1970. *Insecticide resistance and vector control.* WHO Technical Report Series No. 443.

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A STUDY ON THE COMBINING ABILITY OF FOUR EGG LAYING STRAINS

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ABSTRACT

A 4×4 full diallel cross experiment was conducted to study the combining ability of commercial strains for production and egg quality traits.

Both gca and sca effects were highly significant for 20 weeks body weight, age at first egg and rate of lay. Gca sca and reciprocal effects were non-significant for feed efficiency and daily feed consumption. With regard to egg quality traits, gca effects were significant for egg weight, shape index and yolk colour and reciprocal effect were not significant for any of the quality traits except shape index.

Both additive and non-additive gene actions were found to be important for most of the production traits and additive gene action for most of the egg quality traits. Recurrent reciprocal selection might be followed for further improvement of the traits in these strains.

A great deal of intrest is evidenced in the posibilities of utilising hybrid vigour in poultry by adopting line, strain and breed crossing for meat and egg production. Diallel crossing is done to partition the total genetic variability into components arising from general and specific combining ability and reciprocal effects. Hill and Nordskog (1958), Goto and Nordskog (1959), Merrit and Gowe (1960), Redman and shoffner (1961), Yao (1961) and Eisen *et al.* (1967 a, b) reported that variance due to general combining ability was the single most important source of genetic variation for most egg production traits. However, Wearden *et al.* (1965) reported that variance due to specific combining ability was more important for egg production.

In the present study, the relative importance of general combining ability, specific combining ability and reciprocal effects affecting some egg production traits in the four egg laying strains was being reported.

METERIAL AND METHODS

During the year 1975, four commercial egg laying strains, which are considered hybrid arising from strain/line crosses, purchased from different leading franchise hatcheries were crossed in a complete diallel manner. Each group was produced from 32 dams and 4 sires. The chicks were obtained in two hatches with one week interval and reared hatchwise under optimum condition of

management upto 20 weeks of age. After recording 20 weeks body weight, the pullets belonging to a particular groups were housed in separate pens. Traits measured in each group (cross-hatch combination) were age at first egg determined by trap-nest record, feed efficiency for egg mass per group, daily feed consumption 28 days period per groups and daily rate of lay for 24 to 48 weeks of age. At the age of 36 weeks, the egg quality traits were also studied by breaking 3 eggs daily from each of the 16 groups for 10 days. The data on each trait under study was subjected to combining ability analysis of variance as proposed by Griffing (1956) assuming all the effects as fixed. For the traits which showed significant variability due to general (gca) and specific combining ability (sca) or reciprocal effects individual effects were computed, for each strain/cross and significant differences among them were tested according to the formula given by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Production traits :

The overall mean for 20 weeks body weight, age at first egg, rate of lay, feed efficiency and daily feed consumption alongwith individual gca, sca and reciprocal effects of strain/cross are presented in Table 1 and the results of diallel analysis are presented in Table 2. The differences due to gca and sca were found to be significant for 20 weeks body weight, age at first egg and rate of lay, however, the reciprocal effects were significant for the later two traits only suggesting the importance of both additive and non-additive genetic variance for these traits. None of these differences were significant for feed efficiency and daily feed consumption. The 20 weeks body weight (gca effects) of g_4 was significantly higher than g_1 and g_2 but similar to g_3 strain. However, the g_3 was higher in desirable direction for rest of the traits indicating that strain g_4 was superior for body weight only and strain g_3 was superior for other traits. The gca effects of s_{34} was similar to s_{14} for 20 weeks body weight but significantly higher to other combinations (crosses). For age at first egg, sca effects were higher in s_{23}, s_{14} and s_{24}; for rate of lay in s_{12} and s_{14}. The feed efficiency and daily feed consumption was found to be superior in s_{24} and s_{23}, respectively. However, these were not significantly different from other combinations. The differences due to reciprocal effects were significant in r_{24} for body weights, r_{12}, r_{14}, r_{23} and r_{34} for age at first egg and r_{13} and r_{14} for rate of lay. The presence of significant reciprocal effects would require choosing of appropriate male and female parent to be crossed to produce superior crossbred progeny.

Egg quality traits

The overall means for all the egg quality traits (egg weight, shape index, Haugh unit, yolk index shell thickness and yolk colour) alongwith their individual gca, sca and reciprocal effects of each strain/cross have been presented in Table 3. and the combining ability analysis in Table 4.

The differences due to gca were significant for egg weight, shape index and Haugh unit, whereas due to sca were significant for egg weight and yolk colour. The reciprocal effect were significant for shape index only. All the four strains and their reciprocal crosses were

TABLE 1

Gca, Sca and reciprocal effects of production traits

Traits./ Effects	20 weeks body weight (gm)	Age at Ist egg (days)	Rate of lay upto 48 weeks of age	Feed efficiency for egg mass (kg)	Daily feed consumption per bird (gm)
Overall mean (μ)	1212.55	180.43	54..18	4.07	111.09
G. C. A. effects					
g_1	-6.89^a	1.83^a	0.43^a	0.03	2.89
g_2	-27.38^a	0.12^{ac}	0.21^{ac}	0.10	0.83
g_3	14.94^{bc}	-1.42^{bc}	1.10^a	-0.21	-2.23
g_4	19.33^b	-0.51^{bc}	-1.73^{bc}	0.09	-1.48
S. C. A. effects					
s_{12}	-7.20^a	1.79^a	4.39^a	1.15	8.96
s_{13}	-22.50^a	1.09^a	-2.06^b	1.11	-1.21
s_{14}	35.80^{bc}	-2.04^b	-0.89^b	-0.21	-6.81
s_{23}	9.80^{ac}	-3.64^b	-2.38^b	-0.01	-4.74
s_{24}	-5.04^a	-2.55^b	4.31^a	-0.41	-1.53
s_{34}	62.01^b	1.53^a	-0.95^b	0.13	1.45
R. E.					
r_{12}	9.32	1.82*	0.93	0.28	0.52
r_{13}	0.44	0.45	4.01*	0.36	1.14
r_{14}	13.29	1.91*	4.11*	0.30	1.32
r_{23}	8.70	1.76*	3.61	0.33	0.93
r_{24}	27.12*	0.62	1.88	0.05	0.95
r_{34}	17.17	1.68*	0.80	0.15	2.47

Where $s_{ij} = s_{ji}$ * $P < 0.05$
$r_{ij} = r_{ji}$

Effects having different superscripts differ significantly ($P < 0.05$) from each other.

TABLE 2

Combining ability analysis of variance for production traits

S. V.	D. F.	Mean Squares				
		20 week body weight	Age at Ist egg	Rate of lay (%) upto 48 weeks of age	Feed efficiency for egg mass	Daily feed consumption per bird.
G. C. A.	3	3717.66**	15.01**	11.84**	0.17	43.37
S. C. A.	6	3803.52**	15.24**	29.34**	0.13	64.28
R. E.	6	456.71	4.50*	17.04**	0.15	3.73
Error		336.03	1.65	2.04	0.14	35 21
		(774)	(701)	(2672)	(80)	(80)

Within parenthesis are error degrees of freedom.

* $P < 0.05$

** $P < 0.01$

TABLE 3

Gca, Sca and reciprocal effects of egg quality traits

Traits effects	Egg weight (gm)	Shape Index	Haugh Unit	Yolk Index	Shell Thick-ness (mm)	Yolk colour
U	59.86	72.67	87.42	48.71	0.277	11.17
g_1	0.25[a]	0.94[a]	1.25[a]	0.28	-0.0004	-0.03
g_2	-0.57[ab]	-0.62[b]	-2.01[b]	-0.51	0.0038	-0 18
g_3	0.32[ac]	-0.39[c]	0.86[c]	0.33	-0.0010	0.10
g_4	-0.02[b]	0.08[d]	-0.10[d]	-0.11	-0.0018	0.20
s_{12}	0.23[a]	0.52	1.63	0.35	0.0010	0.54[a]
s_{13}	0.66[a]	-0.69	-0.37	-0.60	-0.0001	-0.34[b]
s_{14}	0.36[a]	-0.50	-2.43	0.75	-0.0043	0.42[a]
s_{23}	1.07[a]	-0.46	-0.31	-0.31	-0.0003	0.51[a]
s_{24}	-1.23[b]	0.28	0.10	-0.53	-0.0106	-0,64[c]
s_{34}	0.58[a]	0.57	0.54	-0.65	0.0028	0.12[d]
r_{12}	-0.02	0.44*	0.63	0.78	0.0035	0.30
r_{13}	0.60	0.73*	1.23	0.29	0.0045	0.28
r_{14}	0.70	1.07*	1.71	1.57	0.0085	0.03
r_{23}	0.13	1.12*	1.16	0.81	0.0075	0.48
r_{24}	1.25	0.69*	2.3	0.89	0.0010	0.47

Where $s_{ij} = s_{ji}$ * = $P < 0.05$

$r_{ij} = -r_{ji}$

Effect having different superscript differ significantly ($P < 0.05$) from each other.

TABLE 4

Combining ability analysis of variance for egg quality traits

S. V.	D. F.	Mean Squares					
		Egg weight	Shape Index	Haugh Unit	Yolk Index	Shell Thickness	Yolk colour
G. C. A	3	1.30*	3.79**	16.95**	1.22	50.00	0.19
S. C. A.	6	2.36**	0.68	4.12	1.13	85.00	0.52**
R. E.	6	0.91	1.62**	4.31	1.83	90.00	0.22
Error	464	0.44	0.39	2.31	0.86	143.00	0.16

* $P < 0.05$

** $P < 0.01$

similar in performance regarding yolk index and shell thickness. The additive gene action, in general, was found to be important for egg quality traits (egg weight, shape index and Haugh unit), whereas non-additive gene action was found to be unimportant for egg quality traits except egg weight and yolk colour.

Higher gca effects for egg weight were obtained for g_3 and g_1 strain though both these were statistically similar. The g_1 strain was significantly superior to all other strains for shape index and Haugh unit and g_3 was superior to all other strain with respect to egg weight. The sca effects for all the crosses were not statistically different from each other except s_{24} which had negative gca effects for egg weight (−1.23) and for yolk colour the s_{12}, s_{14} and s_{23} were statistically similar and contributed positive sca effects towards population mean and the other combinations (s_{13} and s_{34}) contributed negatively. All the reciprocal crosses differed significantly from each other with respect to shape index only. These differences were not statistically significant for other quality traits suggesting that sex linked gene and/or maternal effects were not important for the egg quality traits except the shape index.

Goto and Nordskog (1959) provided evidence for the existence of reciprocal effects in the case of age at 50% production, 300 day hen housed per cent egg production in light and heavy type of single crosses. Eisen *et al.* (1967 a) reported that variance due to reciprocal effects accounted for a large amount of variation for age at first egg and 55 week body weight. In a study of crosses of certain inbred lines Yao (1961) found significant gca effects but non-significant sca effects for egg production. General combining ability variance was significant for egg weight, shape index while specific combining ability variance was not significantly different from zero for any of these traits (Eisen *et al.*, 1967b).

Osborn (1953), Hogsett and Nordskog (1956), Hicks (1958) and Redman and Shoffner (1961) have reported evidence of sex linkages in either egg shell colour or egg weight. Redman and Shoffner (1961) further reported that general combining ability accounted for 100% of the total genetic contribution for specific gravity and over 60% for shell colour, egg shape, egg weight and Hough units while specific combining ability represented only about 10% of genetic contribution. In general, the results obtained in the present study are in conformity with the findings reported in the available literature.

From the results of this study, it may be concluded that both additive and non-additive genetic variabilities are important for 20 week body weight, age at first egg, rate of lay and egg weight. Reciprocal recurrent selection programme may be followed to utilize both type of genetic variabilities in these strains for further improvement.

REFERENCES

Eisen, E. J., Bohren, B. B., Mckean, H. E. and King, S. C. 1967a. Genetic combining ability of light and heavy inbred lines in single crosses of poultry. *Genetics* 55 : 5-20.

_____1967b. Combining ability among single crosses and predicting double cross performance in poultry. *Br. Poult. Sci.* 8 : 231-242.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crosses. *Aust. J. Biol. Sci.* 9 : 463-493.

Goto, E., and Nordskog, A. W. 1959. Heterosis in poultry 4. Estimation of combining ability variance from diallel crosses of inbred lines in the fowl. *Poult. Sci.* 38 : 1381-88.

Hogsett, M. L. and Nordskog, A. W. 1956. Genetic covariance analysis of egg production, egg weight, and body weight in the fowl, *Poult. Sci.* 35 : 1148-51.

Hicks, F. 1958. Heritability and correlation analysis of egg weight, egg shape and egg number in chickens. *Poult. Sci.* 37 : 967-75.

Hill, J. F. and Nordskog, A. W. 1958. Hete rosis in Poultry 3. Predicting combining ability of performance in the crossbred fowl. *Poult. Sci.* 37 : 1159-1169.

Merrit, E. S. and Gowe, R. S. 1960. Combining ability among breeds and strains of meat type fowl. *Can. J. Genet. Cytol.* 2 : 286-294.

Osborn, R. 1953. The inheritance of egg weight in the domestic fowl. Further evidence of sex linkage. *Poult. Sci.* 32 : 60-64.

Redman, C. S. and Shoffner, R. N. 1961. Estimates of egg quality parameters utilising a polyallel crossing system. *Poult. Sci.* 40 : 1662-1675.

Snedecor. G. W. and Cochran G. W. 1967. *Statistical methods.* Oxford and IBH Publishing Co. New Delhi.

Wearden, S., Tindell, D. and Craig, J. V. 1965. Use of full diallel cross to estimate genral and specific combining ability in chikens. *Poult. Sci.* 44 : 1043-1053.

Yao, T. S. 1961. Genetic variation in the progenies of the diallel crosses of inbred lines of chickens. *Poult. Sci.* 4 : 1048-59.

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EVALUATION OF SOME ACARICIDES AGAINST PSOROPTIC MANGE IN BUFFALOES

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ABSTRACT

Comparative evaluation of three acaricidal agents against psoroptic mange in buffaloes was conducted in a controlled experiment. Complete control of adults and all of their developmental stages was achieved in 15-20 days through repeated applications of Himax emulsion, Malathion EC 1% spray or Sevin WP 1% spray. Enzyme cholinesterase levels in the treated animals showed that Malathion was not completely safe. Himax required more frequent applications. Sevin was found most satisfactory through all the parameters tried.

Literature on psoroptic mange in buffaloes is scanty, although it appears to be a common condition in these animals. It can be of considerable economic importance due to its reported high prevalence (Mohan, 1968; Shastri and Ghafoor, 1974; Maske, 1979) and due to the undermined productivity and weight loss of the affected animals resulting from irritation and restlessness. There are few published reports on systematic acaricidal treatment of psoroptic mange in cattle and practically none in buffaloes. The work presented herein was undertaken to evaluate comparative efficacy of some chemotherapeutic agents, namely, Himax, Malathion and Sevin against experimental psoroptic acariosis in buffaloes.

MATERIAL AND METHODS

Male buffalo calves ranging from one to two years in age were procured from the local market. They were checked thoroughly for presence of possible natural infection with any external or internal parasite by means of repeated skin scrapings, blood smear and faecal examinations during a pre-experimental observation period of about six weeks. If found infected, they were either not used or were given suitable treatment to rid them of the concerned infection before their use in the experiment. Twenty calves used in the experiment were split into groups (Table 1) and housed in separate pens. A buffalo cow with severe mange infestation, confirmed to be *Psoroptes communis* var *bos bubalis* by skin scraping examination served as donor. Pregnant female mites were picked up under the stereoscope with the help of a moist dissecting needle from the scrapings of the donor animal and transferred to clipped recipients @ 9-12 mites per calf. The experimentaly infected animals were examined daily for the

TABLE 1

Evaluation of insecticides against psoroptic mange in buffaloes (experimental design)

Animals	Himax EC	Malathion EC 1% spray	Sevin WP 1% spray	Untreated control
Infected	3	3	3	3
Uninfected	2	2	2	2

development of symptoms, lesions and different metamorphic stages of the parasite. Usually the infection was well-established within 10 to 14 days.

The drugs evaluated for their relative efficacy in controlling mange mites were : Himax (Indian Herbs) emulsion as topical application, Malathion (Cyanamid) EC as 1% spray and Sevin (Union Carbide) WP as 1% spray. Treatment was commenced a week after the full establishment of infection. The first named of these agents was applied every alternate day, making a total of eight applications till day 15, while the latter two were repeated after 5 days' interval and five applications were made in 20 days. Scrapings were examined before each subsequent application of the drugs to assess the effect with regard to elimination/reduction of eggs, larvae, nymphs and adult mites.

For the purpose of correlating efficacy with toxicity, the status of the enzyme cholinesterase and the levels of the inorganic phosphorus in the whole blood were determined a day prior to the first application of acaricides and subsequently, at days 1, 6, 11, 16, 21 and 26 after the start of the treatment. Cholinesterase activity was determined by colorimetric method of Fleisher and co-workers as described by Robbin *et al* (1958) and expressed in micromoles of acetylcholine hydrolysed by 0.05 ml of blood in 10 minutes. The inorganic phosphorus content of whole blood was measured by the method of Gomorri (1942) as described in the instruction leaflet of 'Inorganic Phosporus Kit' supplied by M/s Span Diagnostics, Surat.

RESULTS

Efficacy. With all the acaricides, the larvae and nymphs were found to be more susceptible while the adults and eggs were relatively resistant. The earliest disappearance of larvae was observed on day 9 in the Himax treated group and after another day nymphs were also eliminated with attendant abatement of symptoms while, on the calves of the other two groups, both larvae and nymphs were persistent upto 10–12 days. Adults were also knocked out earliest (day 13) in the Himax treated group but by day 15 only eggs were surviving in all the experimental groups. No eggs or other stages were found on the animals of the Himax treated group on day 17 and at the subsequent examination the animals of the other two treated groups were also found cleared of all stages of the mites. The treated animals remained free from infection till day 30 when they were last examined while all metamorphic stages were seen to persist throughout on the untreated controls.

Safety. Estimation of the activity of the whole blood cholinesterase enzyme indicated that these values at various intervals post-treatment did not differ significantly from their control values (day 0) except in the Malathion group. In the Malathion treated group, mean cholinesterase activity was depressed (51.5% of normal) on the first day post-treatment and, thereafter, continued to be inhibited throughout the course of the experiment (Table 2). However, no toxic symptoms could be observed in the treated animals. The inorganic phosphorus level, on the other hand, did not show remarkable change following treatment with any of the three agents (Table 2).

Residual effect. Reinfection did not occur upto the period of observation, viz., three weeks following the termination of the experiment.

DISCUSSION

Psoroptic mange is more common than the Sarcoptic type in buffaloes (Mohan, 1968). Because of its predilection for the base of the horn and ear it is often overlooked while taking routine skin scrapings for mange. Psoroptic mange was considered to be the most common skin affection in a review of diseases of the buffalo in Egypt (Kassem and Soliman, 1966). Critical surveys in India have recorded upto 69.7% incidence of psoroptic mange in buffaloes (Shastri and Ghafoor, 1974; Maske, 1979). Notwithstanding the apparent high prevalence and the economic importance the treatment of this disease has not been fully explored. Most of the references pertain to psoroptic mange in cattle and deal with efficacy of colloidal sulphur preparations and fenchlorphos (Il'Yashchenko, 1971) and essential

TABLE 2

Blood values* of cholinesterase and inorganic phosphorus in treated buffalo calves

		Days after start of treatment						
	Agents	0	1	6	11	16	21	26
	Malathion	1.65 ±0.14	0.85 ±0.10	1.07 ±0.20	1.00 ±0.24	0.94 ±0.22	0.98 ±0.26	1.26 ±0.26
Ch E	Sevin	1.40	1.24	1.29	1.28	1.19	1.23	1.29
micromoles		±0.10	±0.10	±0.10	±0.10	±0	±0.10	±0.10
(of Ach hydrolyses)	Himax	1.24 ±0.14	1.11 ±0.17	1.02 ±0.17	1.07 ±0.14	1.07 ±0.20	1.01 ±0.17	1.14 ±0.20
	Malathion	4.07 ±0.40	4.10 ±0.40	4.00 ±0.20	4.07 ±0.36	4.00 ±0.45	5.30 ±0.14	4.70 ±0.63
Inorganic	Sevin	3.63	3.83	3.83	3.90	3.90	4.13	4.17
Phosphorus (mg 100 ml)		±0.78	±0.42	±0.40	±0.51	±0.40	±0.78	±0.26
	Himax	3.87 ±0.61	4.00 ±0.28	4.40 ±0.40	3.83 ±0.55	4.37 ±0.78	4.07 ±0.57	4.23 ±0.48

*Values are mean of observations from 3 animals.

oil of *Cedrus deodara* 10 per cent in castor oil (Tilak, 1977). For buffalo calves having mixed infections of sarcoptic and psoroptic mange, Dieldrin 0.1-0.2% and Lindane 0.05% were reported effective (Shastri and Khan, 1973). Cockrill (1974), while reviewing buffalo mange in Burma, suggested gamma BHC in aquous suspension for its treatment. In India, for treatment of psoroptic mange in buffaloes Neguvon was found effective in one report (Mishra, 1971) while lubricating engine oil, Karangi oil (a plant oil) and Lazin (a proprietary herbal mixture applied with soft brush) were tried in another study (Prajapati and Hiregoudar, 1976). In the present trial, although control of infection was achieved by all the three agents tried, Himax proved to be the quickest and most effective miticide. In addition, it had constituents which helped in the healing of wounds and skin lesions when applied as dressing. Angelo *et al.* (1974) indicated that it was a promising vulnerary agent particularly in horn infections in bovines. There was also greater safety in handling as compared to Malathion or Sevin. A depression of cholinesterase activity in the Malathion treated animals was observed in the present experiment. Although manifest toxic symptoms were absent, the agent could not be regarded completely safe at the levels applied and in this respect, was deficient as compared to Sevin or Himax. On the other hand, Himax required more frequent applications and thorough massage-an operation which was more difficult than spray. The persistence of eggs beyond other stages of mites was expected as they remained unaffected except on hatching out as larvae. This factor underscored the need for repeated applications, minimum two courses of treatment indicated, regardless of the agent used, in an effective control regimen.

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REFERENCES

Angelo, S. J., Misra, S. S. and Malik, G. S. 1974. Clinical observations with Himax–a vulnerary agent in large animal practice. *U. P. Vet. J.* 2 : 101-103.

Cockrill, W. R. 1974. *The husbandry and health of the domestic buffalo.* Food and Agricultural Organization of the United Nations, Rome, Italy. pp. 240-241.

Gomorri, G. 1942. J. Lab. Clin. Med. 27 : 955. Cited in the *Instruction leaflet of 'Inorganic Phosphorus Kit'* supplied by M/s Span Diagnostics, Surat, India.

Il'Yashchenko, V. I. 1971. Trials with new acaricides for the control of psoroptic mange in cattle. Colloidal sulphur, fenchlorphos, and dicresyl-N-methylcarbamate. *Problemy Vet. Sanit.* 40 : 353-358 *(Absts. Vet. Bull.* 42 : 5344).

Kassem, M. H. and Soliman, K. N. 1966. *Diseases of the buffalo.* In : International Encyclopaedia of Veterinary Medicine (Eds. Dalling, Sir Thomas and Robertson, A) Vol. I. W. Green and Sons Ltd. Edinburgh, 1966. pp. 527-533.

Maske, D. K. 1979. Prevalence, pathogenicity and treatment of Psoroptic mange in buffaloes. M. V. Sc. Thesis Haryana Agricultural University, Hissar.

Mishra, P. 1971. Treatment of 'Horn mange' in cattle and buffaloes with Nevugon. *Orissa Vet. J.* 6 : 123.

Mohan, R. N. 1968. Diseases and parasites of buffaloes. (Review article) Part III. *Vet. Bull.* 38 : 735-756.

Prajapati, R. B. and Hiregoudar, L. S. 1976. Treatment of psoroptic mange in buffaloes with mineral and plant oil. *Indian Vet. J.* 53 : 150-151.

Robbin, W. E., Hopkin, T. L. and Roth, A. R. 1958. Application of colorimetric whole blood method for measurement of red blood cell cholinesterase activity. *J. Econ. Ent.* 51 : 326-331.

Shastri, U. V. and Ghafoor, M. A. 1974. Acariasis in buffaloes *(Bubalus bubalis)* due to *Psoroptes* species in India. *Indian Vet. J.* 51 : 274-281.

Srivastava, S. C. and Khan, M. H. 1973. Efficacy of some acaricides for the control of buffalo mange. *Indian Vet. J.* 50 : 984-988.

Tilak, B. D. 1977. Pest control strategy in India. National Chemical Laboratory, Poona. pp. 99-109. *(Abstr. Rev. Appl. Ent. B* 66 : 1402).

RESEARCH NOTE

Haryana agric. Univ. J. Res. Vol. X, No. 2, pp. 314—315 (June 1980)

A NOTE ON EVALUATION OF CERTAIN DRUGS AGAINST CLINICAL CASES OF DIARRHOEA IN CROSSBRED CALVES

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Mortality in cow-calves is common due to diarrhoea. The calves dying of diarrhoea could show the presence of *Escherichia coli* (Ewing, 1962; Smith, 1962; Khera and Dhanda, 1963; Fisher, 1965; Singh and Panghaal, 1975), *Salmonella* sp. (Khera and Dhanda, 1963; Howard, 1969 and Singh and Panghaal, 1975) and other genera of enterobacteriaceae (Khera and Dhanda, 1963; Blood and Henderson, 1968; Singh and Panghaal, 1975).

This study was conducted on cross-bred cow calves suffering from diarrhoea belonging to the Department of Animal Breeding, Haryana Agricultural University, Hissar. A total of 48 faecal samples were collected in sterilised test tubes. These were subjected to bacteriological examination for isolation and characterisation of the bacteria belonging to enterobacteriaceae group as advocated by Edwards and Ewing (1962). The faecal examination of these samples revealed no gastrointestinal parasites.

These calves were divided into 3 groups each having 16 calves. The age of these calves varied from 2 to 20 days. Each group was treated with Strinacin (Triple Sulfonamide/ Streptomycin), Gastina, (Neomycin, Streptomycin), and Vit. A) and Neftin (Nitrofurazone), respectively. Strinacin was given orally at the dose of 3 tablets three times a day for two to four days. Gastina and Neftin were also given orally at the dose of 6 tablets three times a day for two to four days.

Table 1 shows the details of bacterial isolates from faecal samples of cross-bred calves suffering from diarrhoea. The bacteria isolated from the faecal samples were *E. coli, Proteus* sp., *Salmonella sp., Klebsiella* sp. and *Enterobacter* sp. Twelve calves in the group treated with Strinacin were cured and 4 calves died during the period of treatment. The group treated with Gastina showed the best results as all the calves responded to the treatment and there was no mortality. Whereas in Neftin treated group 13 calves were cured and 3 calves died during the period of treatment. The death in these cases could be due to acute septicaemia and dehydration. The percentage recovery in Strinacin, Gastina and Neftin were 75, 100 and 91.3 %. respectively.

TABLE 1

Isolates from faecal samples of 2 to 20 days old cross-bred calves suffering from diarrhoea

No. of calves	Isolates							
	E. coli	*Prot.* sp.	*E. coli*+ *Prot.* sp.	*Sal.* sp.	*Sal* sp. + *Prot.* sp.	*Klebsiella* sp. + *Entero-bacter* sp.	*Kleb.* sp + *Entero-bacter* sp+ *E. coli*	*Sal.* sp.+ *Kleb.* sp. + *Entero-bacter* sp
16 (Strinacin)	5	2	0	2	1	3	2	1
16 (Gastina)	9	2	1	1	0	2	1	0
16 (Neftin)	9	2	0	1	0	2	2	0

REFERENCES

Blood, D. C. and Henderson, J. A. 1968 *Veterinary medicine*, 3rd Ed. Bailliere Tindall and Co. Ltd.

Edwards, P. R. and Ewing, W. H. 1962 *Identification of Enterobacteriae* sp. 2nd Ed. Burgess Pub. Co., Minneapolis, Minn.

Ewing, W. H. 1962 Sources of *Escherichia coli* cultures that belonged to 0 antigen groups associated with infantile diarrhoeal diseases. *J. Infect. Dis.*, 110 : 114.

Fisher, E. W. 1965 Death in neonatal calf diarrhoea. *Br. Vet. J.*, 121 : 132.

Howard, J. R. 1969 Observations of infectious diarrhoea as part of shipping fever syndrome in feed lot cattle. *J. Am. Vet. Med Assoc.*, 154 : 1201.

Khera, S. .S and Dhanda, M. R. 1963 Gastroenteritis in young calves II Colibacillosis and other infections. *Indian J. Vet. Sci. Anim. Husb.* 33 : 12.

Singh, R. P. and Panghaal, R. S. 1975 Evaluation of certain drugs against clinical cases or diarrhoea in buffalo calves. *J. Anim. Hlth.* Prod., 3 : 28.

Smith, H. W. 1962 observation on the etiology of neonatal diarrhoea (scours). *J. Pathol. Bacteriol.* 84 : 147.

BOOK REVIEW

Swamy, B. G. L & Krishnamurthy, K V. 1980

From Flower to Fruit—Embryology of Flowering Plants. Tata McGraw Hill Publishing Co. Ltd., New Delhi pp. vii+162, with a number of line drawings and photographs. Paperback. Price Rs. 25.50

The book "From Flower to Fruit—Embryology of Flowering Plants" contains nine chapters : (i) The Flower, (ii) The Ovule, (iii) The Anther, (iv) Fertilization, (v) The Endosperm, (vi) The Embryo, (vii) Agamospermy and Polyembryony, (viii) The Seed, and (ix) The Fruit. The authors have made a conscientious effort to cover almost all the important topics dealing with the developmental steps of fruit from flower and have presented suitable interpretation of various stages. The clarity in description and brevity in presentation of various topics deserve appreciation. Within the limit of about 142 pages, the authors have done an admirable job of presenting almost all descriptive and applied aspects of embryology A judicial selection of excellent illustrations has been made to make the subject intelligible and comprehensive to the reader. A speciality of the book is the presentation of some of the innovative concepts of the senior author on the classification of embryo sacs, origin of the tapetum, morphology of monocot embryo and the helobial endosperm.

Recognising the contribution and role of embryology in the crop improvement programmes, the authors have covered satisfactorily, topics like androgenic embryoids, male sterility, embryo culture and parthenocarpy. The reading of the subject matter has been made smooth by avoiding references in the text, without sacrificing any recent information on the subject. The references given at the end of each chapter are carefully selected to help gain a deeper knowledge of the subject. The glossary given at the end is of great benefit to the students and amateurs, who are not much conversant with the subject.

The scope and utility of the book could have been increased if topics, like, pollination, pollen physiology and incompatibility were given a wide coverage. This may be taken care of by the authors in the next edition.

The quality of paper and printing are good but the binding and cover leave scope for improvement.

The book will be of great use to the students of Botany and Agriculture and to all those who are interested in the subject. Its publication is timely as a book of this type was long awaited. The authors deserve appreciation for the commendable attempt to present the subject in a precise form and lucid style, understandable even by a novice with some knowledge of botany. *T. M. Verghese, Associate Professor of Botany, Haryana Agricultural University, Hissar—125004.*

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HYBRID VIGOUR IN AN EIGHT-PARENT DIALLEL CROSS FOR YIELD AND ITS COMPONENTS IN WHEAT*

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(Received : July 15, 1978; Revised : December 18, 1979)

ABSTRACT

Hybrid vigour for yield and yield components has been reported from an 8×8 diallel set grown under two fertility levels. Data were recorded for grain yield, tillers per plant, grains per ear, grain weight per ear, 100-grain weight, days to flower and plant height on all the 28 crosses and 8 parents. The manifestation of heterosis was more in high fertility than in low fertility environment. Interestingly, the cross combinations which exhibited high heterosis also recorded high degree of inbreeding depression in F_2 generation indicating non-additive type of gene effect. The hybrid UP 301 × Agra Local involving the most divergent parents recorded the highest hybrid vigour (102.33%). PV 18 × Lerma Rojo registered significant heterosis in both the environments. Hira × Sonora 64 and Hira × UP 301 exhibited negative heterosis for grain yield under low fertility conditions. Heterosis in yield appeared to be manifested through the heterosis in yield components like effective tillers and 100-grain weight. Economic heterosis for all the yield components except the number of grains per ear was observed. UP 301 × Agra Local for tillering, Sonalika × PV 18 for grain weight per ear, Hira × Sonora 64 for earliness, Hira × UP 301 for dwarfness and Hira × Agra Local for 100-grain weight exhibited maximum heterotic response. The exploitation of good cross combinations like UP 301 × Agra Local, Sonalika × PV 18, Sonora 64 × Agra Local, Hira × Agra Local and PV 18 × Lerma Rojo for the development of high yielding wheat varieties has been advocated.

In recent years, large yield increases have been obtained by plant breeders in various crop plants through the use of heterosis. The discovery of both male sterility and genes which restore fertility in wheat has encouraged many workers to examine first generation progeny yields. Briggle (1963) reviewed a large number of studies on heterosis and concluded that "if the commercial production of hybrid wheat is to become a success, a maximum degree of heterosis will have to be attainable, and those specific combinations of parents which express the desired degree of heterosis will have to be determined." The results of present findings would furnish further information on hybrid vigour for yield and its components under two contrasting environments.

*Part of Ph.D. Dissertation of the senior author submitted to Haryana Agricultural University, Hissar-125004.

MATERIAL AND METHODS

Eight wheat varieties, carrying genes from Mexican (Hira, Sonora 64, Sonalika, Kalyansona, PV 18, Lerma Rojo, UP 301) and Indian (Agra Local) gene pool and belonging to different height groups, were crossed in all possible ways, excluding reciprocals. The 8×8 diallel was grown under two fertility levels (High and Low) at the Haryana Agricultural University Research Farm, Hissar, during the winter of 1971. Sowings were done in 3 metre long rows spaced 30 cm apart with a plant to plant distance of 15 cm Data were recorded on five randomly selected plants for tillers per plant, number of grains per ear, grain weight per ear (g), 100-grain weight (g) and grain yield per plant (g). The data for grains per ear and grain weight per ear was recorded separately on each individual tillers and average over all the tillers was worked out. Heterosis over the standard variety Kalyansona (economic heterosis) was computed for yield and its components.

RESULTS AND DISCUSSION

Heterosis over Kalyansona and depression from F_1 to F_2 generation for grain yield have been presented in Table 1. Statistical significance has been shown only of the desirable increase. The expression of heterosis was more under high fertility than under low fertility conditions. This was because hybrids exploit the high yielding and favourable environments better than their parents. Depression from F_1 to F_2 generation was also higher in high fertility than in low fertility. It was interesting to observe that the crosses which exhibited high heterosis also recorded high degree of depression in F_2 generation. This showed a clear positive association between the magnitude of heterosis and extent of inbreeding depression. Hence, it may be concluded that the manifestation of hybrid vigour was largely due to non-additive type of gene effect. Under high fertility conditions, the heterosis ranged from 1.64 to 102.33 per cent. Of the 28 hybrids, 12 manifested economic heterosis. The cross UP 301 × Agra Local involving the most divergent parents recorded the highest (102.33%) hybrid vigour. The hybrid between parents with diverse genetic base usually manifest higher magnitude of heterosis. This has been substantiated by earlier reports in wheat (Mc Neal *et al.*, 1965; Singh and Gupta, 1969; Singh and Singh, 1971; Sun, Shands and Forsberg, 1972; Jatasra and Paroda, 1979).

Under low fertility conditions, the heterosis ranged from minus 46.87 to plus 20.70 per cent. However, only one hybrid (PV 18 × Lerma Rojo) could show significant hybrid vigour (20.70%) over the standard check Kalyansona. The lack of significant heterosis for most of the crosses in low fertility might be due to the fact that the hybrids could not express their full genetic potential in low fertility environment. Interestingly, some hybrids showed negative depression values. Two crosses, viz., Hira × Sonora 64 and Hira × UP 301 registered over 27% negative depression. These crosses showed relatively low depression under high fertility conditions also. The higher yield of these crosses in F_2 than in F_1 generation was primarily due to the fact that the hybrids which were specially adapted to the better and high yielding environments, yielded less than that by F_2 population which being a

TABLE 1

Mean performance of standard variety, F_1's and F_2's and economic heterosis (per cent) as well as depression (per cent) from F_1 to F_2 for grain yield under two fertility levels in wheat

	High fertility				Low fertility			
	F_1	F_2	Heterosis	Depression	F_1	F_2	Heterosis	Depression
Kalyansona	34.6	—	—	—	25.6	—	—	—
Hira × Sonora 64	42.7	34.9	23.1	18.1	18.9	24.0	−26.3	−27.8
Hira × Sonalika	45.4	31.0	31.0	31.7	19.6	19.5	−23.2	0.6
Hira × Kalyansona	48.1	25.0	38.8	47.9	23.7	21.4	−7.3	9.8
Hira × PV 18	45.8	32.8	32.1	28.3	23.9	20.2	−6.4	15.6
Hira × Lerma Rojo	51.8	28.5	49.4*	44.8	22.8	13.5	−10.8	40.6
Hira × UP 301	44.6	30.1	28.6	32.4	14.2	18.1	−44.5	−27.6
Hira × Agra Local	57.2	29.2	65.03*	48.9	26.3	17.0	2.8	35.3
Sonora 64 × Sonalika	50.9	29.2	40.8*	42.5	26.6	13.9	4.0	47.8
Sonora 64 × Kalyansona	51.4	30.0	48.3*	41.6	18.9	16.5	−26.1	12.5
Sonora 64 × PV 18	47.8	29.2	37.9	38.8	24.1	14.9	−5.7	38.0
Sonora 64 × Lerma Rojo	43.6	19.9	25.9	54.4	18.9	13.4	−26.1	28.7
Sonora 64 × UP 301	41.3	26.7	19.1	35.2	13.0	14.5	−46.8	−11.0
Sonora 64 × Agra Local	57.4	25.1	65.6*	56.2	23.7	11.9	−7.4	49.7
Sonalika × Kalyansona	35.2	34.6	1.6	1.7	20.9	20.9	−18.3	−0.2
Sonalika × PV 18	62.2	33.1	79.4*	46.7	21.4	19.6	−16.1	8.3
Sonalika × Lerma Rojo	36.1	35.1	4.1	2.7	27.7	17.3	8.4	37.5
Sonalika × UP 301	38.6	28.5	11.5	26.1	22.3	14.5	−12.7	34.7
Sonalika × Agra Local	37.1	28.5	7.0	23.1	28.7	16.6	12.2	42.1
Kalyansona × PV 18	43.9	28.1	26.8	36.0	21.1	12.7	−17.4	39.6
Kalyansona × Lerma Rojo	46.1	28.7	30.1	36.3	21.0	22.2	−17.8	−5.7
Kalyansona × UP 301	40.9	38.6	18.1	5.6	27.6	23.1	7.9	16.1
Kalyansona × Agra Local	43.5	37.8	25.6	13.1	26.6	21.6	4.1	18.7
PV 18 × Lerma Rojo	52.8	29.2	52.4*	44.6	30.9	22.7	20.7*	26.3
PV 18 × UP 301	50.0	32.1	44.4*	35.8	21.2	16.5	−16.9	22.3
PV 18 × Agra Local	53.9	28.6	55.5*	46.8	19.2	19.6	−24.8	−1.9
Lerma Rojo × UP 301	40.6	36.9	17.3	9.1	15.2	13.6	−40.5	−10.5
Lerma Rojo × Agra Local	50.6	26.3	45.9*	48.0	24.1	16.2	−5.7	32.6
UP 301 × Agra Local	70.1	24.4	102.3*	65.1	27.7	15.6	8.4	43.6

*Significant at 5 per cent level.

heterogeneous population performed better than the F_1 in low fertility environment.

The heterosis over Kalyansona for effective tillers per plant, the number of grains per ear and grain weight per ear is given in Table 2. The range of economic heterosis for effective tillers varied from —26.29 to 93.53 per cent. Seven crosses exhibited significant heterosis in high fertility, whereas only four crosses gave significant heterosis under low fertility conditions. It is of considerable significance that the cross UP 301 × Agra Local which manifested highest heterosis in high (93.53%) as well as low fertility environments (45.50%) for tillering had also given highest hybrid vigour for grain yield. This indicated that heterosis in grain yield was manifested by heterosis in its

TABLE

Mean performance of the standard variety and F_1's and economic heterosis in

	Effective tillers				Grains	
	High		Low		High	
	F_1	Heterosis	F_1	Heterosis	F_1	Heterosis
Kalyansona	18.8	—	10.9	—	62.0	—
Hira × Sonora 64	20.4	8.1	10.1	—7.3	50.4	—18.7
Hira × Sonalika	25.4	34.9*	10.6	—2.7	43.3	—30.0
Hira × Kalyansona	20.4	8.3	12.6	16.1	56.2	—9.3
Hira × PV 18	24.0	27.2	10.6	—2.7	59.6	—3.8
Hira × Lerma Rojo	29.2	54.8*	11.6	6.4	52.0	—16.1
Hira × UP 301	23.7	25.6	7.8	—27.8	46.6	—24.8
Hira × Agra Local	28.7	52.1*	15.5	42.2*	46.5	—24.9
Sonora 64 × Sonalika	24.0	27.2	12.5	14.6	47.2	—23.8
Sonora 64 × Kalyansona	24.4	29.6	7.1	—34.5	60.5	—2.4
Sonora 64 × PV 18	22.3	18.3	10.2	—6.4	56.7	—8.4
Sonora 64 × Lerma Rojo	20.9	10.9	9.4	—13.7	51.1	—17.6
Sonora 64 × UP 301	21.5	13.9	7.8	—28.4	48.1	—22.4
Sonora 64 × Agra Local	30.5	61.7*	12.1	11.2	48.9	—21.0
Sonalika × Kalyansona	13.9	—26.2	11.0	0.9	51.0	—17.6
Sonalika × PV 18	25.3	34.1*	10.7	—1.2	51.9	—16.2
Sonalika × Lerma Rojo	16.7	—11.4	13.4	23.4	52.0	—16.0
Sonalika × UP 301	19.8	5.3	10.0	—8.2	45.4	—26.8
Sonalika × Agra Local	18.9	0.2	11.6	6.9	46.2	—25.5
Kalyansona × PV 18	23.8	26.1	9.7	—10.7	64.8	4.4
Kalyansona × Lerma Rojo	24.4	29.3	9.8	—9.5	59.7	—3.7
Kalyansona × UP 301	20.5	8.6	12.1	11.0	62.3	0.4
Kalyansona × Agra Local	19.6	3.9	12.6	15.5	55.6	—10.2
PV 18 × Lerma Rojo	24.4	29.3	13.9	27.5*	58.5	—5.5
PV 18 × UP 301	23.4	24.3	10.4	—4.5	58.3	—5.9
PV 18 × Agra Local	24.0	27.2	12.3	12.8	54.0	—12.8
Lerma Rojo × UP 301	24.7	31.2	9.1	—16.2	51.4	—17.0
Lerma Rojo × Agra Local	26.2	39.2*	13.6	24.7*	50.7	—18.2
UP 301 × Agra Local	36.5	93.5*	15.8	45.5*	49.8	—19.6

*Significant at 5 per cent level.

most important component, i e., tillers per plant. Of the three crosses, viz., Hira × Agra Local, Lerma Rojo × Agra Local, and UP 301 × Agra Local which exhibited hybrid vigour for tillering in both the environments, all had Agra Local as one of their parents. Mani and Rao (1975) reported 95% heterosis over better parent for tillering in winter × spring wheat crosses. The hybrid combinations did not fare well when compared with Kalyansona for number of grains per ear. All the crosses indicated negative heterosis for this trait under both the environments. Sindhu and Singh (1975) also reported lack of hybrid vigour for the number of grains per ear. The performance of hybrids for grain weight per ear was also not good particularly in low fertility environment where all the 28 crosses showed negative heterosis over Kalyansona. However, three crosses,

2

(per cent) for four yield components under high as well as low fertility conditions wheat

per ear		Grain weight per ear				100-grain weight			
Low		High		Low		High		Low	
F_1	Heterosis	F_1	Heterosis	F_1	Heterosis	F_1	Heterosis	F_1	Heterosis
64.9	—	1.96	—	2.60	—	3.16	—	3.80	—
51.5	−20.6	−2.00	2.0	1.76	−32.3	3.83	21.2*	3.96	4.2
44.1	−32.0	1.76	−10.2	1.96	−24.6	4.26	34.8	4.43	16.5*
60.0	−7.5	2.13	8.6	2.33	−10.3	3.80	20.2*	4.23	11.3*
53.4	−17.6	2.23	13.7	2.16	−16.9	3.66	15.8*	4.13	8.6*
46.7	−27.9	1.96	0.0	1.90	−26.9	3.43	8.5	4.26	12.1*
47.8	−26.3	1.70	−13.2	1.80	−30.7	3.20	1.2	4.06	6.8*
41.7	−35.6	2.02	3.5	1.76	−32.3	4.56	94.3*	4.30	13.1*
47.6	−26.5	2.23	13.7	2.16	−16.9	4.80	51.8*	4.56	20.0*
64.2	−1.0	2.40	22.4*	2.66	2.3	3.73	18.0*	4.30	13.1*
55.8	−13.9	2.03	3.5	2.40	−7.6	3.70	17.0*	4.10	7.8*
48.4	−25.3	2.13	8.6	2.03	−21.9	4.23	33.8*	4.13	8.6*
42.9	−33.8	1.96	0.0	1.66	−36.1	4.16	31.6*	4.33	13.9*
48.3	−25.5	2.16	10.2	2.10	−19.2	4.46	41.1*	4.03	6.0
48.3	−25.5	2.26	15.3	2.20	−15.3	4.63	46.5*	4.50	18.4*
58.5	−9.8	2.40	22.4*	2.26	−13.0	4.50	42.4*	4.76	25.2*
49.0	−24.4	2.36	20.4*	2.26	−13.0	4.56	44.3*	4.93	29.7*
52.4	−19.2	1.96	0.0	2.20	−15.3	4.93	56.0*	3.80	0.0
43.5	−32.8	2.10	7.1	1.70	−34.6	3.20	1.2	4.20	10.5*
59.5	−8.2	2.20	12.2	2.20	−15.3	3.63	14.8*	3.80	0.0
58.3	−10.0	2.03	3.5	2.03	−21.9	4.13	30.6*	4.53	19.2*
56.5	−12.9	2.16	10.2	2.13	−18.0	3.73	18.0*	3.90	2.6
47.8	−26.3	2.26	15.3	2.03	−21.9	3.63	14.8*	3.90	2.6
52.9	−16.8	2.13	8.6	2.13	−18.0	4.06	28.4*	4.23	11.3*
52.2	−19.4	2.16	10.2	2.20	−15.3	3.66	15.8*	3.96	4.2
46.5	−28.3	2.13	8.6	1.83	−29.6	4.20	32.9*	4.20	10.5*
45.1	−30.5	1.80	8.1	1.80	−30.7	3.63	14.8*	3.60	−5.2
44.9	−30.8	2.26	15.3	1.83	−29.6				
45.9	−29.1	1.90	−3.0	1.70	−34.6				

viz., Sonora 64 × Kalyansona, Sonalika × PV 18 and Sonalika × Lerma Rojo gave significant hybrid vigour under high fertility conditions.

Mean values of hybrids and their heterotic response for 100-grain weight are presented in Table 2. All the cross combinations, except three, exhibited significant heterosis for earliness under high fertility conditions. However, only 8 out of 28 crosses were significantly earlier in flowering than Kalyansona under low fertility. The range of heterotic response for days to ear was from —11.95 to 4.14% in high fertility and from —10.57 to 4.09% in low fertility. With regard to plant height, 10 crosses gave significantly negative heterosis under both the fertility conditions. It was interesting to observe that these hybrids involved either of the two tripple dwarf varieties (Hira, UP 301) as one of their parents. The highest negative heterosis (—25.05 and—25.30% in high and low fertility, respectively) was exhibited by the cross between two tripple dwarf varieties (Hira and UP 301). All the crosses except three indicated significant hybrid vigour for 100-grain weight in high fertility, whereas 17 out of 28 crosses registered significant heterosis. The maximum hybrid vigour in high fertility (94.30%) was given by the cross Hira × Agra Local, whereas Sonalika × UP 301 indicated highest hybrid vigour (29.73%) in low fertility environment.

Grafius (1959) indicated that the heterosis for yield should be through heterosis for individual yield components. The maximum hybrid vigour in UP 301 × Agra Local in high fertility appeared to be due to the highest heterosis for tillering. Similarly, under low fertility conditions also the only cross PV 18 × Lerma Rojo with significant hybrid vigour for grain yield, depicted significant heterotic response for tillering and days to flower. Singh and Gupta (1969) and Singh and Kandola (1971) reported that the heterotic response in yield was the result of heterosis in individual characters. The heterotic effect in yield was found to be more as compared with heterosis in yield components. Similar observations have been made by Fonseca and Patterson (1968) and Chaudhry, Rashid and Alam (1972) which indirectly support the contention that heterosis in components also contributes toward the heterosis in yield.

Considering the important yield components and yield *per se*, the performance of cross combinations UP 301 × Agra Local, Sonalika × PV 18, Sonora 64 × Agra Local and Hira × Agra Local, in that order, was outstanding. The hybrid PV 18 × Lerma Rojo which exhibited highest hybrid vigour in low fertility and also significant heterosis under high fertility conditions showed relatively low inbreeding depression under both the fertility levels. Therefore, the exploitation of these hybrids is suggested for developing high yielding varieties of wheat.

REFERENCES

Briggle, L. W. 1963. Heterosis in Wheat-a review. *Crop Sci.* 3 : 407-12.

Chowdhry, A. R., Rashid A. and Alam, K. 1972. Heterosis and inbreeding depression for plant height and grain yield in some wheat crosses. *Pak. J. Sci.* 24 : 187-90

Fonseca, S. and Patterson, F. L. 1968. Hybrid vigour in seven-parent diallel cross in common wheat (*T. aestivum* L.). *Crop Sci.* 8 : 85-88.

Grafius, J. E. 1959. Heterosis in barley. *Agron. J.* 51 : 551-54.

Jatasra, D. S. and Paroda, R. S. 1979. Heterosis and combining ability for synchrony traits in wheat. *Indian J. Genet.* 39 : 528-35.

Mani, S. C. and Rao, M. V., 1975. Heterosis in winter x spring wheat crosses. *Indian J. Genet.* 35 : 330-35.

Mc Neal, F.H., Baldridge, D.E., Berg, M. A. and Watson, C. A. 1965. Evaluation of three hard red spring crosses for heterosis. *Crop Sci.* 5 : 399-409.

Sindhu, J. S. and Singh, R. B. 1975. Heterosis in wheat. *Indian J. Genet.* 35 : 467-69.

Singh, K. B. and Kandola, H. S. 1971. Heterosis in wheat, *Indian J. Genet.* 31 : 53-61.

Singh, K. B. and Gupta, V. P. 1969. Combining ability in wheat. *Indian J. Genet.* 29 : 227-32.

Singh, K. B. and Singh, J. K. 1971. Potentialities of heterosis breeding in wheat. *Euphytica* 20 : 586-90.

Sun, P. L. F., Shands, H. L. and Forsberg, R. A. 1972. Inheritance of kernel weight in six spring wheat crosses. *Crop Sci.* 12 : 1-5.

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CHEMICAL CONTROL OF GRAM POD BORER, *HELIOTHIS ARMIGERA* HUBNER AND SEMI-LOOPERS, *PLUSIA* SPP. ON GRAM, *CICER ARIETINUM* L.

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ABSTRACT

During 1977-78, two experiments were carried out, one on *Kabuli* gram (variety L 144) and other on *desi* gram (variety G 130) with seven insecticides, viz., quinalphos 0.05%, phosalone 0.07%, endosulfan 0.07%, monocrotophos 0.04%, fenitrothion 0.05%, chlorpyriphos 0.04% and phenthoate 0.1% against gram pod borer and semi-looper (*Plusia orichalsia* F. and *Plusia nigrisigna* Wlk.). In all experiments, spraying of endosulfan 0.07% proved significantly superior in reducing incidence of *H. armigera* and *Plusia* spp. and gave an increase of 105.3% in yield over control in variety L 144 and 155.5% in G 130. The next best treatment was the spraying of monocrotophos 0.04% which besides giving significant reduction in the incidence of gram pod borer and semiloopers, also gave an increase of 69.8 and 97.6% in grain yield in varieties L 144 and G 130, respectively. All other insecticides, although were superior in reducing pest incidence and increasing yield of the crop significantly over control, yet their results were inconsistent and were considered inferior than endosulfan and monocrotophos.

During the crop season of 1977-78, the gram pod borer appeared in very serious form and caused considerable loss to the yield of gram crop. The semiloopers (*Plusia orichalsia* F. and *Plusia nigrisigna* Wlk.) which were earlier considered as minor pests on gram crop also appeared in very serious form during the crop season of 1977-78. These two species of semiloopers besides feeding on leaf buds, leaves, flower buds and flowers, also fed on young as well as on mature pods of gram. Feeding of semiloopers on different parts of gram plant resulted in poor pod formation, which adversely affected the crop yield. Studies on chemical control of *H. armigera* on gram crop although, have been made by several workers (Doval *et al.*, 1976; Subba Rao *et al.*, 1972; Singh *et al.*, 1973 and Balasubramanian *et al.*, 1974), yet no work on this aspect has been done in Haryana. Considering the importance of pod borer and semiloopers in this part of the country, field experiments were conducted to evaluate the efficacy of several insecticides in their liquid formulations for the control of these important insect pests.

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MATERIAL AND METHODS

The experiments for the control of *H. armigera* and *Plusia* spp. were carried out at the Farm of Haryana Agricultural University, Hissar (India) on gram crops. During 1977-78, two experiments were carried out, the first on the *Kabuli* gram (variety L 144) and second on *Desi* gram (variety G 130) with seven different insecticides (Table 1). The doses of insecticides were taken mostly on the basis of recommendations made either by the manufacturers of the insecticides or recommendations already given by earlier workers. Experiments were carried out in randomised block designs, replicated four times in plots of 4.5 × 3 m size. The crop in these experiments were sown in the last week of October, 1977. Only one spray was done in each experiment, generally in the middle of March, when about 50% pods were formed. The spray material was used @ 500 L/ha. Observations on incidence of pests on pods was recorded only once at the time of harvest of the crop. For recording incidence of pod borer as well as incidence of semiloopers on pods, observations were recorded from 5 different places in each plot by selecting 4 plants at one place, the total being 20 plants per plot. Total number of healthy and damaged pods present on these plants were counted and per cent incidence was calculated. The nature of damage of these two pests on pods were quite distinct. Caterpiller of *H. armigera* made only one circular hole in each pod. *Plusia* spp. on the other hand made irregular cut and most of the cases, almost entire pod was eaten off. To estimate the percentage plants attacked by *Plusia* spp., total number of healthy as well as attacked plants were counted at the green plant stage from the two middle rows of each plot. Yield data were also recorded.

RESULTS AND DISCUSSION

Comparative efficacy of different insecticides in experiments carried out during 1977-78 with variety L 144. The percentage of plants damaged by *Plusia* spp. in this experiment was significantly lower (29.5-52.8%) in all the insecticidal sprayed plots than control plots (77.5%) (Table 1). Among the various insecticides, plots sprayed with endosulfan recorded lowest incidence of (29.5%) followed by monocrotophos (37.8%) and differences in per cent incidence in these two treatments were non-significant. The phosalone and quinalphos were the next best insecticides for reducing incidence of these semiloopers. In other insecticidal treatments, incidence of semiloopers varied from 48.4 to 52.8 per cent.

Even for reducing incidence of semiloopers to pods, all the insecticides proved superior over control and the incidence of these pests was lowest in the plots treated with endosulfan and monocrotophos (1.6 and 2.6%, respectively). In other insecticidal treated plots, the pod infestation by *Plusia* spp. varied from 3.4 to 5.0% compared to 6.6% in control plots.

The infestation by *H. armigera* was also lowest in endosulfan treated plots (3.2%) followed by plots sprayed with monocrotophos (6.6%), the difference between these two treatments being non-significant. The incidence of pod borer in the remaining insecticidal sprayed plots ranged from 8.9 to 10.6% as compared to 29.4% in the control. This shows that all the insecticidal treat-

TABLE 1

Effect of different insecticidal sprays on the incidence of *H. armigera* and *Plusia* spp. and on yield of crop (varieties L 144 and G 130)

Treatments	Variety L 144					Variety G 130			
	Plant damaged by *Plusia* spp. (%)	Pods damaged at harvest by (%)		Yield (q/ha)	Increase in yield over control (%)	Pods damaged at harvest by (%)		Yield (q/ha)	Increase in yield over control (%)
		Plusia spp.	*H. armigera*			*Plusia* spp.	*H. armigera*		
Quinalphos 0.05%	41.5 (40.09)	5.0 (12.06)	8.9 (17.17)	11.04	41.7	4.4 (12.06)	40.4 (39.44)	11.5	55.1
Phosalone 0.07%	40.8 (38.15)	4.1 (10.33)	9.2 (17.95)	11.29	44.9	3.4 (10.33)	31.7 (34.24)	12.9	69.8
Endosulfan 0.07%	29.5 (32.89)	1.6 (8.82)	3.2 (10.02)	15.99	105.3	2.5 (8.82)	12.3 (20.47)	18.19	155.5
Monocrotophos 0.04%	37.8 (37.88)	2.6 (12.38)	6.6 (14.56)	12.23	69.8	4.6 (12.38)	25.6 (30.37)	14.07	97.6
Fenitrothion 0.05%	49.2 (44.55)	4.2 (12.88)	10.6 (18.89)	9.53	22.3	5.0 (12.82)	29.2 (38.55)	13.32	87.1
Chlorphyriphos 0.04%	48.8 (44.32)	3.7 (11.03)	9.0 (17.46)	12.03	54.4	3.7 (11.03)	51.5 (48.51)	13 53	90.0
Phenthoate 0.1%	52.8 (46.62)	3.4 (12.55)	9.7 (18.12)	10.99	41.1	4.7 (12,55)	26.6 (30.98)	13.94	95.8
Control	77.5 (61.79)	6.6 (15.03)	29.4 (29.9)	7.79	0.0	6.8 (15.03)	87.8 (51.89)	7.12	0.0
C. D. (P=0.05)	(6.69)	(1.79)	(4.91)	0.79	—	(2.32)	(1.57)	1.96	—

ments proved superior over control in reducing incidence of gram pod borer.

The plots, treated with endosulfan gave the highest yield of 15.99 q/ha as compared to only 7.79 q/ha in control plots. The next best insecticide for giving highest yield (13.23 q/ha) was monocrotophos but the difference between the yield of these two insecticides was non-significant. The yield in other insecticidal treated plots varied from 9.53 to 12.03 q/ha, the lowest being in plots treated with fenitrothion (9.53 q/ha). Plots sprayed with endosulfan gave highest increase of 105.3% in yield followed by 69.8% in monocrotophos. In other insecticidal treated plots, increase in yield over control varied from 22.3 to 54.4%, the lowest being in fenitrothion.

Comparative efficacy of different insecticides in the experiment carried out during 1977-78 with variety G 130. In this experiment also, incidence of *Plusia* spp. to pods was lowest (2.5%) in endosulfan followed by phosalone (3.4%) and chlorpyriphos (3.7%) and the differences in the incidence to pods among these three insecticides were non-significant (Table 1). In other insecticidal treatments, although per cent pod infestation by semiloopers varied from 4.4 to 5.0%, yet all the insecticidal treatments gave superior reduction over control, except fenitrothion (5.0%) which was almost similar to unsprayed plots (6.8%).

Regarding damage by *H. armigera* to pods, all the insecticide treated plots recorded lower borer infestation (12.3-40.4%) than control (87.8%). As observed in other two experiments, the spraying of endosulfan was found to be the best treatment in this experiment also, as the plots sprayed with this chemical recorded lowest damage of only 12.3 per cent. The other effective insecticides for reducing pod borer damage were monocrotophos, and phenthoate which recorded 25.6 and 26.8% damaged pods, respectively. Damage by borer in other insecticidal sprayed plots varied from 29.2 to 40.4 per cent.

The yield of crop was highest in the plots sprayed with endosulfan (18.19 q/ha) followed by plots treated with monocrotophos (14.7 q/ha). The yield of gram in other insecticidal treated plots ranged from 11.05 to 13.93 q/ha as compared to only 7.12 q/ha in the control plots. The per cent increase in yield over control in different insecticidal sprayed plots ranged from 33.1 to 155.5%, the highest being in endosulfan and lowest in quinalphos. The percentage increase in yield in monocrotophos, phenthoate, chlorpyriphos, fenitrothion and phosalone was 97.6, 95.8, 90.0, 87.1 and 69.8%, respectively.

Considering over all efficacy of different insecticides tested in both the experiments, spraying of endosulfan (0.07%) was found to be the best effective treatment because it not only reduced the damage by pod borer and semilooper but also gave consistently highest production in the gram yield. This insecticide was also reported to give effective control of *H. armigera* when sprayed on gram crop by Subba Rao *et al.* (1972) and on berseem *(Trifolium alexandrium* L.) by Singh *et al.* (1973). Spraying of monocrotophos (0.04%) was the second best treatment both for reducing the pod borer incidence *(Plusia* spp. and *H. armigera)* and increasing

grain yield of gram significantly. All other insecticides although, had shown significantly superior performance over control in reducing the damage by *Plusia* spp. *H. armigera* and also in increasing yield of gram crops, yet their results were inconsistent in the two experiments.

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REFERENCES

Balasubramaniam, G., Mohammad, H. A., Leela David, A. and Subramaniam, T. R. 1974. Chemical control of pod borer on bengal gram. *Madras Agric. J.* 61(7) : 232-33.

Doval, S. L., Bohra, O. P. and Sharma, S. K. 1976. Studies on the chemical control of *Heliothis armigera* Hubn. in gram *(Cicer arietinum)*. *Indian J. Pl. Prot.* 4(1) : 6-8.

Singh, Balraj, Chahal, B. S. and Singh, Gurmeet, 1973. Chemical control of *Heliothis armigera* (Hubner) (Lepidoptera : Noctuidae) on berseem, *Trifolium alexandrium* L. *Indian J. Entomol.* 35(4): 285-88.

Singh, H., Brar, B. S. and Mavi, C. S. 1973. Insecticidal trial for the control of *Heliothis armigera* (Hubner) on gram. *Indian J. Entomol.* 35(4) : 325-28.

Subba Rao, P. V. Rangarajan, A. V. and Azeez Basha, A. 1972. A note on control of *H. armigera* on Bengal gram. *Sci. & Cult.* 58 : 202-03.

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FLAG LEAF, ITS COMPONENTS AND GRAIN YIELD OF WHEAT

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ABSTRACT

Wheat genotypes significantly varied in respect of grain yield, flag leaf area (FLA) and its angles with peduncle. A positive association was recorded between grain yield and flag leaf area. The base angle of flag leaf with peduncle was also positively correlated with the grain weight m^{-1} row length. Therefore, it is suggested that higher FLA and wide base angle, preferably more than 45° are suitable parameters for evolving genotypes with high photosynthetic rate and high yield of wheat.

Wheat varieties show considerable differences in photosynthesis and respiration rates in the flag leaf, which is a major source of assimilates for the developing grain of wheat (Voldeng and Simpson, 1967). However, most of the photosynthates utilized in grain development is synthesized in flag leaf or ear itself (Thorne, 1966). Lower and older leaves do not contribute much to the grain. Simpson (1968) reported the highly positive correlation coefficient (0.840) between weight of grain and flag leaf lamina area. Components of flag leaf such as its photosynthetic surface, length, width and angle from the peduncle, needs further testing the association with grain yield. Therefore, information on these aspects may suggest suitable selection criteria in the tailoring of superior wheat ideotype for higher yields.

MATERIAL AND METHODS

Fifteen promising wheat *(Triticum aestivum* L.*)* genotypes were tested under high fertility (120 kg N+60 kg P_2O_5/ha) and sufficient irrigation facilities at the Research Farm of the Haryana Agricultural University, Hissar during the *rabi* season of 1977-78. The part of the experiment was planted on 12th November, 1977. The soil of the field was sandy loam, with organic carbon 0.27%, available phosphorus 18 kg/ha, available potash 708 kg/ha and pH 7.9. These nutrients were analysed with the methods followed by Walkley and Black (1947), Olsen (1954) and Morgan (1941) for organic carbon, phosphorus and potash, respectively. The pH was determined from the solution of water and soil in the ratio of 2 : 1 by pH meter. 97.4 mm rain was received during the crop season. The maximum and minimum air temperature, mean relative humidity and evaporation varied from 19.3 to 31.3 °C and 1.7 to 15.2 °C, 44.5 to 77.0% and 1.8 to 7.2 mm/day, respectively. The observations on flag leaf area and grain yield were recorded from the one meter marked row from each plot. On 25th Feb.,

1978 the flag leaf area was measured by Portable area meter Model LI-3000. Length and width of flag leaf was measured with plastic scale. The angle between flag leaf and peduncle and also the angle of drooping of the tip were measured with the help of 'D'

Grain yield was recorded from the harvesting and threshing of marked one meter row of matured crop. The association of different components were worked out as discussed by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Data in Table 1 indicate that the maximum (77.9 dm^2) flag leaf area/m row was recorded in the variety UP 2002 and minimum in variety sonalika (30.0 dm^2). The varieties UP 2002 and HD 2236 were at par. The difference in flag leaf area amongst the varieties sonalika WH 208, WH 199, HD 2234 and HD 2233 were not well marked. The variety HD 2232 had the maximum (30.6 cm) length of the flag leaf whereas variety HD 2009 the minimum (21.0 cm). The difference between Raj 1418 and HD 2232 was not well marked. The variety HD 2233, did not differ markedly with the varieties HD 2009, HD 2234, WL 1536, WH 208, UP 2002 and Kalyansona. The maximum (56°) angle between the base of flag leaf and peduncle was recorded in the varieties UP 2002 and Raj 1418, and minimum in variety HD 2009 (33°). The varieties HD 2009, Raj 1418, WL 1536, HD 2237, HD 2236, HD 2234, and WH 199 did not differ markedly themselves in respect to base angle. The variety UP 2002 produced maximum (120 6 g/m) grain yield and the variety sonalika minimum (72.6 g/m). The difference among the varieties UP 2002, Raj 1418, WL 1536 and HD 2236 were not well marked. On the other hand, sonalika did not differ markedly from WH 208 and HD 2233. Variation in yield might be due to differences in photosynthetic activity of different genotypes (Voldeng and Simpson, 1967 and Malhotra, 1978). Simpson (1968) reported that 85% of the photosynthates translocated to grain was produced from above the flag leaf node. Flag leaf size and its angle at base have influence on the photosynthetic efficiency and grain yield.

It is evident from the data (Table 2) that there was positive and significant correlation between photosynthetic surface of flag leaf and grain yield. Similar trend was obtained for leaf base angle with peduncle and grain yield by Wicke *et al.* (1972) who while working on winter wheat, found a good relation between the flag leaf area index and the grain yield. However, none of the other components of flag leaf (Length and width) showed significant correlation with the grain yield. Therefore, the base angle of flag leaf with peduncle seemed to be an important component of the flag leaf, and, thus, might be considered for efficient energy harvesting.

Flag leaf area and angle of base have been ploted against grain yield and depicted in figure 1. It is clear from the

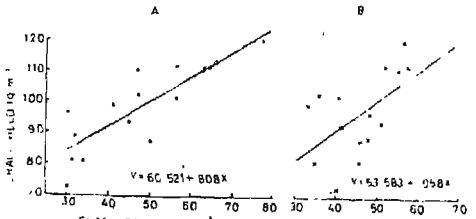


FIG. 1 REGRESSION LINE FOR THE ASSOCIATION OF WHEAT GRAIN YIELD TO FLAG LEAF AREA AND LEAGE ANGLE

TABLE 1

Flag leaf components and grain yield of different genotypes

Varieties	Flag leaf area/m row (dm^2)	Size of leaf (cm)		Leaf angle*		Grain yield per m(g)
		Length	Width	Base	Tip	
HD 2232	40.8	30.6	2.4	43	38	93.5
HD 2233	31.7	21.4	2.2	46	56	81.7
HD 2234	30.5	21.3	1.7	48	64	97.7
HD 2236	64.1	25.1	2.5	52	53	112.7
HD 2237	45 7	25.3	1.9	51	54	94.4
HD 2009	40.9	21.0	1.9	33	56	99.4
WL 1536	47.7	23 6	2.3	55	57	111.3
WH 198	50.2	26.8	1.9	46	47	88.4
WH 199	31.8	22.8	1.9	48	47	89.5
WH 208	34.1	21.9	1.7	35	47	81.3
WH 209	47.3	23.1	1.7	36	52	103.3
UP 2002	77.9	23.0	2.0	56	50	120.6
Raj 1418	56.1	28.4	1.9	56	46	112.2
Kalyansona	56.7	21.4	2.0	41	59	103.3
Sonalika	30.0	25.7	1.8	41	32	72.6
Mean ($\bar{x}$)	45.71	24.09	2.00	45.80	49.86	97.44
SD (σ)	13.82	2.85	0.24	7.56	7.35	13.47

*Base=Angle between peduncle and base of the flag leaf.

Tip=Angle between tip and the middle of the flag leaf.

TABLE 2

Association between grain yield and flag leaf components

	Correlation coefficient (r)		
Grain yield	× Flag leaf area	=	0.773**
Grain yield	× Length of leaf	=	0.025
Grain yield	× Width of leaf	=	0.007
Grain yield	× Base angle of leaf	=	0.535*
Grain yield	× Tip angle of leaf	=	0.472

*Significant at 5%

**Significant at 1%

figure that the grain yield was linearly related to flag leaf area and base angle. Therefore, an increase in FLA or base angle could increase the grain yield. Erectophile (lesser than 45° angle between leaves and main shoot) type of leaf is desired for higher grain production (Murty and Ruwali 1977). In the present study, the mean leaf base angle for different varieties was 45.8° and varied from 36° to 56°. Therefore, the situation of planophile (90° angle between leaf and peduncle) flag leaf was not present in any of the variety under test. Angles greater than 60° might be harmful as a result of an increased mutual shading

effect and decreasing photosynthesis of lower green leaves in the canopy. However, Singh *et al.* (1977) working on aestivum wheat found that varieties having high LAI should have erect leaves and with low LAI should have droppy leaves at boot stage. More work is required to be done for the correct manipulation of the flag leaf angle and its area as an indicator of high yield.

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REFERENCES

Malhotra, O. N. 1978. Review of work done on physiological aspects of wheat. Paper presented in 17th All India Wheat Workers' Workshop held at APAU, Hyderabad.

Morgen, M. F. 1941. Chemical soil diagnosis by the Universal soil testing system. *Bull. Conn. Agric. Expt. Sta.* 450.

Murty, K. S. and Ruwali, K. N. 1977. *Physiological Assessment of wheat cultivars for their grain yield.* Paper presented in 16th All India Wheat Workers' Workshop held at IARI, New Delhi 22nd-27th August.

Panse, V. G. and Sukhatme, P. V. 1967. *Statistical methods for agricultural workers.* ICAR, New Delhi, Second Edition pp. 103-09.

Olsen, S. R. 1954. *Estimation of available phosphorus in soils by extraction with sodium carbonate.* Circ. U. S. Dept. Agric. 939.

Simpson, G. M. 1968. Association between grain yield per plant and photosynthetic area above the flag leaf node in wheat. *Can. J. Plant Sci.* 48 : 253-60.

Singh, M., Sharma, K. C. and Prakash, A. 1977. *Physiological assessment of wheat genotypes grown at Pantnagar.* Paper presented in 16th All India Wheat Workers' Workshop held at IARI, New Delhi 22nd-27th August.

Thorne, G. N. 1966. *Physiological aspects of grain in cereals.* In the growth of cereals and grasses. Butter Worths. London pp. 88-105.

Voldeng, H. D. and Simpson, G. M. 1967. The relationship between photosynthetic area and grain yield per plant in wheat. *Can. J. Plant Sci.* 47 : 359-69.

Walkley, A. and Black, L. A. 1947. A critical examination of a rapid method for determining organic carbon in soils-effect of variations in digestion conditions and of inorganic soil constituents. *Soil Sci.* 63 : 251.

Wicke, H. J., Stock, H. G. and Singh, D. P. 1972. Studies on the effect of sprinkler irrigation on the yield of cereal crops. Aroh. Acker, U. P. Flenzenbous 4. *Bodenkund* 16 : 837-45.

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HISTOPATHOLOGICAL STUDIES OF LEAF BLIGHT OF ROSE CAUSED BY *ALTERNARIA ALTERNATA* (Fr.) KELSSLER

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ABSTRACT

Penetration of the infection hyphae took place through the stomatal pore and the initial symptoms developed in the spongy parenchyma The subsidiary cells came closer due to the enlargement of the epidermis, thereby resulting in the blocking of the stomatal pore. The mycelium was intercellular.

Alternaria leaf blight disease is quite widespread in Punjab and Haryana. The symptoms induced by the incitant on rose are almost the same as reported by Rao (1964) and Dutta and Hussain (1959). The average losses due to the disease vary from 10 to 50% depending upon the environmental conditions and the variety involved (Bedi and Singh, 1972). In view of the huge losses caused by the disease, it was considered necessary to investigate the histopathology of the pathogen so that further research could be planned to achieve suitable control measures.

MATERIAL AND METHODS

The diseased material for investigation was collected from the Zakir Rose-Garden, Chandigarh; the Madhuban Park, Hissar and the rose garden of the Haryana Agricultural University, Hissar.

For the study of histopathology, the healthy and diseased leaves were fixed in formalin-acetic acid-Alcohol. The material was transferred in 70% alcohol after 24 hours. The microtome preparations were made by conventional method (Johansen, 1940), using xylene as clearing agent. The sections were cut 10 to 15 μ thick and stained with safarin and fast green.

RESULTS AND DISCUSSION

Histopathological studies showed that the infection hypha entered the host through the stomatal pore and the first cells affected were, the spongy parenchyma lying adjacent to stomatal chamber (Fig. 1). The mycelia were intercellular. With the spreading of the infection all the living cells were filled with brownish contents. This marked the death of the cell and prior to this change the chloroplasts were completely eliminated from the cell.

Other changes brought about by the fungus were a limited extent of hyper-

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Fig. 1. Showing infected spongy parenchyma near stomatal pore.



Fig. 2. Showing infected leaf at the early stages, epidermis cells show slight hypertrophy.

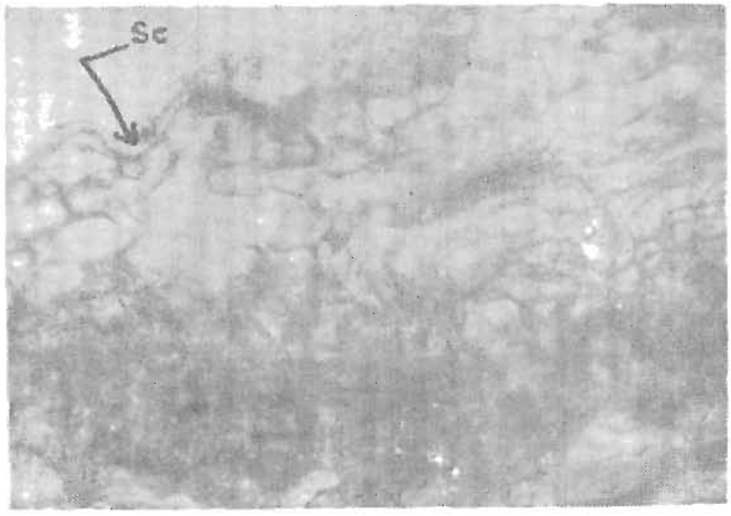


Fig. 3. Showing the blocked stomatal pore. Sc = subsidiary cell.

trophy in some of the epidermal cells (Fig. 2), division and increase in number of the palisade cells, the enlargement of the spongy parenchyma resulting in the reduction of intercellular spaces or complete obliteration of these and the increase of epidermal cells resulting in the blocking of the stomatal pore due to approximation of the subsidiary cells (Fig. 3). The disease could, therefore, result in decreased photo-synthesis, respiration and transpiration due to the blocking of the stomatal pore, the reduction and then disappearance of intercellular spaces in spongy parenchyma and the disappearance of chloroplasts in the cells.

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REFERENCES

Bedi, P. S. and Singh, J. P. 1972. Leaf blight of rose in the Punjab. *Indian Phytopath.* 25 : 534-39.

Dutta, A. K. and Hussain, S. M. 1959. Leaf spot of rose caused by *Curvularia lunata* (Wakker) Boedijn. *Curr. Sci.* 28 : 413.

Johansen, D. H. 1940. *Plant micro-technique.* McGraw Hill Book Co., New York.

Rao, V. G. 1964. A new leaf spot of rose from India. *Plant Dis. Rep.* 48 : 397-99.

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HETEROSIS STUDIES IN OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH)

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ABSTRACT

A 7×7 diallel cross involving genetically divergent parents and 21 F_1 was grown at Vegetable Research Farm, Haryana Agricultural University, Hissar during 1977-78 to study the extent of heterosis in okra crop. Highly significant differences were observed for the characters studied. The cross I. C. 6653×I. C. 6316 expressed significantly high amount of heterosis for fruit yield per plant, length of fruit and number of fruits per plant and cross I. C. 6653×I. C. 12930 showed high heterosis for fruit yield, fruits per plant and fruits per branch. Heterosis for fruit length and diameter, number of fruits per plant and number of seeds per fruit was also observed significant in some cross combinations. Nine crosses expressed desired heterosis for disease incidence. No consistency was recorded between yield and disease incidence.

Hybrid vigour study has become a familiar tool in the evaluation and selection of germplasm for further improvement of the crop under experimentation. Hybrid vigour first of all in okra was reported from Indian Agricultural Research Institute in 1954 and since then several workers have reported heterosis in okra for plant height, number of fruits per plant, yield per plant and seed yield. With the available material, the present investigations were designed to provide information on the extent of heterosis in a seven parent diallel cross of okra.

MATERIAL AND METHODS

Seven varieties of okra, namely, I. C. 6653 (P_1) I. C. 12930 (P_2), I. C. 6316 (P_3), Pusa Sawani (P_4), Narnaul Collection (P_5), Dwarf Green Smooth (P_6), and Selection-2 (P_7) selfed during 1975-76 were taken for study. These varieties were crossed in all possible combinations excluding reciprocals during 1976-77. The resulting 21 F_1 hybrids along with their seven selfed parents were sown on June 30, 1977 for evaluation in a randomised block design with three replications. Each treatment was grown in three rows 2.4 meters long each accomodating eight plants. The distance between rows was 60 cm and between plants being 30 cms. Five plants were randomly selected for each treatment in each replication for recording observations on number of fruits per plant, number of seeds per fruit, diameter of fruit, length of fruit, weight of

fruit, days to 50% flowering, branches per plant, fruits per branch, plant height, yield per plant and disease incidence. Heterosis was calculated as the per cent increase or decrease of F_1 mean performance in the desired direction above the mean performance of the better parents. Statistical analysis was also carried out for variance study of the genotypes.

RESULTS

The analysis of variance of the design of experiment for eleven characters has been given in Table 1. Perusal of data indicated significant genotypic differences for all the characters among the genotypes. Block effect variances were also significant for four characters.

The mean values of seven parents and their 21 F_1 progenies and per cent heterosis over better parent are presented in Table 2. Pusa Sawani was earliest in flowering among parents and I. C. 12930, being the late. All the hybrids were earlier than the late parent for days to flowering varying from 48.46 to 57.53. However, two crosses involving late parents expressed, though non-significant but desired earliness. A significant decrease in height of crosses (F_1) was recorded. Here it can be seen that parents involved in such crosses were having either lowest or maximum plant height.

Branches, an undesirable character in okra varied from 1.93 to 5.8. Only one cross $P_2 \times P_5$, involving parents with maximum branching habit showed significant decrease in branch number per plant. Considerably low branching was recorded in five crosses. Maximum fruits per branch were observed in the cross $P_6 \times P_7$. All the hybrids carried higher fruit number per branch either of the parents involved. Crosses among P_1, P_2 and P_5 showed significant increase in fruit number per branch. The mean performance with regard to fruit per plant varied from 7.66 to 20.60. The

TABLE 1

Analysis of variance for different characters in okra

Characters	Mean Square		
	Replications	Treatments	Error
d. f.	2	27	54
Days to 50% flowering	3.7500	31.5137**	5.6706
Plant height (cm)	5861.5800**	435.4485**	104.2494
Number of branches per plant	3.6973*	3.0626**	0.7884
Number of fruits per branch	2.0467	15.9228**	2.4492
Number of fruits per plant	3.7305	27.5788**	10.8846
Number of seeds per fruit	448.8000*	340.9893**	120.7852
Diameter of fruit (cm)	0.0186	0.0759**	0.0173
Length of fruit (cm)	0.5575	33.0397**	1.1302
Weight of fruit (g)	14.6330	13.8899**	5.5035
Yield per plant (g)	6537.0500	9649.8074**	4545.3129
Disease incidence (%)	1848.8650**	232.0029**	110.1716

*, **Significant at 0.05 and 0.01 probability, respectively.

TABLE 2

Mean values of parents and F_1 hybrids, % heterosis over better parent (B. P.) for eleven characters in a diallel set of Okra

Parents and hybrids	Days to 50% flowering		Plant height (cm)		No. of branches per plant		No. of fruits per branch		No. of fruits per plant	
	Mean	Heterosis over B. P.	Mean	Heterosis over B. P.	Mean	Heterosis over B. P.	Mean	Heterosis over B. P.	Mean	Heterosis over B. P.
1.	48.20		81.00		2.46		7.25		12.00	
2.	58.73		97.93		5.26		4.45		10.46	
3.	48.53		97 66		1.93		11.27		14.06	
4.	46.73		105.86		2.26		10.22		17.26	
5.	58 46		80.66		4.80		4.57		7.66	
6.	47.00		93.20		2.40		11.81		17.93	
7.	54.73		122.53		3.13		8.99		18.53	
1×2	49.60	2.90	95.80	—2.17	3.06	24.39	10.27	41.65*	14.80	23.33
×3	50.40	4.56	87.83	—10.06	3.26	68.91*	10.65	—5.50	18.53	31.79*
×4	49.26	5.41	96.73	—8.62	2.86	26.54	11.28	10.47	18.66	8.11
×5	49.06	1.78	87.00	7.40	2.66	8.13	8.52	31.31*	12.80	6.66
×6	49.60	5.53	96.00	3.00	3.06	27.50	11.36	—3.81	16.73	6.69
×7	48.86	1.36	97.00	-20.83*	2.63	6.92	10.30	14.57	19.66	6.09
2×3	53.33	9.89*	93.00	—5.03	4.13	113.98*	10.04	—10.91	16.60	18.06
×4	54.00	15 55*	108 80	2.77	4 05	79.64*	5.35	– 47.60*	11.33	—34.33*
×5	57.53	—1.59	80.00	—9.11	3.53	—26.45*	6.39	39.82*	10.40	—00.57
×6	49.33	4.95	102.46	4.62	4.13	72.08*	8.16	—30.90*	16.33	—8.92
×7	53.60	—2.06	111.00	– 9.40	5.80	85.30*	6.13	—31.81*	16.66	—10.09
3×4	62.93	13.36*	105.26	—0.56	2.46	24.33	1.87	5.32	15.40	—10.77
×5	54.06	11.39*	75.40	—22.79*	4.60	138.35*	8.11	—19.66	18.13	23.94*
×6	51.13	8.78*	107.60	10.17	2.40	24.35	11.27	—4.57	16.60	—7.41
×7	50.60	4.26	104.06	—15.07*	3.13	62.19*	9.27	—13.30	17.80	—3.93
4×5	53.40	14.27*	70.53	—29.59*	2.66	17.69	11.54	13.02	16.26	—5.79
×6	53.26	13.97*	106.46	0.56	2.66	17.69	11.57	—2.03	16.20	—9.64
×7	52.80	12.98*	108.60	—11.36*	2.53	11.94	11.23	9.99	15.40	—16.89
5×6	50.40	7.23*	86.13	—7.58	4.33	8.41	9.81	—16.93	16.53	7.80
×7	52.20	—4.62	105.53	—13.87*	4.66	48.89*	8.35	—7.11	15.73	—15.11
6×7	48.96	3.10	117.33	—4.24	2.66	10.83	12.33	4.40	20.60	11.17
S. E.	±1.375		±5.895		±0.513		±0.904		±1.905	
C. D. at 5%	3.898		16.722		1.452		2.567		5.394	

TABLE 2 (Contd.)

Mean values of parents and F_1 hybrids, % heterosis over better parents (B. P.)

Parents and hybrids	No. of seeds per fruit		Diameter of fruit (cm)		Length of fruit (cm)		Weight of fruit (g)		Yield per plant (g)		Disease incidence (%)	
	Mean	Heterosis over B.P.	Mean	Heterosis over B.P.	Mean	Heterosis over B.P.	Mean	Heterosis over B.P.	Mean	Heterosis over B.P.	Mean	Heterosis over B.P.
1	56.00		1.81		11.70		15.36		189.99		52.79	
2	73.67		1.97		8.70		19.74		197.49		76.67	
3	62.00		1.66		14.90		14.74		207.18		70.44	
4	65.68		1.82		14.13		13.86		242.09		46.60	
5	70.00		2.29		8.13		10 67		83.38		62.54	
6	61.33		1.78		16.30		15.47		277.47		65.79	
7	83.66		1.58		21.60		17.08		254.35		66.74	
1×2	65.33	−11.30	1.94	−1.52	13.03	11.36*	19.07	−3.39	289.73	46.49*	53.92	2.14
×3	72.06	15.19	1.09	4.97	15.03	0.46	16.98	10.54	309.63	49.44*	68.97	30.64*
×4	54.00	−17.95	1.18	−0.54	13.26	−6.15	17.15	11.65	315.85	30.46	68.08	28.96*
×5	65.88	−6.67	2.11	−7.86*	13.46	14.52*	15.54	7.68	308.98	9.98	72.02	36.42*
×6	64.33	4.89	1.78	−1.65	14.73	−9 63*	13.34	−13.76	221.66	−20.11	70.69	33.90*
×7	62.38	−25.48*	1.75	−3.31	18.00	−15.73*	16.75	−1.75	329.58	29.57	54.25	2.74
2×3	91.33	23.98*	1.80	−8.62*	12.06	−19.38*	17.07	−13.52	283.22	36.30	48.12	− 28.78*
×4	97.60	31.68*	2.05	4.06	12.30	−13.04*	15.85	−19.70*	181.22	−25.14	54.02	−20.05*
×5	92·66	25.79*	1.90	−17.03*	8.43	−3.10	16.62	−15.38*	173.25	−12.27	59.41	−5.00
×6	73.86	00.00	1.76	−10.65*	13.50	−17.70*	18.08	−8.40	295.80	6.60	47.73	−35 06*
×7	80.66	−3.58	1.83	−7.10*	13.86	−35.83*	18.70	−5.26	313.22	23.14	44.50	−32.32*
3×4	63.00	−4.05	1.74	−4.39	17.30	15.64*	14.10	−3.73	221.60	−8.46	60.33	−10.76
×5	73.66	5.22	2.10	−8.29*	12.23	−18.24*	14.21	−3.59	266.60	28.68	57.46	−8.12
×6	71.35	14.04	1.79	00.56	14.33	−12.08*	13.36	13.63	223.46	−19.47	70.13	6.58
×7	68.60	−17.92*	1.85	11.44*	21.80	0.92	13.43	−21.34*	244.86	−3.73	66.86	0.17
4×5	72.00	2.85	1.70	−25.76*	12.30	−14.86*	12.07	−12.91	202.32	−16.37	70.74	13.11
×6	60.66	−7.61	1.69	−7.14*	13.60	−16.56*	13.64	−11.82	221.55	−20.15	53.26	−19.04*
×7	62.38	−25.49*	1.76	−3.29	16.73	−22.54*	16.32	−4.44	255.02	0.26	65.29	−2.02
5×6	79.00	12.85	2.04	−10.91*	10.36	−36.44*	14.07	−9.04	238.29	−14.12	59.25	−5.26
×7	71 00	−15.13	1.85	−19.21*	16.50	−23.61*	16.47	−3.57	262.84	3.33	57.37	−8.26
6×7	67.00	−19.19*	1.72	−3.37	18.36	−15.00*	16.77	−1.81	347.49	25.12	46.12	−29.89*
S. E.	±6.345		±0.066		±0.614		±1.354		± 38.924		± 6.061	
C.D. at 5%	17.985		0.188		1.740		3.880		110.355		17.182	

*Significant at 0.05 probability.

hybrids for this character had significantly superior performance over the parents in many cases. Significant increase in fruits per plant over better parent was exhibited by hybrids $P_1 \times P_2$ and $P_3 \times P_5$. Three crosses, namely, $P_2 \times P_3$, $P_2 \times P_5$ and $P_2 \times P_4$ showed maximum seeds per fruit and also high heterosis for this character. Only one cross $P_2 \times P_7$ recorded significant increase in fruit diameter, while for fruit length three crosses exhibited significant heterosis over better parent.

For fruit weight P_3 among parents and $P_1 \times P_2$ among hybrids indicated maximum value. None of the cross combinations manifested increase over better parent for this character. High yield per plant was recorded in cross $P_6 \times P_7$, whereas significant heterosis was shown by the crosses $P_1 \times P_2$ and $P_1 \times P_3$. Also $P_3 \times P_5$ exhibited considerable heterotic performance. Increased yield in these crosses was mainly due to increase in fruit number per plant.

Crosses $P_1 \times P_3$, $P_1 \times P_4$, $P_1 \times P_5$, $P_2 \times P_3$, $P_2 \times P_6$ and $P_2 \times P_7$ with desired heterosis for disease incidence (per cent) also expressed positive heterosis for yield per plant. On the other hand, crosses $P_3 \times P_6$, $P_4 \times P_6$ and $P_6 \times P_7$ with desired heterosis for disease incidence showed negative heterosis for yield.

DISCUSSION

Variance analysis carried out to mark the genotypic difference among genotypes indicated significant variation for all the characters. Pusa Sawani was the earliest flowering variety. Heterosis for lateness was a regular phenomenon in the population under study. Similarly, a decrease in the height of hybrids was recorded. One cross combination exhibited considerable increase in the height in okra. Branching in okra is undesirable due to lateral distribution of food material resulting in delayed and low yield. However, cross of maximum branching parents ($P_2 \times P_5$) contributed significant decrease in branches per plant.

All the hybrids were superior for mean number of fruits per branch either of the parents involved. Six crosses exhibited increase in fruit number per branch. Cross $P_6 \times P_7$ had maximum fruits per branch and per plant but the heterosis was not significantly higher. Two hybrids $P_1 \times P_3$ and $P_3 \times P_5$ showed significant increase in fruits per plant over better parents with 31.79 and 23.94% heterosis, respectively. Heterosis for fruit number to contribute towards yield was also started by Joshi *et al.* (1958), Raman (1965) and Anon (1965). Significant heterosis for seed numbers was exhibited by the crosses of P_2 with P_3, P_4 and P_5. Heterosis for seed number per fruit was also reported by Joshi *et al.* (1958), Anon (1965) and Jalani and Graham (1973). Increased fruit diameter as well as the length of fruit was expressed by the cross $P_3 \times P_7$ Joshi *et al.* (1958), Swamy and Giri Raj (1974) and Swamy and Ramu (1975) reported heterosis for the size of fruit which contributed towards the total yield. None of the cross combinations manifested increase over better parent for fruit weight. Hybrid $P_1 \times P_2$ had the highest weight of fruit and highest yield per plant was recorded in cross $P_6 \times P_7$ while significant heterosis over better parent was expressed by two crosses $P_1 \times P_2$ and $P_1 \times P_3$. $P_3 \times P_5$ also gave considerable heterosis for yield. Heterosis for yield per plant was also sug-

gested by Joshi *et al.* (1958), Raman (1965) and Anon (1965) due to increased fruit number while Singh *et. al.* (1975) reported it due to increased fruit weight. Yellow vein mosaic, a severe disease of okra, reduced yield considerably but the results showed no consistency between these two characters in relation to heterosis.

From this study it is evident that where the mean performance as well as the heterosis value both were high, the production of hybrid seed would be desirable. Genetic component of variance study revealed that except seeds per fruit for all the characters both additive and non-additive gene actions were important. Additive component was higher in magnitude than dominance for these characters except fruits per plant and yield per plant ('Partap', 1978). Further it can be stated that when the heterosis value was not significant but *per se* performance was comparatively high then selection might also be executed for such characters taking into consideration the gene action present.

REFERENCES

Anonymous, 1965. Annual Sci. Report. *Indian Agricultural Research Institute*, New Delhi, P : 230.

Jalani, B. S. and Graham, K. M. 1973. A study of heterosis in crosses among local and American varieties of Okra. *Malays. Agric. Research* 2 (1) : 7-14.

Joshi, B. S., Singh, H. B. and Gupta, P. S. 1958. Studies in hybrid vigour III Bhindi. *Indian J. Genet.* 18 : 57-68.

'Partap', P. S. 1978. Diallel analysis to study heterosis and combining ability in okra *(Abelmoschus esculentus* (L.) Moench). M. Sc. Thesis, H. A. U., Hissar (Unpublished).

Raman, R. K. 1965. Studies on intervarietal crosses and hybrid vigour in bhindi *(A. esculentus* (L.) Moench). *Madras Agric. J.* 52 : 365 (Abstract).

Singh, S. R., Srivastava, J. P. and Singh, H. N. 1975. Heterosis in bhindi *(A. esculentus). Progressive Horticulture* 7 (2) : 5-15.

Swamy Rao, T. and Giri Raj, K. 1974. Hybrid variety in bhindi. *Curr. Res.* 3 (8) : 97-98.

Swamy Rao, T. and Ramu, P. M. 1975. Genetic analysis of three pod characters in bhindi. *Madras Agric. J.* 62 (6) : 331-37.

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EMERGING PATTERNS OF LEADERSHIP IN RURAL HARYANA

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ABSTRACT

The data analysis revealed that the age old traditions of selecting the leaders had undergone drastic changes. In the contemporary, rural society, young and middle age persons were preferred for the role of leadership as compared to the aged. Economic status of an individual was found to have minimum effect on the choice of leaders. Literacy helped individuals in their selection for leadership role. Moreover, the role of caste was not so determinantal in the selection of leaders as it was in the past. Women's participation in the rural leadership phenomenon was also noticed. All this speaks of a significant alteration in the value system of the rural society for leadership selection.

Most of the new nations of the world are committed to a policy of planned economic and social change. In many of them, the process of modernization is being pressed at an accelerated pace. In reference to these countries, the study of the existing and emerging pattern of leadership has assumed a crucial significance. Accurate identification and effective utilization of leadership provides the key to the smooth and speedy implementation of the developmental plans. India is no exception to this phenomenon for transformation.

The topic under investigation also attracted the attention of many social scientists in the past. Stogdill (1959) concluded that in most of the cases leaders had come from higher socio-economic background. Srivastava (1963) concluded that the numerical strength of a particular caste had no relationship with the number of leaders provided. Similarly in the village community there was a great respect for age. Roy (1967) revealed that representative of high caste, more education and of middle economic status were chosen as leaders in the village community. Sen (1969) reported that the important differences between leaders and followers were literacy, contact with the larger society, higher status both ascribed and achieved. Sisodia *et al.* (1970) reported that less than one-third of the leaders were educated, 51 pre cent of them were below 40 years. Gangrade (1974) reported that each group, according to its caste or kinship, had a leader who had to be consulted if any work had to be done in the village. Misra (1977) mentioned that rural leaders were mainly drawn from the young and middle age groups, elite castes, and literate strata of society. Saran (1978) pointed out that the leadership was no longer

confined to the high caste but was distributed among the upper, intermediate and in the lower castes of the village. Charyulu (1979) reported the literacy level of the rural areas being what it was (23.73%) according to 1971 census, a big section of the Panchayat Raj confunctionaires were semi-literates.

Haryana, being a part of the Indian union, has also been subjected to the policy of planned socio-economic change and more so in the last decade. Hence, a study of this nature has acquired special significance, especially when programme like 'Lab to Land' is under active consideration of the government. Therefore, the present study examined this issue in the light of the following objectives:

(i) To identify the role of selected socio-economic variables in the emergence of rural leaders.

(ii) To suggest a strategy for locating viable leaders for rural reconstruction.

MATERIAL AND METHODS

The locale for the present study was the rural areas of Haryana State. Two villages from each district were purposively selected for giving representation to both urbanized and non-urbanized villages. In this way, 22 villages in all were chosen to cover all the districts of the State for the purposes of data collection. Both, formal and informal leaders of the sampled villages were chosen as respondents. A list of formal leaders was obtained from the Gram Sachivs of the sampled villages, whereas informal leaders were located with the help of formal leaders in group meetings. Informal leader was defined as a person whose advice was sought by formal leaders on village and caste matters. In this way, 270 rural leaders were interviewed personally with the help of a suitably constructed schedule in the year 1978. The data, thus, obtained was analyzed by calculating percentages.

RESULTS AND DISCUSSION

The astrological, phrenological and pseudogenetic theories and hypothesis that tried to understand and explain the leadership qualities of unique individuals in terms of the distinctive constellation of stars at the times of their birth or the presence of special visible physical characteristics in them have been discarded. Psychologists and sociologists working on this theme are beginning to produce a body of reliable data on the determinants of leadership (Dube 1963). A few of them have identified factors which have been found to be associated with leadership, could probably all be classified under the general heading of capacity, achievement, responsibility, participation, situation and status. However, an attempt was made to understand the leadership phenomena in relation to literacy, landholding, caste, age, sex and income of the leaders. Srivastava (1965), Roy (1967), Sisodia *et al.* (1970), Misra (1977) and Saran (1978) also investigated the role of these variables.

Table 1 details the influence of literacy, landholding and caste in the emergence of rural leaders in Haryana.

It is evident from above that about one half of the respondents were literate,

TABLE 1

Distribution of respondents as per their literacy, landholding and caste

Literacy level	Size of land holding	Caste			Total
		Upper	Backward	Scheduled	
Illiterate (55%)	Landless	9	18	33	60
	Small (0.5)	13	13	9	35
	Medium (6-15)	24	2	3	29
	Large (16 and above)	23	3	—	26
Primary (25%)	Landless	5	6	5	16
	Small	10	2	3	15
	Medium	20	—	—	20
	Large	15	—	—	15
Above Primary (20%)	Landless	4	2	5	11
	Small	12	—	—	12
	Medium	11	—	—	11
	Large	20	—	—	20
	Grand Total	166(61%)	46(17%)	58(22%)	270

of these 25 and 20% were educated upto primary and above primary levels, respectively. However, the literacy percentage of Haryana as a whole was 26.9% according to 1971 census, whereas it was still lower for rural areas of the State. This shows that literacy of an individual played a vital role in one's selection/election for the leadership role, mainly because of his better understanding and knowledge about the complexities of existing knowledge. Roy (1967), Krishna (1967), Sen (1969), Sisodia *et al.* (1970), Misra (1977) and Charyulu (1979) also reported about the increasing importance of literacy in the choice of present day leaders.

Ownership of landholding generally determines the status of a family in an agricultural community. So, the influence of the size of landholding on the selection of rural leaders was analyzed in order to test the above assumption in the present study. A perusal of Table 1 reveals that about 32% leaders had no land, whereas 68% leaders were land owners. Amongst the land owners, 23, 22 and 23% respondents were having landholdings upto 5 acres, between 6-15 acres, and more than 16 acres respectively. Moreover, the proportion of the households' population of Haryana as a whole under landless and land owning classes were 37 and 63%, respectively, whereas landowners were having 28, 22 and 13% landholdings representing upto 5 acres, between 6-15 acres and more than 16 acres, respectively. Based upon these observations, it may be concluded that the size of landholding in general and landholding in particular were not influencing the choice of present day leaders, thereby nullifying the assumption that landholding is a determinantal factor in the emergence of rural leaders.

Caste played an important role in the choice of rural leaders in the traditional Hindu society. Moreover, the leadership of the traditional panchayats was generally in the hands of elite castes

(Stogdill, 1959; Roy, 1967; Krishna, 1967; and Misra, 1977). However in the present study, 61% leaders belonged to the upper castes, whereas 17 and 22% were from backward and scheduled castes, respectively, indicating a shift in the traditional pattern. i.e., in favour of backward and scheduled castes. These results were further supported by the population structure of the sampled villages. The upper caste's families constituted 61% of the total households of these villages, whereas backward classes and scheduled castes represented 14 and 25%, respectively. The obvious reasons for this change might be the introduction of statutory panchayats and provision for reservation of seats for scheduled castes. Secondly, other concessions to lower castes people in spheres of education, employment, etc. This points to the fact that caste is still playing a role in the choice of rural leaders. However, its determinantal influence is on the decrease and leadership is not confined only to elite castes. Gangrade (1974) and Saran (1978) also held similar views.

Table 2 explains the influence of age, sex and income of an individual on one's emergence as leader.

Age has been an important determinantal factor influencing the emergence of rural leaders. Elders were usually chosen as leaders in the ancient Hindu society, whereas the situation is quite opposite in the modern times as is evident from the results of the present study. Sixty seven per cent leaders were drawn from the young (below 28 years) and middle age (29-50 years) groups. Most studies conducted since 1970 revealed similar results (Sisodia *et al.*, 1970; Misra, 1977). The probable reason for this situation was the introduction of statutory panchayat election which did not suit the temperament of the old traditional leaders.

Women were generally not favoured for the leadership role in the past. Hence, an attempt was made to test this assumption over here. The data presented in Table 2 reveals that about 9% women were formally selected for the Gram Panchayats, whereas none took interest voluntarily/informally in the village welfare programmes. Their formal involvement was materialized only through the statutory provision under the Gram Panchayat Act. Moreover, these formally elected women took passive interest and hardly attended any meeting of these

TABLE 2

Classification of respondents as per their age, sex and income

Age groups	Sex	Income level			Total
		Upto 5000	5001 to 10000	10001 and above	
Young (upto 28 years-15%)	Male	19	4	17	40
	Female	—	—	—	—
Middle (29-50 yrs.-52%)	Male	52	51	28	131
	Female	6	3	—	9
Old/aged (51 and above-33%)	Male	50	10	15	75
	Female	5	9	1	15
Grand total		132(49%)	77(29%)	61(22%)	270(100%)

Panchayats. All this speaks of the low status assigned to our women folks. However, their active involvement is indispensable for overall progress of the rural society, because, they (women) constitute one half of our population and exert much influence in the socialization process at the earlier stages.

Economic status also played a decisive role in one's choice as a leader (Roy 1967; Stogdill, 1959 and Krishna, 1967). This assumption was also put to test and the results revealed that about one half of the respondents belonged to the lower income category ranging upto Rs. 5000/- whereas 29% belonged to an income level of Rs. 5001/- to 10000/- annually. However, 22% belonged to the upper income group thereby contradicting the widely accepted assumption that economic status was positively associated with the emergence of leaders. This conclusion is further strengthened by the fact that more than 4/5th respondents were having per capita income less than that of the per capita income of the state (Rs. 982/- p.m.) of the nation (Rs. 698/-).

Measures suggested

The above analysis suggested the following points for locating effective leaders for rural reconstruction. First, literacy helped individual to be chosen for the leadership role, because of his better understanding capacity and much enthusiasm and interest for interaction with village functionaries. Hence, it was suggested to encourage and ensure the involvement of literate individuals in the rural reconstruction programmes. Secondly, the government should initiate and accelerate the adult education programme in order to eradicate illiteracy atleast from the leaders for securing their maximum involvement in the village welfare programmes. Second, larger size of landholding and high income of an individual did not ensure the supply of effective leaders. This might be due to their ulterior motives to perpetuate their dominance over the masses. So, the change agents need not to knock their doors too often for getting dynamic and effective leaders for their missions. Moreover, it was advocated that persons having leadership qualities and missionary zeal for community work, even though belonging to lower strata of the society should be involved to discharge the leadership role. Third, the monopoly of the upper caste in supplying rural leaders was on the decline, whereas the participation of the scheduled and backward castes was on the increase. This proves that enlightened persons from each caste groups had become conscious of their rights and privileges. Therefore, it was emphasized that the enlightened people from all the major castes groups should be encouraged to take a leading part in the community activities rather than to involve people of a particular caste. This would secure people's participation to the maximum.

Fourth, preference for young and middle age persons as leaders in the contemporary rural society is definitely a deviation from the age old tradition to choose elders. This alteration may be necessiated because of the lack of comprehension about the modern innovations by the aged. Secondly, the present situation required much flexibility and adjustment which did not suit the temperament of the old traditional leaders. Therefore, it was advocated that young and middle age persons, should be encouraged to take an active part in the village leadership. Finally, women's involve-

ment in the village welfare programme was distressingly very poor, moreover, they constituted one half of the rural population. Their participation was indeed very much indispensable for overall progress of the village communities. Their participation could be secured by two ways. First, by eradicating illiteracy from them which is very high. Second, by ensuring their participation atleast in the programmes meant for their welfare. The formal and informal leaders of the village community could be of much help in this endeavour.

REFERENCES

Ross, M. G. and Hendry, C. E. 1957. *New understandings of leadership;* Association Press, New York, p. 18.

Stogdill, R. M. 1959. *Personal factors associated with leadership;* in Browne and Cohan's (ed). The Study of Leadership, the Interstate Printers and Publishers, INC, Illinois, p. 58.

Dube, S. C. 1963. *Framework for the study of rural leadership in transitional societies;* in International Round Table Conference, Mussoorie, 1963 Report, p. 23.

Srivastava, S. K. 1963. *Directed Social Change and Rural Leadership in India;* in International Round Table Conference, Mussoorie, 1963 Report, p. 151.

Roy, P. 1967. *The Characteristics of Emergent Leaders, in L. P. Vidyarthi (ed) Leadership in India,* Asian Publishing House, New Delhi, p. 294.

Krishna, K. 1967. *Leadership in Panchayat Elections of Uttar Pradesh, in L. P. Vidyarthi (ed) – Leadership in India,* Asian Publishing House, New Delhi, pp. 297-99.

Sen, L. K. 1969. *Opinion Leadership in India* N. I. C. D., Hyderabad-30, p. 26.

Sisodia, G. S. and Sharma, M. L. 1970. *Panchayat Leader's Role Discharge—an organizational study in Haryana;* Jr. of Research, PAU, Ludhiana, VII(1), p. 29.

Gangrade, K. D. 1974. *Emerging patterns of leadership;* Rachana publications, Delhi, p. 247.

Government of Haryana 1974-75. *Statistical Abstract,* Planning Department.

Misra, S. N. 1977. *Pattern of Emerging Leadership in Rural India,* Associated Book Agency, Patna, pp 242-43.

Saran, P. 1978. *Rural Leadership in the context of India's Modernization;* Vikas Publishing House, New Delhi, p. 149.

Charyulu, U. U. N. 1979. *Development of personnel and financial management of Panchayati Raj Bodies;* Rural Development Digest, 2(1), p. 80.

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EVALUATION OF SPRINKLER IRRIGATION SYSTEM AND COMPARISON WITH SURFACE SYSTEM (A CASE STUDY)

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ABSTRACT

Sprinkler irrigation system in District Bhiwani (Haryana) was evaluated and the cost of installation of such a system was compared with surface system. The sprinkler system in all the sample farms was either over-designed or under designed. The capacity of tube-well was not in proportion to farm size. Comparison of cost of sprinkler versus surface irrigation system showed that cost/hect/year for five sample farms was higher in case of surface system than sprinkler system and it was lower in one of the sample farms. Field study showed that the soils of the region were sandy, basic intake rate was very high and the topography of the land was undulating and full of sand dunes.

Aggarwal and Aggarwal (1977) evaluated sprinkler irrigation at farmer's fields in Haryana. They observed changes in yield, increase in irrigated area and cost of irrigation with the adoption of sprinkler methods of irrigation on the fields of farmers. The study did not include the cost comparison of sprinkler versus surface method.

Singh & Singh (1969) carried out a study to compare the performance of sprinkler and surface irrigation in Tarai area (Distt. Nainital). They compared the cost of production of spring maize by sprinkler irrigation and surface irrigation. But the cost of installing these systems had not been compared.

Kaushal and Pathak (1976) carried out a study on economics and water use efficiency of sprinkler versus border irrigation. This study did not have the mention of cost comparison and evaluation.

From the above review, it may be said that very limited studies seem to have been made on the design and comparison and economic evaluation of sprinkler system versus surface system in India. It was, therefore, considered useful to make an analysis on this problem.

South-Western districts of Haryana in general and district Bhiwani in particular fall under arid to semi-arid Zone, are chronically drought affected. The soils of agricultural lands are light in texture with undulating topography. Basic intake rates of soils are very high. Ground water resources are limited and most of the aquifers contain saline water. Irrigation efficiency is quite low due to enormous conveyance and deep parcolation losses and, thus, the adoption of sur-

face irrigation system is least economical. Irrigation by sprinkler system is a better alternative under such situations, inspite of its high initial cost and running expenses. To overcome this difficulty, the Haryana Government has taken a lead for boosting up the programme of sprinkler irrigation, and the farmers are being given 25% subsidy, resulting in the installation of about 1500 sprinkler sets in this part of the State. The study was undertaken to evaluate the present system of sprinkler irrigation by working out the actual technical design for the sample farms and to make an appraisal of the improvements over the existing system, and also to compare its cost with the system of surface irrigation.

MATERIAL AND METHODS

Six sample farms in district Bhiwani were selected and categorized into three size groups, i. e., 0 to 4.00 hectares, 4.00 to 8.00 hectares and 8.00 hectares and above. Topographical survey was carried out for all the sample farms and contour maps were prepared. Soil samples were taken for every 10 cms depth and up to a total depth of 70 cms for estimating moisture content at various depths. Infiltration tests with the help of ring infiltrometers were carried out. The basic intake rates of soil varied from 10.2 cms/hr to 15.3 cms/hr. The mechanical analysis of soil established the texture of the soil as fine sandy loam, and the apparent specific gravity was found to be 1.51. The available soil moisture for all the soil samples was determined by the pressure plate apparatus which was found to be within 0.1 to 15 atmosphere tension range. The peak consumptive use for wheat was found to be 5.00 mm/day by the Penman method. The design of the sprinkler system for all the six farms were worked out in order to compare with the existing design.

For comparing cost of both the sprinkler system the surface irrigation system was also designed. This included the design of lined open channels and the underground pipe line system (wherever necessary). The amount of earth work was calculated by cut and fill method. The fixed cost and operational cost per hectare per year for both the systems were worked out by making suitable assumptions.

RESULTS AND DISCUSSIONS

The evaluation of the present system of sprinkler irrigation was done by working out the design of the system on the basis of detailed technical informations. It was observed that the existing system designs were worked out on the rule-of-thumb and not on the basis of actual data collected from the fields. The sprinkler main lines were underdesigned. This resulted in a higher head loss and, thus, a higher consumption of power. In all the samples farms the electric motors used were of 10 h. p. each, irrespective of discharge and water depth, whereas the proposed design showed a requirement for only 7.5 h. p. motor for each farm. It was also observed that the existing system of sprinkler irrigation was not sufficient to irrigate the whole of the farm. The proposed design covered the whole farm adequately. The given Table 1 shows the cost comparison of both the systems. Unit investment costs for both the systems of irrigation are compared graphically in Fig. (1).

CONCLUSIONS

The evaluation of the existing system for all the six sample farms showed that

TABLE 1

Farm size, cost comparison under Sprinkler and Surface Irrigation System

Sr. No.	Farm size (Hect.)	Sprinkler irrigation system			Surface irrigation system		
		Fixed cost (Rs.)	Operational cost (Rs.)	Cost/hect./ year (Rs)	Fixed cost (Rs.)	Operational cost (Rs.)	Cost/hect./ year (Rs.)
1.	3.2	498.60	936.00	1434.60	684.60	763.00	1447.60
2.	4.0	415.30	1064.40	1479.70	533.75	933.15	1466.90
3.	5.9	315.50	804.00	1118.50	363.50	881.80	1245.30
4.	6.5	288.55	685.30	973.85	565.15	846.00	1411.15
5.	10.0	200.50	465.20	665.70	334.45	709.20	1043.65
6.	10.4	210.60	606.80	817.40	550.00	968.35	1518.35

The sprinkler is only used in Rabi season and not used in Kharif, but the operational cost has been taken for whole of the year except the labour cost which has been taken for the operating season only.

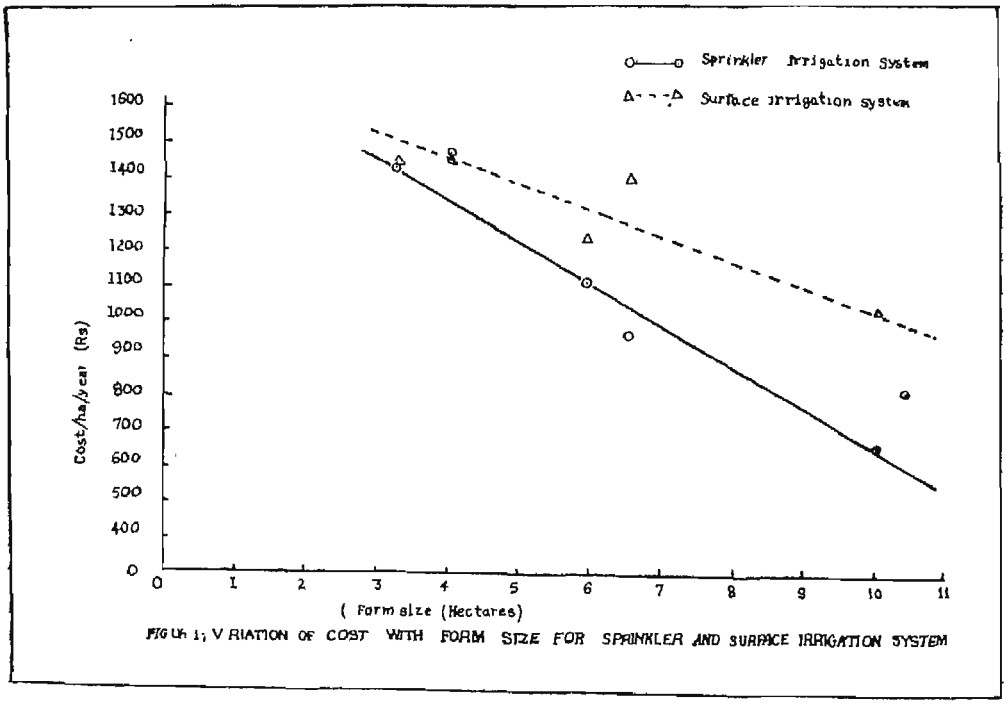


FIGURE 1; VARIATION OF COST WITH FARM SIZE FOR SPRINKLER AND SURFACE IRRIGATION SYSTEM

the system had either been over-designed, or under-designed. Further, in all the sample farms, the sprinkler equipment was not sufficient to irrigate the whole area. The prime mover, i. e., the electric motor was over designed, resulting in a considerable loss in energy. It was also found that the capacity of the tube-wells was not in proportion to the farm size.

The design of the sprinkler systems for efficient functioning should be based on crop, soil and climatic factors and the topographical survey. The cost comparison showed that the sprinkler system of irrigation was more economical and a better system than the surface irrigation system for the particular conditions of land and climate.

REFERENCES

Anonymous, 1971. A guide for estimating water requirement, water management division, Ministry of Agriculture, Govt. of India. Technical series No. 2 p. 50.

Anonymous, 1977. Project report of Jui Canal Command Area Development Authority Bhiwani, Haryana.

Anonymous, 1971. Operating and Instructional Manual for Premier Irrigation System. Premier Equipment Pvt. Ltd. Pub. No. T 26 Issue No. 1 p. 35.

Kaushal, M. P. and Pathak, B. S. 1976. Economics and water use efficiency of sprinkler versus border irrigation on sand dunes. *Indian J. Agric. Sci.* 47 (5) : 240-44.

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DEVELOPMENT OF VESICULAR-ARBUSCULAR MYCORRHIZA IN PLANTS IN RELATION TO PHOSPHATE UPTAKE

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ABSTRACT

Vesicular-arbuscular mycorrhiza developed extensively in wheat and pearl millet under controlled conditions. At vegetative phase of host development, generally, few roots were infected by the mycorrhizal endophyte; subsequently the proportion of colonized roots increased to maximum levels at reproductive phase. Increased phosphate uptake and total dry weight/plant were obtained by mycorrhizal inoculation. These growth response parameters were meaningful since mycorrhizal colonization was extensive and well developed when most dry matter was produced; phosphorus uptake corresponded closely dry matter production. Three different spore types of *Endogone* spp. were observed from test soils; honey-coloured, sessile spores being prevalent.

It is often not realized that most of the crop plants growing under natural conditions are 'mycorrhizal'. It may be due to the fact that vesicular-arbuscular (V-A) type of mycorrhizal infections caused by *Endogone* produce no appreciable change in external root morphology, and the fungal symbiont cannot be isolated and grown in pure culture (Gerdemann, 1968; Mosse, 1973).

Crop plants benefit from the mycorrhizal association because of the greater efficiency in nutrient and water uptake (Daft and Nicolson, 1969; Safir *et al.* 1971) from soil; particularly with respect to phosphorus uptake. V-A mycorrhiza can markedly improve growth of the host plants when quantum of available phosphate is a limiting factor (Gerdemann, 1968; Harley, 1969). Phosphorus-deficiency symptoms on plants grown in soils of low fertility can be prevented by inoculation with a mycorrhizal *Endogone* spp. (Gerdemann, 1964).

Although it is now becoming increasingly clear that V-A mycorrhiza is one of those fungus-root associations with a probiotic influence on higher plants, no information of any kind is available in India on plant growth responses to V–A mycorrhizas. Investigations were, therefore, initiated here to study the relationship of mycorrhizal and host development in wheat and pearl millet vis-a-vis phosphate uptake and examining root colonization by *Endogone* at different phases of plant growth.

MATERIAL AND METHODS

Two hosts, viz., wheat (var. S 308) and pearl millet (var. T 55) were used as test plants. Stock cultures of *Endogone* spp.

were maintained on tomato seedling roots in order to minimise the probability of contamination by subsequent cultures with test host pathogens. Mycorrhizal roots of tomato were washed free from adhering soil and cut into small segments of 1 cm. The soil in each experimental pot of 9" diameter, maintained at 30-35% moisture content, was then mixed with 2 g mycorrhizal inoculum In case of non-mycorrhizal checks no inoculum was added.

In each experimental pot, seven seeds were sown and subsequently allowed to grow under screen-house conditions. After about a week the seedlings were thinned out so as to leave one plant/pot. Each treatment was replicated three times. No source of phosphorus was added to any of the treatments.

The intensity of mycorrhizal development was assessed at three different phases of crop growth, depending upon the experiment. The mycorrhizal estimation was done by the method of Jalali and Domsch (1975). Roots were washed free from soil and cut into 1 cm pieces; these were then cleared in 10% KOH for 1 hr at 90°C. After rinsing and acidifying with dil. HCl, the root segments were stained by simmering in trypan-blue in lactophenol for 5 minutes (Phillip and Hayman, 1970); mounted in lactophenol, and examined for mycorrhizal infection The intensity of infection was recorded by grading (grade 0-4) mycorrhizal structures along the alignment of each root segment. The roots were simultaneously examined for the presence of fungal vesicles.

Number of extramatrical spores of *Endogone* spp./g dry soil was estimated by 'wet-sieving and decanting' technique of Gerdemann and Nicolson (1963). Total dry weight/plant was estimated by drying freshly harvested plants in a drying cabinet maintained at about 55°C for 60 hrs. and then weighed The phosphorus content of washed roots and shoots were determined by the colorimetric method of Dickman and Bray (1940).

RESULTS

Vesicular-arbuscular mycorrhiza developed abundantly in both of the test plants grown in pots (Table 1). At vegetative phase of the host growth (first sampling time) colonization of root systems by *Endogone* was low and the mycorrhizal grade ranged between 1.02 and 1.59. However, the proportion of roots colonized subsequently increased at generative and reproductive phases of host growth (second and third sampling time); particularly in the latter phase the leading hypae extended through the inner cortex more or less parallel to the root axis. (Fig 1). Most of the inner cortex was densely colonized by arbuscules and vesicles. Mycorrhizal infection attained maximum levels at third sampling time.

The number of fungal vesicles (Fig. 2) of *Endogone*/30 root segments along the alignment of the root fell in the range of 41-62 (mean : 50.5). Soil analysis where pearl millet was grown revealed the number of extramatrical spores to be between 26-34 (mean : 30) per gram of soil. Three different spore types were observed on microscopic examination, and their identification has yet been deferred. Honey-coloured, sessile spores were, however, observed more frequently.

Although there was extensive infection, mycorrhizal and non-mycorrhizal

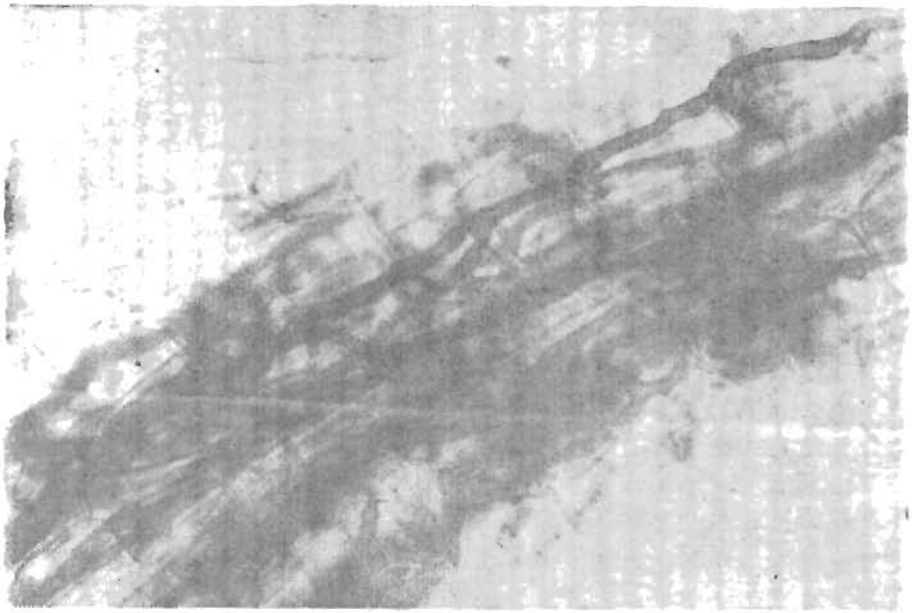


Fig. 1. Mycorrhizal wheat root segment showing arbuscular stage. 'Arbuscules' are distributed throughout the cortex more or less parallel to the root axis.

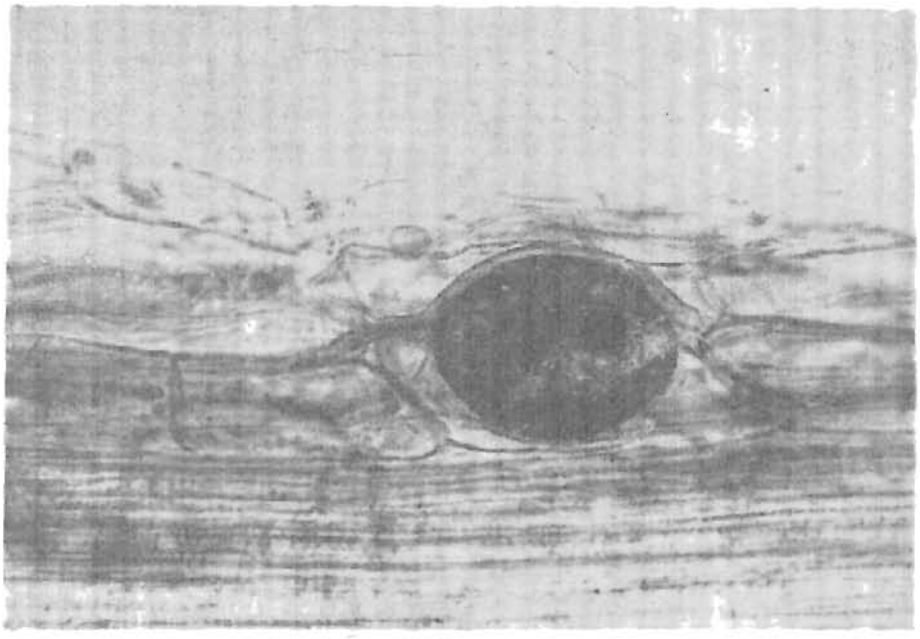


Fig. 2. Mycorrhizal wheat root segment showing 'Vesicle' formed by the fungal endophyte.

TABLE 1

Development of vesicular-arbuscular-mycorrhizal infection at three different phases of host growth

Host	Date of sowing	Sampling time (days from sowing)	Phase of host development	Mycorrhizal grading*
Pearl millet	July, 8	20	vegetative	1.49
		50	generative	2.63
		67	reproductive	3.01
Wheat	November, 11	30	vegetative	1.12
		73	generative	1.99
		103	reproductive	3.18

*Mean of 3 replications; each replication of 50 root segments.

TABLE 2

Dry matter and phosphorus analysis of mycorrhizal and non-mycorrhizal wheat and pearl millet*

Host	Treatment	Total dry weight per plant (g)	%P	
			Root	Shoot
Pearl millet	Mycorrhizal	20.03	0.137	0.129
	Non-mycorrhizal	17.75	0.056	0.062
Wheat	Mycorrhizal	13.63	0.109	0.113
	Non-mycorrhizal	11.19	0.047	0.053

*Values are means of two experiments; each consisting of 20 plants taken at random. Differences in dry weight and P-contents between mycorrhizal and non-mycorrhizal plants were significant at 5% level of probability.

wheat and pearl millet plants grew initially alike and there was no significant difference between them 30 days after sowing. However, the mycorrhizal infection expressed a profound influence by 53 days and onwards; mycorrhizal plants were taller with well-developed root system. Total dry weight of mycorrhizal plants of both the hosts was appreciably greater than non-mycorrhizal ones. Phosphorus analysis of root and shoot portions of these plants expressed higher P-uptake in mycorrhizal as compared to non-mycorrhizal plants (Table 2).

DISCUSSION

Present studies indicated that mycorrhizal endophyte existed and survived in tropical soils, and were able to cause successful mycorrhizal infection. Roots of pearl millet and wheat in particular were colonized intensively by *Endogone* spp. at generative and reproductive phases of plant growth. This marked increase might be associated with the formation of extensive mycelium in the soil by *Endogone* from which penetration structures were produced, thus, initiating abundant new colonies in the roots. Multiple infections

caused by germinated *Endogone* spore might also contribute in rapid colonization of roots.

Data on phosphorus uptake and total dry weight/plant revealed that beneficial effects of mycorrhizal association on host nutrition might be expressed only after the fungal endophyte gets established in roots. Sparse colonization of roots during vegetative phase of host development probably precluded a significant influence on host nutrition. The enhanced ability of mycorrhizal plants to absorb phosphorus complements the results of previous investigations carried out by feeding P^{32} (Gerdemann, 1968; Jalali, 1975). Jalali (1979) further showed that the increased ability of mycorrhizal roots to absorb phosphorus was lost when such plants were subjected to different fungicidal applications.

Although the number of extrematrical spores recovered from soils was on a lower scale, three different spore types were encountered; honey-coloured sessile spores were comparatively predominant than other two types. Since these spores are the means by which *Endogone* spp. survive in time, the ecological significance of this phenomenon should not be overlooked.

These studies offer, therefore, indications that V-A mycorrhizal association could effectively be used as an important tool in enriching tropical soils for enhanced crop development. Reports that V-A mycorrhizas thrive better in soils of low fertility (Hayman and Mosse, 1971), may in the long run prove to be of practical relevance since many of our soils are nutritionally deficient, particularly under arid and semi-arid conditions. More detailed work is in progress to elucidate the ecological and economical implications, besides studying the feasibility of field inoculation by mycorrhizal *Endogone* spp.

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REFERENCES

Daft, M. J. and Nicolson, T. H. 1969. Effect of *Endogone* mycorrhiza on plant growth. III. Influence of inoculum concentration on growth and infection in tomato. *New Phytol.* 68 : 953-63.

Dickman, S. R. and Bray, R. H. 1940. Colorimetric determination of phosphate. 2nd Eng. *Chem. Anal.* 12 : 665-68.

Gerdemann, J. W. 1964. The effect of mycorrhiza on the growth of maize. *Mycologia.* 56 : 342-49.

Gerdemann, J. W. 1968. Vesicular-arbuscular mycorrhiza and plant growth. *Ann. Rev. Phytopathol.* 6 : 397-418.

Gerdemann, J. W. and Nicolson, T. H. 1963. Spores of mycorrhizal *Endogone* species extracted from soil by wet-sieving and decanting. *Trans. Brit. Mycol. Soc.* 46 : 235-44.

Harley, J. L. 1969. *The biology of mycorrhiza.* 2nd ed. Leonard Hill, London.

Hayman, D. S. and Mosse, B. 1971. Plant growth responses to vesicular-arbuscular mycorrhiza. I. Growth of *Endogone* inoculated plants in phosphate deficient soils. *New Phytol.* 70 : 19-27.

Jalali, B. L. 1975. Studies on the uptake of labelled P^{32} by vesicular-arbuscular mycorrhiza. *Proc. All India Conf. Microbiol.* 119-20.

Jalali, B. L. 1979. Response of soil fungitoxicants on the development of vesicular-arbuscular mycorrhiza and phosphate uptake in wheat. In : 'Soil-Borne Plant Pathogens' (B. Schippers and W. Gams, eds.), Academic Press Inc., London pp. 525-30.

Jalali, B. L. and Domsch, K. H. 1975. Effect of systemic fungitoxicants on the development of endotrophic mycorrhiza. In : 'Endomycorrhizas' (F. E. Sanders, B. Mosse and P. B. Tinker, eds.). Academic Press, Inc. London. pp. 619-26.

Mosse, B. 1973. Advances in the study of vesicular-arbuscular mycorrhiza. *Ann. Rev. Phytopathol.* 11 :171-96.

Phillip, J. W. and Hayman, D. S. 1970. Improved procedures for clearing roots and staining parasitic and vesicular-arbuscular mycorrhizal fungi for rapid assessment of infection. *Trans. Brit. Mycol. Soc.* 55 : 158-61.

Safir, G. R., Boyer, J. S. and Gerdemann, J. W. 1971. Mycorrhizal enhancement of water transport in soybean. *Science.* 172 : 581-83.

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CHEMICAL COMPOSITION OF SEWAGE WATER IN HARYANA

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ABSTRACT

Forty sewage water samples of 29 different cities of whole of Haryana State were analysed for pH, E. C., N, P, K, S, B, Cl, $CO'_3+HCO'_3$, $Ca^{++}+Mg^{++}$ values. This was found to be a good source of nutrients like N, P, K and S. The suitability of this water for irrigation, on the basis of R. S. C., conductivity and S. A. R. values was discussed and it was concluded that 40% of the total analysed samples did not require gypsum application while 5, 20 and 35% of the total samples required addition of 50 kg, 50 to 100 kg and >100 kg gypsum/ha/ irrigation, respectively.

Sewage water is a mixture of various types of industrial, house-hold waste and human excreta which are organic in nature and contains plant nutrients in varying quantities. It is considered as a good source of nutrients to the soil when used for irrigation. The suitability of sewage water for irrigation depends upon a number of factors such as pH, E. C., $CO'_3+HCO'_3$ and B content. Sewage water has been beneficially used for raising crops like rhodes grass, guinica grass, elephant grass, water melon, walnut, groundnut, sweet potato, okra, banana, citrus, olives and egg plant (Viraraghavan, 1969). Pillai (1955) reported that the sandy soil, which was poor with fertility point of view gave better crop yields when irrigated with sewage water. Kutera and Majdowaki (1972) reported good yields of hay, when mixture of waste water from municipal sewage were supplemented by addition of nitrogen fertilizers. However, some of the sewage waters showed high pH and high amounts of heavy metals which if absorbed in high amounts might depress yield.

In India, about 200 million gallaons of sewage water is being utilised daily for irrigation of about 12,260 hectares of land. So, it becomes necessary to evaluate its nutritional and irrigation qualities. The present study was undertaken to study the quality of sewage waters of Haryana State in relation to crop yields.

MATERIAL AND METHODS

Forty representative sewage water samples were collected from 29 cities of Haryana (Fig. 1). Since the quality of sample changed continuously both with time (i. e., from morning to evening) and with position (i. e., from top to bottom) in the same sewer at one place so a

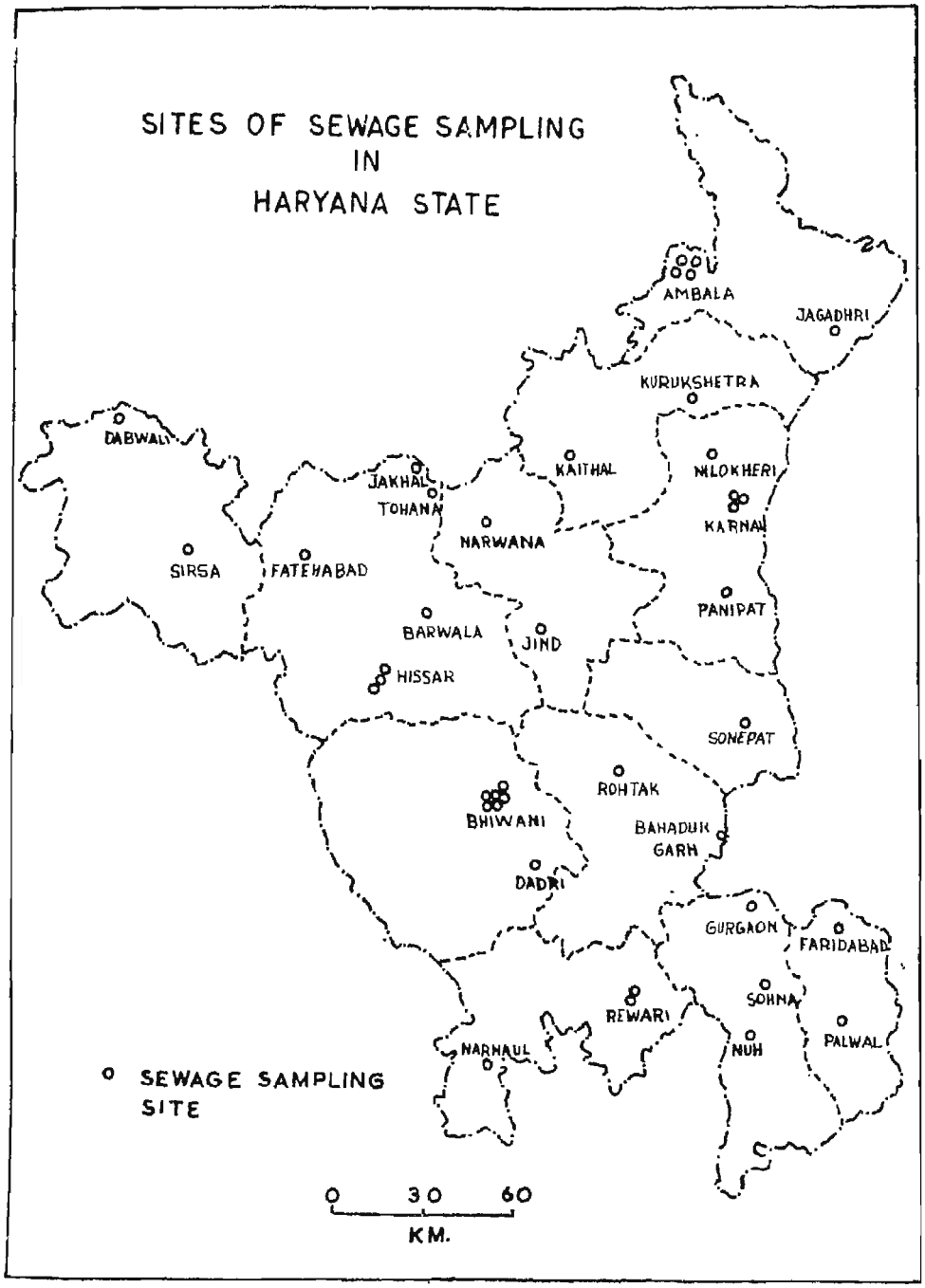

SITES OF SEWAGE SAMPLING
IN
HARYANA STATE
AMBALA
JAGADHRI
KURUKSHETRA
DABWALI
JAKHAL
TOHANA
KAITHAL
NILOKHERI
KARNAL
NARWANA
SIRSA
FATEHABAD
PANIPAT
BARWALA
JIND
HISSAR
SONEPAT
ROHTAK
BHIWANI
BAHADUR
GARH
DADRI
GURGAON
FARIDABAD
SOHNA
REWARI
PALWAL
NUH
NARNAUL
SEWAGE SAMPLING
SITE
0 30 60
KM.

FIG. 1

rough average was obtained by taking a number of grab samples each of atleast 120 ccs, every hour throughout the day and then finding out the mean by giving weightage to the flow taking place at each sampling time, being called the composite (mixture of grab) sample. The quality of the grab samples might change due to biological activity during the hours that the composite sample was being made; which was prevented or minimised by keeping the samples in polythene bottles at cool temperature (between 4.5 to 10°C).

Sewage water was subjected to analysis, e. g., nitrogen by Nesseler's reagent method (Lindner, 1944); phosphorus by Olsen's (1954) method; potassium by Flame photometer, sulphur by Chesnin and Yien's (1950) method and boron by Hatcher and Wilcox's (1950) method. pH and E. C. were determined by routine methods and carbonate, bicarbonate and chloride were determined by using the methods of A.O.A.C. (1950). Calcium and magnesium were determined by Chang and Bray's (1951) method. R. S. C. was calculated by deducting sum of $Ca^{++}+Mg^{++}$ from the sum of $CO''_3+HCO'_3$ and SAR by the formula;

$$SAR=\frac{Na^{+}}{\sqrt{\frac{Ca^{++}+Mg^{++}}{2}}}$$

RESULTS AND DISCUSSION

The analysis of sewage waters for N, P, K, S, B and Cl is given in Table 1. The data show that Sonepat, Gurgaon, Jind, Bhiwani and Sirsa contained more N and it ranged from 14.05 to 95.50 ppm. However, sewage waters from Hissar, Ambala, Rohtak, Mahendergarh, Kurukshetra and Karnal were lower in N which ranged from 0.03 to 5.62 ppm. In the State, the average concentration of N was 10.2 ppm meaning thereby that 7.68 kg N would be added per hectare per irrigation. Maximum concentration of P was found in sewage water from Sonepat district (24.5 ppm), whereas in other areas it was found in low concentration (0.4 to 2.3 ppm). Average value of P was 1.6 ppm, thus, adding about 1.21 kg P/ha/irrigation in the soil. Potassium was found more in samples from Rohtak (156.2 ppm); Sonepat (156.0 ppm) and Jind (135.0 ppm) districts and less in other districts (40.4 to 91.2 ppm). The average was 72.0 ppm indicating that 54.1 kg K was added per hectare with one irrigation.

Maximum S (110.0 ppm) was found in the samples from Kurukshetra followed by Jind (66.5 ppm), Karnal (61.2 ppm) and Mahendragarh (60.3 ppm) and minimum between 19.6 to 39.0 ppm in the samples from Gurgaon, Hissar, Ambala, Rohtak, Sonepat, Sirsa and Bhiwani. Average concentration of all waters for S was 41.1 ppm. Boron content in sewage water in all the districts was found to be between 0.2 to 0.8 ppm (safe for boron sensitive crops e. g. orchard crops), except Karnal, Mahendragarh and Hissar where it ranged from 1.2 to 2.0 ppm which was fit for growing only semi-tolerant crops (Wilcox, 1960). Concentration of Cl' was 195.2 to 431.7 ppm and it might be due to the addition of common salt from household and from human diet. Average concentration of Cl' was 266.2 ppm which meant that 199.9 kg Cl' would accumulate in the soil per hectare per irrigation.

The pH of all sewage waters varied from 7.5 to 9.9 (Table 2) and the E. C.

TABLE 1

Chemical composition of sewage water (mg/litre)

Name of the district		Nitrogen	Phosphorus	Potassium	Sulphur	Boron	Chloride
Hissar	Range	1.0—10.2	0.1—1.4	28.7—18.0	3.5—48.7	0.1—2.2	30.9—383.4
	Average	5.6	0.4	67.7	23.4	1.2	260.6
Sirsa	Range	3.7—24.3	0.6—3.4	55.0—127.5	33.5—42.5	0.1—0.4	142.0—298.2
	Average	14.0	2.0	91.2	38.0	0.2	220.1
Bhiwani	Range	1.0—9.0	0.2—4.6	35.0—110.0	27.5—51.8	0.1—1.4	134.9—269.8
	Average	4.2	1.6	62.6	39.0	0.7	203.1
Gurgaon	Range	5.0—72.5	0.1—2.2	20.0—128.5	18.8—26.7	0.1—1.3	163.3—479.2
	Average	31.9	0.9	74.1	19.6	0.4	289.0
Ambala	Range	1.2—2.7	0.3—1.3	17.5—71.2	9.5—53.0	0.3—0.4	106.5—781.0
	Average	1.9	0.9	40.4	28.9	0.4	284.0
Rohtak	Range	3.5—3.7	0.6—0.7	127.5—185.0	12.0—48.0	0.3—0.8	188.1—319.5
	Average	3.6	0.6	156.2	30.0	0.5	253.8
Sonepat	Range	95.5	24.5	156.0	32.0	0.7	322.3
	Average	95.5	24.5	156.0	32.0	0.7	322.3
Jind	Range	11.2 - 27.0	2.0—2.6	86.0—148.0	36.5—86.4	0.7—0.9	191.7—214.4
	Average	19.1	2.3	135.0	66.4	0.8	203.1
Mahendragarh	Range	0.0—0.2	0.1—2.7	32.0—62.0	52.5—68.5	1.3—2.1	306.7 - 575.1
	Average	0.1	1.5	43.3	60.3	1.6	431.7
Kurukshetra	Range	0.2—9.0	0.5—0.7	33.6—70.0	40.0—180.0	0.2—0.2	230.0—522.6
	Average	4.6	0.6	51.8	110.0	0.2	376.3
Karnal	Range	0.0—0.2	0.1—1.9	28.2—124.0	20.0—170.0	1.4—2.9	93.7—367.8
	Average	0.1	1.0	66.3	61.2	2.0	195.2
Mean Average		10.2 (7.7)*	1.6 (1.2)	72.0 (54.1)	41.1 (30.8)	0.9 (0.7)	266.2 (199.9)

*Figure in parenthesis shows the average amount of nutrient added per ha per sewage irrigation.

TABLE 2

Composition of sewage water

Name of the district		pH	E. C. (mmhos/cm)	$CO''_3+HCO'_3$ (me/lit)	$Ca^{++}+Mg^{++}$ (me/lit)	R. S. C. (me/lit)	S. A. R.
Hissar	Range	7.8–8.9	1.2—2.3	4.5–12.0	2.1–7.8	0.0—4.8	0.3—18.4
	Average	8.4	1.9	7.6	6 6	1.7	6.8
Sirsa	Range	7.8—8.5	1.0—2.1	1.3—7.8	3.0—5.7	0.0—2.0	3.1—8.2
	Averaga	8.1	1.5	4.6	4.4	1.0	5.6
Bhiwani	Range	7.5—8.6	0.7—2.4	0.0—3.4	1.7—4.8	0.0—1.2	3.8—21.5
	Average	8.2	1.6	2.1	3.2	0.4	13.1
Gurgaon	Range	8.3—8.9	1.1—2.2	1.3—12.2	3.7—8.5	0.0—5.3	2.2—6.1
	Average	8.6	1.5	9.1	6.4	3.2	4.0
Ambala	Range	8.0—8.5	0.9—1.9	8.2—11.1	2.7—5.2	3.2—7.5	2.2—8.0
	Average	8.2	1.5	9.7	4.2	5.6	5.0
Rohtak	Range	8.8—9.0	1.2—1.7	12.8—15.0	5.8—7.6	7.0—7.4	1.7—2.2
	Average	8.9	1.4	13.9	6.7	7.2	1.9
Sonepat	Range	8.1	2.4	8.2	4.1	4.1	11.1
	Average	8.1	2.4	8.2	4.1	4.1	11.1
Jind	Range	8.3—8.3	1.0—1.5	4.2—10.4	3.0—9.1	0.2—1.4	4.0—8.9
	Average	8.3	1.2	7.3	6.1	0.8	6.4
Mahendragarh	Range	8.5—8.9	1.4—2.0	6.0—12.4	4.0—6.3	0.0—7.5	4.2—9.1
	Average	8.7	1.7	9.7	5.1	4.7	7.1
Kurukshetra	Range	8.8—8.9	1.0—2.5	9.6—15.6	5.0—7.0	4.6—8.6	2.3—9.4
	Average	8.9	1.8	12.6	6.0	6.6	5.8
Karnal	Range	8.2—8.8	0.7—1.9	7.2—12.4	3.6—9.6	1.6—7.0	1.6—8.6
	Average	8.5	1.0	10.3	5.8	4.5	4.8
Mean average		8.5	1.5	8.5	5.5	3.4	6.3

from 0.6 to 2.5 mmhos which was of good to normal waters (Bhumbla and Abrol, 1972). The concentration of $CO''_3 + HCO'_3$ of sewage water was greater than the concentration of $Ca^{++} + Mg^{++}$ except that in Bhiwani district.

On the basis of average RSC, these waters could be classified (Manchanda, 1976) as follows :

Safe (2.5 me/l)—Sewage water of Hissar, Sirsa, Bhiwani and Jind districts.

Marginal (2.5 to 5.0 me/l)—Sewage water from Gurgaon, Sonepat, Mahendergarh and Karnal districts.

Unfit (75.0 me/l)—Sewage water from Ambala, Rohtak and Kurukshetra districts.

At some places the sewage waters were found deficient in Ca and Mg which could be economically utilised only by adding gypsum as an amendment given in Table 3.

Sewage water could also be classified on the basis of E. C. (mmhos/cm) and SAR values (Richards, 1954). The following classification is based on the average E. C. and average SAR values (Table 2).

C_3S_1–Sewage water from Sirsa, Gurgaon, Ambala, Rohtak, Kurukshetra and Karnal can be placed under this group and good salt tolerant crops can be grown.

TABLE 3

Gypsum requirement

Sr. No.	Name of the utilization centre	Gypsum requirement kg/ha/irrigation
1.	Thana Sadar, Hissar	58.7
2.	Jakhal	143.3
3.	Hansi	91.4
4.	Faridabad	6.2
5.	Palwal	174.7
6.	Nuh	94.5
7.	Sohna	92.6
8.	Banauri Ilaka, Ambala City	206.9
9.	Railway Station Ambala City	98.8
10.	Model Town Ambala	311.8
11.	Ambala Cantt	285.9
12.	Jagadhari	43.2
13.	Rohtak	277.9
14.	Bahadurgarh	302.6
15.	Sonepat	98.8
16.	Main Disposal Works, Rewari	263.0
17.	Dharuhera, Rewari	307.5
18.	Kurukshetra	132.1
19.	Kaithal	379.1
20.	Meerut Road, Karnal	218.6
21.	Jundla Gate Karnal	179.1
22.	Model Town Karnal	277.9
23.	Nilokheri	67.9
24.	Model Town Panipat	50.6

C_3S_2–Sewage water from Hissar, Jind and Mahendergarh fall under this category. Such water can be used on coarse textured soil with good permeability and good drainage facilities.

C_3S_3–Sewage water from Bhiwani falls under this group and crops having high tolerance for salts can be grown, provided adequate drainage facility exists. Chemical amendments may be required for replacement of exchangeable sodium.

C_4S_3–Water from Sonepat district can be classified under this category. This water can be used occasionally if the soil is permeable and adequate drainage facility exists.

Inspite of high pH (Table 2), these waters were a rich source of N and thus, prevented the harmful adsorption of sodium by plants (Heiman, 1961; Kanwar, 1961; Paliwal and Maliwal, 1966).

From the foregoing data it might be inferred that water was a good source of nutrients and needed further investigations about its effect on crop yields in relation to nutrients economy.

REFERENCES

A. O. A. C. 1950. *Official methods of analysis of association* of official and agricultural chemists. Washington, 7 Ed. 536-39.

Bhumbla, D. R. and Abrol, I. P. 1972. Is your water suitable for irrigation? *Indian Fmg.* 22(7) : 15-6.

Chang, K. L. and Bray, R. H. 1951. Determination of calcium and magnesium in soils and plant materials. *Soil Sci.* 72 : 449-58.

Chesnin, L. and Yien, C. H. 1950. Turbidimetric determination of available sulphates. *Soil Sci. Soc. Amer. Proc.* 15 : 149-51.

Hatcher, J. T. and Wilcox, L. V. 1950. Colorimetric determination of boron using carmine. *Analyt. Chem.* 22 : 567-69.

Heiman, H. 1961. Irrigation with saline waters and ionic environment. *Potash Symp. Berne* : 193-220.

Kanwar, J. S. 1961. Quality of irrigation water as an index of its suitability for irrigation purposes. *Potash Rev. September, 1961*/ 1-13.

Kutera, Jan and Majdowaki, Franciszek 1972. Possibilities for agricultural use of industrial waste waters. Pyruszynski Czeslaw: *Gaz Wada Tech Sanit* 46(a) 292-95.

Lindner, R. C. 1944. Rapid analytical methods for some of the more common inorganic constituents of plant tissues. *Plant Physiol.* 19 : 76-86.

Manchanda, H. R. 1976. Quality of ground waters of Haryana, Haryana Agricultural University Monograph.

Olsen, S. R., Cole, C. V., Watanbe, F. S. and Dean, L. A. 1954. *Estimation of available phosphorus in soil using sodium bicarbonate* U. S. D. A. Circ. No. 939.

Paliwal, K. V. and Maliwal, G. L. 1966. Quality of irrigation waters in relation to plant growth under field conditions. (Paper read at the symposium on water management; Udaipur, May 22, 1966).

Pillai, S. C. 1955. Investigations on sewage farming. Biochemistry Deptt. Indian Institute. of Science, Bangalore.

Richards, L. A. 1954. *Diagnosis and improvement of saline alkali soils;* Agricultural Hand Book No. 60, U.S.D.A., 69-82.

Viraraghavan, T. 1969. Sewage treatment with special reference to use on land for irrigation purposes. *J. Inst. Eng. (India)* 59(2) 1 : 25-30.

Wilcox, L. V. 1960. *Boron injury to plants.* U.S.D.A. information bulletin No. 211.

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WATER-STRESS ASSOCIATED PROLINE ACCUMULATION IN WHEAT SEEDLINGS

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ABSTRACT

Effect of water-stress at -1, -3, and -5×10^5 Pa osmotic potential was studied on proline accumulation in the seedlings of two wheat cultivars. Cultivar S 308, which is less drought resistant than C 306, showed higher proline accumulation under stress. The increase in proline accumulation with increase in stress was also more in S 308 seedlings.

Water-stress is known to affect a number of physiological and biochemical processes in plants (Hsiao, 1973) and based on such observations, several criteria have been suggested for drought resistance character in plants. One such parameter is proline content and magnitude of proline accumulation has been positively correlated with the drought resistance and irrigation scheduling (Palfi, 1969; Singh *et al.*, 1972). Accordingly, the effect of water-stress was studied on proline accumulation in wheat cultivars known to be having differential water requirements at seedling stage, for an early testing of strains for drought resistance character.

MATERIAL AND METHODS

Seeds of cultivar C 306 (more drought resistant) and S 308 (less drought resistant) were obtained from the Department of Plant Breeding of this University. Seeds were germinated in quarter strength nutrient solution (Arnon and Hoagland, 1940) and stress was created by polyethylene glycol (6000) solutions of -1, -3, and -5×10^5 Pa osmotic potential (Michel and Kaufmann, 1973). Growth chamber was maintained at 25 ± 1°C with an 8 hr photoperiod of 5000-700 lx. Seedlings (without endosperm) of uniform growth were sampled at 2 day interval and proline was extracted by homogenisation in 3% sulfosalicylic acid and the homogenate was centrifuged at $10,000 \times g$ for 30 min. Proline estimation was done in the supernatant according to the method of Bates *et al.* (1973).

RESULTS AND DISCUSSION

Proline was present in the seeds of both the cultivars and S 308 seeds had a higher proline content compared to seeds of C 306 (Table 1). Proline content increased in the seedlings of both the cultivars with increase in seedling age. At the end of 8 day growth period, proline content of S 308 seed-

TABLE 1

Proline content of wheat seedlings under water stress

Days	Proline (mg/axis)			
	Osmotic potential × 10^5Pa			
	0	−1	−3	−5
S 308				
0	1.45	—	—	—
	(0.03)			
2	8.40	9.12	12.62	12.80
	(2.84)	(3.39)	(7.74)	(8.53)
4	15.18	16.49	13.45	11.81
	(1.15)	(1.59)	(1.58)	(1.57)
6	13.42	19.32	20.40	35.53
	(0.76)	(1.28)	(1.51)	(3.38)
8	26.50	32.43	42.42	47.38
	(1.17)	(1.47)	(1.97)	(2.49)
C 306				
0	0.95	—	—	—
	(0.02)			
2	4.14	4.10	6.21	7.05
	(1.51)	(1.86)	(3.54)	(4.54)
4	5.86	5.06	5.52	8.55
	(0.63)	(0.68)	(0.81)	(1.77)
6	17.02	17.21	24.33	32.43
	(1.15)	(1.24)	(2.36)	(3.70)
8	18.74	21.67	21.62	26.52
	(1.22)	(0.96)	(1.22)	(1.57)

Figures in parenthesis indicate proline content in mg/g dry matter.

lings was one and a half time more than C 306 seedlings. Proline content of stressed seedlings was much higher than the unstressed seedlings. Increase in proline content was more with increase in stress level in both the cultivars. Seedlings of S 308, which is less drought resistant, had a higher proline content and higher magnitude of increase in proline content with increase in stress level compared to the seedlings of C 306 which is more drought resistant.

Increase in proline accumulation has been attributed to several factors such as increased biosynthesis and decreased catabolism (Barnett and Naylor, 1966) and inhibition of protein and polysaccharide synthesis (Stewart *et al.*, 1966). The observed increase in proline also suggested an increase in the oxidative deamination of amino acids producing ammonium ions; the toxicity of ammonium ions being removed by diverting into proline formation. However, during germination a major source of proline

to the growing seedling could be from the degradation of proline rich reserve protein gliadin, in the endosperm. Hence, the higher amounts of proline in the growing axis of the stressed seedlings, might be due to a greater transport of proline from the endosperm. The physiological significance of the accumulated proline was not clear. It was observed that the proline accumulation was reversible and once the stress was relieved the proline was rapidly metabolised, the rate of metabolism being more in tissues which accumulated more proline. The rate of recovery was also more in tissues which accumulated more proline. Hence, it was suggested that proline might be a major source of energy and nitrogen for a rapid recovery of plants when stress was relieved (Stewart *et al.*, 1966, Singh *et al.*, 1973).

The ability to accumulate more proline under water-stress was correlated with the drought resistance of the plants (Palfi, 1969; Singh *et al.*, 1972). Seedlings of S 308 showed higher proline content under water-stress compared to C 306 seedlings. But C 306 was an established drought resistant cultivar. Hence, it appeared that proline accumulation alone might not serve to indicate the drought resistance capacity of a cultivar. It was also reported by Sinha and Rajgopal (1976) that drought tolerant cultivar M 35-1 (Jowar) accumulates low amounts of proline under both field and pot conditions. Conversely, there might not be sufficient proline accumulation in drought resistant cultivars until a severe stress was imposed. Our other observations (Rao, 1975) showed that the rate of mobilisation of food material, water uptake and levels of soluble proteins which constituted the enzymatic complement, was less affected with increase in stress levels in C 306 seedlings as compared to S 308, which suggested that probably C 306 seedlings might survive better under continuous stress for a longer time. Another possibility for the lower amounts of proline in C 306 axis might be its efficient utilisation of proline and/or decreased mobilisation of proline into the growing axis as compared to S 308.

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REFERENCES

Arnon, D. I. and Hoagland, D. R. 1940. Crop production in artificial solutions and in soils with special reference to factors influencing yields and absorption of inorganic nutrients. *Soil Sci.* 50 : 463-83.

Barnett, N. M. and Naylor, A. W. 1966. Amino acid and protein metabolism in bermuda grass during water stress. *Pl. Physiol.* 41 : 1222-30.

Bates, L. S., Waldren, R. P. and Teare, I. D. 1973. Rapid determination of free proline for water stress studies. *Plant and Soil.* 39 : 205-07.

Hsiao, T. C. 1973. Plant responses to water stress. A. Rev. *Pl. Physiol.* 24 : 519-70.

Michel, B. F. and Kaufmann, M. R. 1973. The osmotic potential of polyethylene glycol 6000. *Pl. Physiol.* 51 : 914-16.

Palfi, G. 1969. Determination of irrigation requirement and the selection of drought tolerant plant varieties by means of a new method (Isatin paper indicator method). *Noventermetes* 18 : 25.

Rao, A. S. 1975. Studies on some enzymatic and amino acid levels in water stressed wheat seedlings. M. Sc. Thesis, Haryana Agricultural University, Hissar, India.

Singh, T. N., Aspinall, D. and Paleg, L. G. 1972. Proline accumulation and varietal adaptation to drought in barley : a potential metabolic measure of drought resistance. *Nature new biol.* 236 : 188-90.

Singh, T. N., Aspinall, D, and Paleg, L. G. 1973. Stress metabolism. I. Nitrogen metabolism and growth in the barley plant during water stress. *Aust. J. Biol. Sci.* 26 : 45-46.

Sinha, S. K. and Rajgopal, V. 1976. Effect of moisture stress on proline accumulation in sorghum and wheat. In nitrogen assimilation and crop productivity. Sen, S. P., Abrol, Y. P. and S. K. Sinha. Ed. pp 158-163., Associated Publishing Company, New Delhi, India.

Stewart, C. R., Morris, J. C. and Thompson, J. F. 1966. Changes in amino acid content of excised leaves during incubation. II. Role of sugar in the accumulation of proline in wilted leaves. *Pl. Physiol.* 41 : 1585-90.

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RAPID TECHNIQUE FOR SCREENING THE BARLEY (*HORDEUM VULGARE* L.) VARIETIES FOR THEIR RELATIVE DROUGHT TOLERANCE

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ABSTRACT

Seven varieties of barley were sown in petri-dishes as well as in the field under water stress conditions. In petri-dishes, polyethylene glycol (PEG-6000 Mol. wt.) induced stress resulted in decreased growth of coleoptile and radicle and reduction in the fresh weight of embryo axis. Coleoptile growth was more adversely affected than that of radicle which was evident from the higher radicle/coleoptile ratio under osmotic stress. The length of coleoptile at −8 bars stress showed a significant direct correlation (r=0.86) with the grain yield under dryland condition, whereas radicle length had no relationship with yield (r=0.15). Therefore, coleoptile length during germination under simulated water stress could be used as a rapid screening technique to select cultivars of barley for their relative drought tolerance.

Several measurement techniques have been suggested or used for screening the crop plants for their relative tolerance to water stress (Larson and Eastin, 1971; Singh *et al.*, 1972). However, there is no method or combination of methods that has been generally accepted as the most desirable for measuring drought tolerance and each approach has its merits and demerits (Sullivan, 1971; Hanson *et al.*, 1977). Moreover, opinions and results reported in the literature are often contradictory. Buchinger (1930) considered the tests based on osmotic pressure as good tools to select for drought tolerance of wheat cultivars, whereas Schmidt *et al.*, (1940) opposed this idea. Nevertheless, germination trials with peanut using sucrose, are reported to have good agreement with drought oriented field trials (Gautreau, 1967). Others have also reported a good relationship between the germination test and drought tolerance of different crop plants (Dotzenko and Haus, 1960; Vasudevan and Balasubramanian, 1965; Kaul, 1966; Pandya *et al.*, 1973; Saint-Clair, 1976). Therefore, the present investigation was carried out with the aim to find out some index/indices for determining relative drought tolerance of barley varieties.

MATERIAL AND METHODS

Seeds of seven varieties, viz., BG 25, BP 339, BG 118, BG 186, C 164, C 138 and DL 3 of barley (*Hordeum vulgare* L.) were surface sterilized with 1% sodium hypochlorite for 10 min. and placed in

sterilized petri-dishes lined with whatman No. 1. In petri-dishes, water stress of −2, −4, −6 and −8 bars was created by adding 10 ml. aqueous solution of polyethylene glycol (PEG-6000 Mol. wt.). The PEG solutions of different osmotic potentials were prepared as described by Michel and Kaufmann (1973). Distilled water served as the control. The seeds were allowed to germinate at 25°C in seed germinator. There were four replicates of 10 seeds each, for each variety × stress level. Data for germination (emergence of radicle) was recorded at 24 hr intervals upto 120 hr of sowing. 120 hr after sowing, seedlings were sampled for recording the growth of coleoptile and radicle as well as the weight of embryo axis.

Field experiment was also conducted to study the grain yield in above mentioned barley varieties during *rabi* 1976-77 at Dryland Agriculture, Haryana Agricultural University, Hissar. All the seven varieties were placed in a randomized block design with four replications on 15th November, 1976 in plots of 4×3 meter size. Yield data was recorded at the time of maturity.

RESULTS AND DISCUSSION

Results presented in Table 1 reveal that water stress upto−8 bars delayed the germination but had no effect on final germination per cent in any of the varieties studied. However, there was a consistent decrease in fresh weight of embryo axis, radicle and coleoptile length with the increase in osmotic stress except with a slight increase in radicle length of varieties C 164 and DL 3 at-2 bars of water stress (Table 1). Such increased radicle growth under mild stress has also been reported by others (Jarvis and Jarvis, 1963; Pandya *et al.*, 1973, 1975). Varietal differences were clear regarding the seedling growth under these conditions. Least reduction in growth (Fresh weight, coleoptile and radicle length) was observed in C 138 followed by BG 186, whereas maximum reduction in growth was recorded in variety C 164.

The adverse effect of increasing water stress was more evident on coleoptile than on radicle growth. This was also apparent from the increasing radicle to coleoptile ratio under stress conditions. Interestingly, the variety C 138 registered little increase in the radicle/coleoptile ratio, whereas C 164 showed a large increase in radicle/coleoptile ratio under stress. Similar response has also been reported in wheat, barley, *raya* and *sarson* (Kaul, 1966; Pandya *et al.*, 1975). The greater reduction in coleoptile than radicle length under stress has been explained that this is due to the greater dependence of root on the seed reserve food and less dependence on water uptake during early non-photosynthetic stage of seedling growth (Parmar and Moore, 1968).

Results presented in Table 2 showed a significant varietal differences in growth, yield components and final grain yield under dryland conditions. The maximum grain yield was recorded in variety C 138 followed by BG 186, whereas least yield was obtained in variety C 164. The most affected yield components under stress were ear length and number of grain per ear.

The importance of root system as a characteristics of drought hardy varieties for the maintenance of favourable water balance in the plant, has been indicated by Misra (1956) and Salim *et al.*, 1965.

TABLE 1

Germination and growth of different varieties of barley, 120 h after sowing under simulated water stress

Varieties	Osmotic potential PEG (bars)	Germination (%)	Coleoptile length (cm)	Radicle length (cm)	Fresh weight (g/5 seedlings)	Radicle/ coleoptile ratio
BG 118	Control	89	10.4	15.2	1.151	1.46
	−2	92	7.1	13.2	0.735	1.90
	−4	94	4.4	9.1	0.472	2.07
	−6	92	1.4	5.2	0.335	3.64
	−8	93	0.9 (91)*	4.4 (71)	0.252 (78)	4.89
C 164	Control	99	8.4	15.0	1.216	1.78
	−2	100	6.2	16.0	0.901	2.58
	−4	99	2.7	8.9	0.569	3.30
	−6	98	1.0	4.7	0.273	4.70
	−8	98	0.2 (97)	2.4 (84)	0.140 (88)	12.0
BP 339	Control	92	7.8	13.1	1.052	1.68
	−2	92	4.9	12.1	0.597	2.47
	−4	90	3.9	8.7	0.437	2.23
	−6	91	2.4	6.1	0.300	2.54
	−8	91	0.7 (91)	4.2 (66)	0.185 (82)	6.00
BG 186	Control	100	9.6	13.8	0.958	1.44
	−2	97	6.5	12.7	0.694	1.95
	−4	100	4.3	11.7	0.407	2.72
	−6	98	2.9	7.6	0.321	3.00
	−8	97	0.9 (90)	5.3 (61)	0.254 (73)	5.89
BG 25	Control	97	9.2	12.4	0.948	1.35
	−2	97	6.5	8.5	0.812	1.31
	−4	100	3.8	6.7	0.670	1.76
	−6	100	2.0	4.8	0.586	2.40
	−8	99	0.4 (96)	2.4 (82)	0.245 (74)	6.00
C 138	Control	100	9.8	11.3	1.022	1.15
	−2	99	6.8	9.9	0.874	1.46
	−4	100	3.7	7.0	0.700	1.86
	−6	97	2.3	5.1	0.612	2.22
	−8	98	1.6 (83)	3.7 (67)	0.328 (68)	2.30
DL 3	Control	100	9.0	13.2	0.962	1.43
	−2	97	7.8	14.6	0.605	1.87
	−4	98	5·7	12.3	0.466	2.16
	−6	98	2.4	6.2	0.216	2.70
	−8	99	0.6 (96)	2.0 (84)	0.073 (92)	3.33
C. D. at 5% (at−8 bars)			0.346	0.967		

*Values in parenthesis represents the reduction at −8 bars over the control.

TABLE 2

Growth and yield data of seven varieties of barley grown under dryland conditions

Varieties	Plant height (cm)	No. of tillers	Ear length (cm)	No. of grain/ ear	Grain yield (g/plot)
BG 118	50.6	4.5	7.5	50.3	875
C 164	44.8	4.0	3.9	34.9	586
BP 339	41.0	3.0	7.4	37.1	718
BG 186	52.8	3.6	6.6	49.1	1000
BG 25	50.2	5.9	7.8	45.1	788
C 138	54.0	4.5	7.2	45.7	1450
DL 3	38.6	4.8	7.4	41.6	888
C. D. at 5%	5.249	1.207	0.611	6.609	370

Varieties differ in seminal root characteristics within a species. Differences of this type, if established, may be used as an index for drought tolerance. But our results presented in Table 1 and 2 did not show any relationship between the grain yield and radicle growth (r=0.15) under stress conditions. However, a highly significant correlation (r=0.86) existed between the length of coleoptile and grain yield of barley under water stress conditions (Fig. 1).

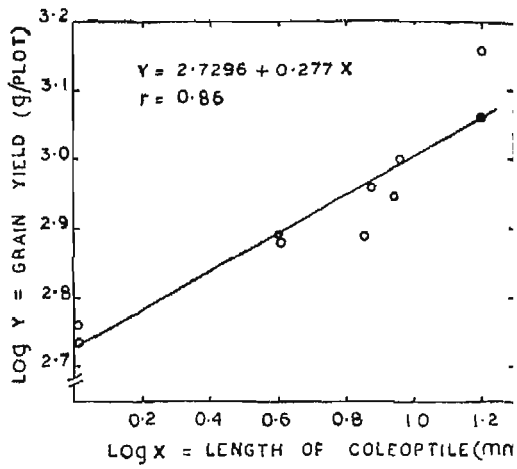


Fig. 1. Correlation between the length of coleoptile (mm) and the grain yield (g/plot) of barley varieties.

From these results, it appears that coleoptile length might serve as a more sharp and deciding character for judging the effect of moisture stress on varietal performance of barley, rather than the germination counts and radicle growth under osmotic stress as reported by a number of workers (Hunder and Erickson, 1952; Gautreu, 1967; Kaufmann, 1969; Saint-Clair, 1976). Correlation studies by Parmar and Moore (1968) and Pandya *et al.*, (1973) has also indicated that shoot (Coleoptile) growth alone was an acceptable measure for simulated influence of drought conditions, as better coleoptile elongation might have a favourable influence on the emergence of the seedlings from the soil, under rainfed cultivation where deep sowing of seeds was a common agronomic practice. Hunter and Erickson (1952) reported that ability of alfalfa cultivars to germinate at high osmotic pressure was heritable. If so, this finding would be of much practical interest in breeding programme designed for the selection of varieties which could grow better under limited soil moisture.

REFERENCES

Buchinger, A. 1930. Die Bedeuntung der selektion nach der saugkraft fur die Pflanzenzuchtunz. *Z. Zucht. A.* 15 : 101-14.

Dotzenko, A.D. and Huns, T.E. 1960. Selection of alfalfa lines for their ability to germinate under high osmotic pressure. *Agron. J.* 52 : 200-01.

Gautreu, J. 1967. Recherches varietales sur la resistance de arachide a la recheresse. I. Les tests de germination a pression osnotique elevee. *Oleogineuf.* 7: 441-44.

Hanson, A. D., Nelsen, C. E., and Everson, E. H. 1977. Evaluation of free proline accumulation as an index of drought resistance using two contrasting barley cultivars. *Crop Sci.* 19 : 720-26.

Hunter, J. R. and Erickson, A. E. 1952. Relation of seed germination to soil moisture tension. *Agron. J* 44 : 107-09.

Jarvis, P. G. and Jarvis, M. S. 1963. Effect of several osmotic substances on the growth of *Lupinus albus* seedlings. *Physiol. Plant* 16 : 485-500.

Kaufmann, M. R. 1969. Effects of water potential on germination of lettuce, sunflower and citrus seeds. *Can. J. Bot.* 47 : 1761-64.

Kaul, R. 1966. Relative growth rates of spring wheat, oats and barley under PEG induced water stress. *Can. J. Plant Sci.* 46 : 611-17.

Larson, K. L. and Eastin, J. D. 1971. Drought injury and resistance in crops. *CSSA Spec. Publ.* 211-17.

Michel, B. E. and Kaufmann, M. R. 1973. The osmotic potential of polyethylene glycol 6000. *Plant Physiol.* 51 :914-16.

Misra, D. K. 1956. Relation of root development to drought resistance of plants. *Indian J. Agron.* 1 : 41-46.

Pandya, R. B., Khan, M. I. and Yadava, T. P. 1973. Varietal response of raya (*Brassica juncea* Coss.) to different moisture regimes during germination. *Indian J. Plant Physiol.* 16 : 79-83.

———, ———, Gupta, S. K. and Dhindsa, K. S. 1975. Germination, seedling growth and sugar metabolism of two species of *Brassica* under PEG induced water stress. *Biochem. Physiol. Pflanzen.* 167 : 439-45.

Parmar, M. T. and Moore, R. P. 1968. Carbonox 6000, mannitol and sodium chloride for simulating drought conditions in germination studies of corn (*Zea mays*) of strong and weak vigor. *Agron. J.* 60 : 192-95.

Saint-Clair, 1976. Germination of Sorghum Bicolor under PEG induced stress. *Can. J. Plant Sci.* 56 : 21-23.

Salim, H. M., Todd, G. W., and Schlehuber, A. M. 1965. Root development of wheat, oats and barley under conditions of soil moisture stress. *Agron. J.* 57 : 603-07.

Schmidt, H., Duwald, K. and Stocher, O. 1940. Plasmatische untersuchungen and durrempfindlichen and durresistenten sorten Land-wirlrehaftlicher Kulturpflanzen. *Planta.* 31 : 559-96.

Singh, T. N., Aspinall, D. and Paleg, L. G. 1972. Proline accumulation and varietal adaptation to drought in barley, a potential metabolic measure of drought resistance. *Nature (New Biol.)* 236 : 188-90.

Sullivan, C. Y. 1971. Techniques for measuring plant drought stress. Reprinted from drought injury and resistance in crops. *CSSA spr. Publ.* 2 : 1-7.

Vasudevan, V. and Balasubramanian, S. 1965. Expermination in osmotic solution as an index of drought resistances in sorghum. *Madras Agric. J.* 52 : 386-90.

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EVALUATION OF EXOTIC GRAPES GROWN IN HARYANA FOR RED WINE PRODUCTION

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ABSTRACT

Six exotic grape cultivars, viz., Beauty Seedless, Seedless, Kishmish Charni, Carignane, Charas and Red Prince were screened for dry red table wine preparation for three years (1974-1976). None of these cultivars were found to have the requisite balling for wine production. Carignane was found to be more acidic (0.9 to 1.1%) as compared to other varieties. During the period of study colour intensity of wines prepared from Carignane and Beauty Seedless was consistently higher and there was no appreciable decrease in the intensity during ageing. Organoleptically, wine from Carignane was rated the best. Chemical constituents of all the wines prepared were within the ISI Standards for dry red table wines. However, acceptable quality of wine with supplementation could be produced from Beauty Seedless and Carignane.

Grape is one of the important fruit crops of Haryana and covers about 400 ha. Agroclimatic conditions of this region although considered marginal for grape cultivation because of onset of early rain during the fruiting season yet the yields and quality of early varieties like Perlette, Delight and Beauty Seedless are very encouraging (Daulta and Bakhshi, 1978). For improvement of grape cultivation in this area a large number of exotic varieties are being continuously introduced in the experimental Vineyard of Haryana Agricultural University, Hissar and are evaluated for earliness, yield, juice recovery and other characteristics considered suitable for table purposes. Testing a variety for wine making is also of utmost importance because the duration of the crop is very short and there is glut in the market. Thus, the grape growers do not get remunerative price of their produce. Secondly, grapes being highly perishable in nature, cannot be kept for more than 24 hr for table purpose. Thus, as an alternative, if the variety is equally suitable for wine making it can find its way in the industry for table wines. Suitability of white grape cultivars for wine production has already been reported (Kundu *et al.*, 1979). The present communication deals with screening of red grape varieties for dry red table wine production.

MATERIAL AND METHODS

Fresh grapes (5 Kg) of Beauty Seedless, Seedless, Kishmish Charni, Carignane, Charas and Red Prince were obtain-

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ed from the Experimental Vineyard of Haryana Agricultural University, Hissar. The wine yeast *Saccharomyces cerevisiae* var. *ellepsoideus* (Montrachet 522) was from the Department of Enology and Viticulture, University of California, United States of America.

The grapes were destemmed and crushed gently with hands immediately after harvesting. The crushed grapes were treated with 100 ppm of SO_2 (as potassium metabisulphite) and ameliorated with cane sugar and tartaric acid to raise the Brix to 24° and wherever required total acidity to 0.75%, respectively The fermentation was initiated by the addition of 5% inoculum of 24 hr old yeast culture ($\simeq 3\times10^8$ cells/ml) grown in pasteurized juice of respective variety. In order to extract the red anthocyanin pigments from grape skin, the juice was fermented along with skin upto 8° Brix at 20±2°C and then pomace was removed by soft pressing through cheese cloth. The juice was further allowed to ferment to dryness. The SO_2 content was then increased to 100 ppm and stored at 5±1°C for cold stabilization for one week and racked to remove the sediment. The wines were clarified with 200 ppm of agar-bentonite mixture (2 : 1) and stored in air tight amber bottles at 12±1°C for six months for ageing.

The wines were analysed for chemical constituents and organoleptically by the procedure described earlier (Bardiya *et al.*, 1976 and Kundu *et al.*, 1979). The colour intensity of the wines was determined by determining the optical density at 520 nm (Rossi and Sigleton, 1966), using Bousch and Lomb Spectronic-20c olorimeter.

RESULTS AND DISCUSSION

The composition of most fruits is affected significantly by the environmental conditions under which they are grown (Amerine *et. al.*, 1972). In order to get a correct representative picture of the suitability of the grapes for wine production all the varieties were tested for 2-3 years consecutively (1974-76). Red Prince, Seedless and Charas were not included in the studies in 1974 and 1975, respectively, because of improper development of berry colour. Some of main characters of these grape varieties are listed in Table 1. Beauty Seedless, Seedless and Kishmish Charni were seedless varieties and remaining three were seeded. Beauty seedless was an early maturing variety while Kishmish Charni, Carignane were late maturing varieties. Beauty Seedless was the heaviest yielder among all varieties tested under the Knifin system of training.

Table 2 shows the chemical analysis of the must from different grapes. Total acidity and Brix reading of all the cultivars varied appreciably from year to year. This showed more sensivity of all these cultivar to variation in climatic conditions. Carignane was found to be most acidic variety (0.9 to 1.1%) as compared to the rest of the cultivars (0.6 to 0.8%). None of the varieties tested had the requisite Brix reading (24° Brix) for dry red table wine preparation. Therefore, it was essential to increase the Brix to 24° so that the desired ethanol level (10-12%) in the dry wines was obtained.

The red wines are judged primarily by their red colour intensity and its stability during storage (Webb, 1964). Considering this the consistently higher colour

TABLE 1

Characteristics of red grape cultivars

Variety	Bunch compactness	Berry		Ripening Time	Av. Yield (Kg/vine)
		Colour	Seeds		
Beauty Seedless	Compact	Bluish Black	Seedless	Last week May	25.0
Kishmish Charni	Loose	Brick Red	Seedless	Third week June	17.5
Carignane	Very Compact	Bluish Black	2	Third week June	10.0
Charas	Loose	Bluish Black	2	Second week June	13.6
Red Prince	Loose	Purplish Red	1-2	Second week June	16.0
Seedless	Very Loose	Black	Seedless	First week June	15.9

TABLE 2

Analysis of must prior to fermentation

Variety	Year	Chemical characteristics			
		pH	Degree brix	Total acidity (%)	Balling/acid
Beauty Seedless	1974	3.2	19.0	0 75	27.3
	1975	3.2	17.0	0.82	20.7
	1976	3.1	17.0	0.82	20.7
Kishmish Charni	1974	3.3	20.0	0.72	28.2
	1975	3.4	22.5	0.68	33.7
	1976	3.1	16.5	0.75	22.0
Carignane	1974	3.0	17.0	0.94	17.9
	1975	2.9	16.0	1.05	15.2
	1976	2.9	15.5	1.11	13.9
Charas	1974	3.2	20.5	0.79	25.9
	1975	—	—	—	—
	1976	3.3	18.0	0.69	28.2
Red Prince	1974	—	—	—	—
	1975	3.1	19.0	0.81	23.4
	1976	3.2	16.0	0.75	21.3
Seedless	1974	—	—	—	—
	1975	3.2	17.0	0.75	22.6
	1976	3.3	16.0	0.67	23.9

intensity was observed in Carignane and Beauty Seedless wines (Table 3). The Seedless variety gave a wine of light red colour (Ros'e). The variety Charas gave a brick red colour wine but the Vintage variations were very high. The colour intensity followed closely the total phenol content of dry red table wines. This showed that apart from other phenolic compounds common to all wines, anthocyanine were the major phenolic compounds of red wines (Somers, 1972). The ethanol content of wines varied from 10.2 to 11.4% and this might be due to change in chemical composition of the grapes. As far as chemical constituents of red wines were concerned they were well within the limits of ISI standards for dry red table wines (ISI, 1974).

After ageing for 6 months, the colour intensity decreased in all the wines (Table 4). This might be due to partial destruction of anthocyanin pigments by various chemical reactions or by condensation with tannins (Berg and Akiyoshi, 1962). Total acidity and pH also decreased during storage because of tartrate precipitation. Though, SO_2 content of fresh wines was raised to 100 ppm at the time of processing, it also declined perhaps due to voltailization and/or binding with anthocyanin pigments (Ribereau Gayon, 1974). However, no appreciable change was observed in rest of the constituents. The aged wines were also subjected to organoleptic evaluation by a panel of wine tasters using the 20 point score card of Ough and Baker (1961). It was found that

TABLE 3

Analysis of fresh dry red table wines from different grape varieties

Variety	Year	Chemical characteristics							
		Colour intensity (O.D. at 520 nm)	pH	Total acidity (%)	Volatile acidity (mg/100ml)	Ethanol (%, v/v)	Total aldehydes (ppm)	Residual sugars (%)	Total phenols (mg/100 ml)
Beauty	1974	2.8	3.4	0.70	29.0	10.7	26.4	0.28	66.0
Seedless	1975	2.0	3.3	0.69	20.0	10.2	44.8	0.13	52.0
	1976	2.4	3.4	0.66	19.0	10.2	59.4	0.26	59.0
Kishmish	1974	0.5	3.7	0.63	15.0	11.4	49.5	0.28	34.0
Charni	1975	1.9	3.9	0.63	23.0	11.2	46.2	0.16	63.0
	1976	2.2	3.9	0.60	12.0	11.2	54.5	0.36	84.0
Carignane	1974	3.2	3.4	0.69	19.0	10.5	22.0	0.15	104.0
	1975	3.4	3.1	0 99	18.0	10.6	22.4	0.16	87.0
	1976	2.8	3.2	0.88	22.0	10.1	59.4	0.46	80.0
Charas	1974	2.8	3.6	0.68	17.0	11.0	17.0	0.18	74.0
	1975	—	—	—	—	—	—	—	—
	1976	0.5	3.8	0.57	23.0	11.1	62.4	0.43	37.0
Red Prince	1974	—	—	—	—	—	—	—	—
	1975	1.7	3.3	0.72	21.0	10.8	44.0	0.16	57.0
	1976	1.2	3.4	0.67	16.0	11.0	33.0	0.40	50.0
Seedless	1974	—	—	—	—	—	—	—	—
	1975	0,6	3.3	0.65	24.0	10.6	48.0	0.12	56.0
	1976	0.6	3.3	0.67	22.0	10.9	23.7	0.42	45.0

TABLE 4

Analysis of dry red table wines after ageing from different grape varieties

Variety	Year	Chemical Characteristics								
		Colour intensity (O.D. at 520 nm)	pH	Total acidity (%)	Volatile acidity (mg/100ml)	Ethanol (%, v/v)	Total aldehydes (ppm)	Total phenols (mg/100 ml)	Total SO_2 (ppm)	Mean score (20)
Beauty	1974	2.3	3.7	0.61	34.0	10.5	19.8	65.0	22.4	14.7
Seedless	1975	1.8	3.3	0.68	33.0	10.0	38.3	52.0	56.0	13.5
	1976	2.2	3.4	0.65	39.0	10.1	44.3	55.0	16.0	14.0
Kishmish	1974	0.3	3.8	0.58	48.0	11.2	28.6	33.0	20.8	9.9
Charni	1975	1.6	3.9	0.64	54.0	11.0	39.0	60.0	80.0	10.2
	1976	1.7	3.7	0.59	22.0	10.9	46.2	75.0	24.0	10.5
Carignane	1974	2.8	3.7	0.63	25.0	10.2	24.2	95.0	31.4	16.3
	1975	3.1	3.3	0.96	45 0	10.2	19.8	89.0	56.8	15.8
	1976	2.6	3.3	0.90	45.0	9.8	52.1	80.0	55.3	14.9
Charas	1974	2.2	3.6	0.66	30.0	11.0	17.6	73.0	22.4	12.8
	1975	—	—	—	—	—	—	—	—	—
	1976	0.6	3.8	0.58	34.0	11.0	58.5	30.0	52.8	11.9
Red Prince	1974	—	—	—	—	—	—	—	—	—
	1975	2.0	3.3	0.68	39.0	10.6	26.4	52.0	75.2	12.0
	1976	1.0	3.4	0.66	39.0	10.7	19.8	50.0	42.8	11.2
Seedless	1974	—	—	—	—	—	—	—	—	—
	1975	0.8	3.3	0.62	44.0	10.6	18.7	50.0	44.8	9.6
	1976	0.7	3.3	0.62	49.0	10.8	14.5	45.0	32.0	10.7

the wine produced from Carignane variety was the best which was closely followed by the wine from Beauty Seedless (Table 4).

Apart from the suitability of the cultivar for wine making, its yield potential and suitability for table purposes are also additional factors which are to be considered. Beauty Seedless being heavy yielder (25 Kg/vine) as compared to Carignane (10 Kg/vine) and being seedless more suitable serves as a purpose variety.

REFERENCES

Amerine, M. A., Berg, H. W. and Cruess, M. V. 1972. *The technology of wine making.* Westport, ,connecticut, AVI Pub. Company, Inc , USA.

Annonymous, 1974. Indian Standard Specification for Table wines. 15 : 7058-1973.

Bardiya, M. C., Kundu, B. S. and Tauro, P. 1976. Control of maderization in Indian white wines. *J. Food Sci. Tech.* 13 : 268-69.

Berg, H. W. and Akiyoshi, M. 1962. Colour behaviour during fermentation and ageing of wines. *Am. J. Enol. Vitic.,* 13 : 126-32.

Daulta, B. S, and Bakhshi, J. C. 1978. Evaluation of vinifera varieties. II. Yield and Fruiting behaviour. *Haryana J. Hort. Sci.,* 7 : 156-61.

Kundu, B. S., Bardiya, M. C. and Tauro, P. 1979. Sun backed sherry. process *Biochem.* : 14 : 14-15.

Kundu, B. S., Bardiya, M. C., Daulta, B. S. and Tauro, P. 1979. Evaluation of exotic grapes grown in Haryana for white table wines. *J. Food Sci. Tech.* (In press).

Ough, C. S. and Baker, C. A. 1961. Sensory evaluation of wines. *Higardia,* 30 : 587.

Riberean Gayon, P. 1974. The chemistry of red wine colour. *Advances Chemistry Series No.* 137 : 50-87.

Rossi, J. Jr. and Singleton, V. L. 1966. Flavour effects and adsorption properties of purified fractions of grape seed phenols. *Am. J. Enol. Vitic.* 17 : 240-46.

Webb, A. D. 1964. Anthocyanins of grapes. Plant Phenolics of Group of North America, Montreal.

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ZINC, IRON AND MANAGANESE NUTRITION IN COWPEAS *(VIGNA SINENSIS* L.). AS INFLUENCED BY MOLYBDENUM AND COPPER

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ABSTRACT

Investigations carried out in a screen-house have shown that Fe absorption in leaves of cowpeas decreased with increasing levels of Mo and Cu. Iron increased following Cu application in stems and roots. Molybdenum reduced Fe in stems and roots. Manganese concentration in leaves, stems and roots increased with Cu, while Mo decreased it. In leaves and stems, Zn content increased following Cu and Mo application. In roots, 20 ppm Cu reduced Zn, whereas Mo had a favourable effect.

Interaction between micronutrients may occur within plant or outside it, namely, the substrate in which it is grown. A nutrient whose application is unquestionable due to its essentially may aggravate the deficiency or alleviate the toxicity of other nutrient. Application of Mo decreased the availability of Fe in plants (Cheng and Ouellette, 1970 1972) and Cu has been reported to antagonise Zn in plants (Kausar *et al.* 1976). Since, Mo and Cu are intricately involved in the nutrition of other trace elements, therefore, the present investigation was carried out to study the effect of Mo and Cu application on the absorption of Zn, Mn and Fe in cowpeas.

MATERIAL AND METHODS

The pertinent physico-chemical properties of the soil used for the study are given in Table 1.

TABLE 1

Physico-chemical characteristics of the soil

Texture	Loamy sand
pH (1:2 soil water suspension)	8.30
EC (1:2) (mmhos/cm)	0.09
Organic carbon (%)	0.03
$CaCo_3$ (%)	Nil
Available P (ppm)	3.00
Available Mo (ppm)	0.04
DTPA extractable nutrients	
Cu (ppm)	0.40
Zn (ppm)	0.32
Fe (ppm)	2.25
Fe (ppm)	3.33

Molybdenum and Cu were applied at the rate of 0, 0.5, 1.0 and 2.0 ppm Mo, and 0,5, 10 and 20 ppm Cu in the form $Na_2MoO_4 . 2H_2O$ and $CuCl_2 . 2H_2O$, respectively. All the treatments were replicated thrice. Four kg soil was filled in polyethylene lined earthen pots. A

basic dressing of 10 ppm N, 20 ppm P, 20 ppm K and 5 ppm Zn was applied in solution as A. R. grade Co $(NH_4)_2$, NH_4HPO_4, KCl and $ZnSO_4.7H_2O$, respectively. Cowpeas (HFC 42-1) was grown for six weeks. Zinc, Cu, Fe and Mn in soil were extracted with DTPA as described by Lindsay and Norvell (1978). Plant samples were digested in diacid mixture $HNO_3 : HClO_4$ (5:1). Zinc, Cu, Fe and Mn in soil and Zn, Fe and Mn in plant parts were determined by atomic absorption spectrophotometry. Available Mo was extracted by the method of Grigg (1953) and estimated by the method of Gupta and Mackay (1966), pH, EC, OC, $CaCo_3$ and available P were determined according to the methods outlined by Chopra and Kanwar (1976).

RESULTS AND DISCUSSION

Iron concentration in leaves, stems and roots

The perusal of data (Table 2) indicate that Mo application reduced the Fe absorption in all plant parts. Iron content decreased by 20, 23 and 27% with 2 ppm Mo in the absence of added Cu against 0 ppm Mo in leaves, stems and roots, respectively. The mean effect showed a significant depression in Fe content in leaves at 0.5 ppm and 1.0 ppm Mo when compared with 0 ppm Mo. Iron content of stems decreased significantly at 2 ppm Mo as compared to other levels of Mo in roots The differences amongst levels of Mo were significant in roots.

TABLE 2

Effect of Mo and Cu on the concentration of Fe in leaves, stems and roots

Mo levels (ppm)	Cu levels (ppm) 0	5	10	20	Mean
		Fe (ppm)			
		Leaves			
0	324.9	272.9	262.1	252.6	277.9
0.5	309.2	276.3	251.6	246.3	268.6
1.0	267.3	251.5	246.8	231.1	249.2
2.0	257.6	245.1	232.1	241.5	244.1
C.D. at 5% : Mo and Cu=13.7; Mo x Cu=N.S.					
		Stems			
0	68 8	89.1	96.5	99.6	88.6
0.5	65.5	83.8	91.7	93.4	83.8
1.0	62.9	76.0	89.1	91.7	79.9
2.0	52.4	73.7	81.2	83.8	72.7
Mean	62.4	80.5	89.7	99.3	
C.D. at 5% : Mo and Cu=5.8; Mo x Cu=N.S.					
		Roots			
0	1352	2233	2316	2862	2191
0.5	1319	1803	2044	2600	1942
1.0	1203	1415	1478	1950	1512
2.0	985	1342	1373	1835	1384
Mean	1215	1698	1803	2312	
C.D. at 5% : Mo and Cu=86.4; Mo x Cu=172.8.					

The mean values show that Fe content of leaves decreased significantly due to added Cu when compared with 0 ppm Cu. In stems and roots, the trend was reverse. It was obvious from the mean values of Fe content of stems that the increase was significant upto 10 ppm Cu in comparison to other levels, while in roots, it was significant at each level of Cu when comparison was made between levels.

The interaction between Mo and Cu was non-significant for Fe content of leaves and stems, while for roots the interaction was significant.

A depression in Fe concentration, consequent to increased Mo application obviously indicated that these two ions behaved antagonistically. Hanger (1965) Berry and Reisenauer (1967) and Gupta and Mehla (1979) also reported parallel results in red clover, tomato and berseem, respectively. It can be surmised that antagonistic effect of Mo on Fe was due to the formation of a sparingly soluble Fe-molybdate complex.

Results indicated that Fe concentration in stems and roots increased with Cu. Dokiya *et al.* (1968) reported inhibiting effect of Cu on Fe absorption in leaves. It can be inferred that application of Cu favoured the translocation of Fe to roots and shoots, but checked in the leaves. Misra and Dwivedi (1977) and Brar and Sekhon (1978) presented similar results. In the present study, Fe content of roots was higher than the stems and leaves, which indicated that inhibitory effect of Cu on Fe was more pronounced in roots followed by stems.

Manganese concentration in leaves, stems and roots

Data (Table 3) reveal that application of Mo decreased Mn content in leaves and roots of cowpeas significantly. The differences due to 1 and 2 ppm Mo were significant, while there was non-significant difference between 0 and 0 5 ppm Mo. Added Mo, lowered Mn content in roots when compared with control. Similar depressing effect of Mo on Mn content was also observed by Cheng and Ouellette (1970, 1972). Tanner (1977) also reported that added Mo, decreased, Mn content in the presence of added Cu. The antagonistic effect of Mo on Mn concentration is attributed to their involvement in oxidation-reduction reactions in plants.

Application of higher level of Cu contributed significantly in the reduction of Mn content in leaves. Manganese content of stems increased significantly at 10 and 20 ppm Cu when compared with control. But at 20 ppm Cu, a significant decrease was observed with respect to 10 ppm Cu. Manganese content of roots increased significantly with graded doses of Cu and the differences amongst varying levels of Cu were significant.

Molybdenum and Cu interaction in leaves and stems was non-significant with regard to Mn concentration while for roots it was significant. Molybdenum had nagative, while Cu had positive interaction with Mn in roots. The interaction of Mo for Mn content was significant at 2 ppm Mo only in the absence of Cu and in the presence of Cu it was significant only with 0.5 ppm Mo.

The results of present investigation showed increasing trend with applied Cu which corroborate with the findings of Younts and Patterson (1964) who reported favourable effect of Cu on Mn

TABLE 3

Effect of Mo and Cu on the concentration of Mn in leaves, stems and roots

Mo levels (ppm)	Cu levels (ppm) 0	5	10	20	Mean
		Mn (ppm)			
		Leaves			
0	32.1	34.9	34.6	33.5	33.8
0.5	30.4	34.4	34.4	33.2	33.1
1.0	28.1	33.3	30.6	29.5	30.3
2.0	26.7	32.0	30.6	30.1	29.8
Mean	29.3	33.6	32.5	31.6	
C.D. at 5% : Mo and Cu = 1.3; Mo x Cu = N.S.					
		Stems			
0	10.6	11.4	11.4	12.8	11.5
0.5	10.2	10.3	11.4	12.6	11.1
1.0	10.3	10.8	11.6	12.4	11.3
2.0	10.3	10.9	12.6	12.4	11.6
C.D. at 5% : Mo and Cu = .97; Cu x Mo = N.S.					
		Roots			
0	58.3	81.0	91.5	97.5	82.1
0.5	55.5	58.5	75.0	84.0	68.2
1.0	52.1	58.3	72.0	75.0	64.4
2.0	49.2	55.2	64.5	70.5	59.9
Mean	53.8	63.3	75.7	81.7	
C.D. at 5% : Mo and Cu = 4.3; Mo x Cu = 8.7.					

content at lower levels of Cu, but depressing effect at higher level. Our study indicated similar results in leaves. Misra and Dwivedi (1977) in maize also observed that Cu additions led to increased concentration of Mn. Lower levels of Cu enhanced the translocation of Mn from roots to the leaves but at higher level it was affected adversely. The Mn concentration was in order : roots >leaves>stems.

Zinc concentration in leaves, stems and roots

The perusal of data (Table 4) indicated a significant increase in Zn concentration due to added Mo in leaves and stems. The differences between 1 and 2 ppm Mo were non-significant in leaves. Zinc content in stems increased significantly only with 2 ppm Mo when compared with lower levels of Mo. Effect due to Mo x Cu on Zn was non-significant. In roots, a consistent decrease in Zn content was observed with Mo application.

Copper addition significantly enhanced Zn content of leaves and stems. Zinc content of leaves markedly increased with 5 ppm Cu when compared with control and 20 ppm Cu in comparison

TABLE 4

Effect of Mo and Cu on the concentration of Zn in leaves, stems and roots of cowpeas

Mo levels (ppm)	Cu levels (ppm) 0	5	10	20	Mean
		Zn (ppm)			
		Leaves			
0	35.2	37.1	37.1	38.3	34.9
0.5	36.8	37.7	39.2	41.3	38.7
1.0	37.9	38.7	39.8	45.4	40.5
2.0	37.8	39.1	40.9	47.2	41.3
Mean	36.9	38.2	39.2	43.1	
C.D. at 5% :					
		Stems			
0	30.5	32.3	34.1	34.6	32.9
0.5	31.7	33.2	34.1	35.3	33.6
1.0	32.3	33.5	34.3	35.3	33.9
2.0	34·1	34.7	35 3	37.1	35.3
Mean	32.2	33.4	34.4	35.6	
C.D. at 5% : Mo and Cu=1.6; Mo x Cu=N.S.					
		Roots			
0	61.9	64.3	73.4	59.7	64.8
0.5	43.1	57.4	60.3	49.6	49.3
1.0	40.0	41.3	57.1	46.9	46.3
2.0	38.9	40.3	53.5	45.2	44.5
Mean	45.9	47.5	61.2	50.4	
C.D. at 5% : Mo and Cu=7.6; Mo x Cu=N.S.					

to other levels. Zinc content of stems also increased significantly at 10 and 20 ppm Cu when compared with control and 5 ppm Cu. In roots, it was affected favourably upto 10 ppm Cu. It is interesting to note that addition of 20 ppm Cu had a depressing effect on Zn content of roots when compared with 10 ppm Cu. The interaction for leaves was significant.

An increasing trend in Zn content with the application of Mo in leaves and stems and reverse in roots indicates that Mo might have helped in the translocation of Zn from roots to the tops of plant.

Copper had increased Zn content of all the organs which was inconformity with the results of Brar and Sekhon (1978) who reported that at lower rates of Cu, Zn content increased in roots and stems. Zinc and Cu are known to behave antagonistically but in the present investigation, Cu had a favourable effect on the absorption of Zn in all the plant organs, which suggested that in cowpeas even 20 ppm Cu could not antagonise Zn.

Zinc absorption by leaves and stems increased with Mo application, similar to the results of Pande *et al.* (1976), who reported that Mo application enhanced the Zn content of straw in the presence of Cu and Zn.

REFERENCES

Berry, Joseph, A. and Reisenauer, H.M. (1967) The influence of molybdenum on iron nutrition of tomato. *Plant and Soil.* 27 : 303-13.

Brar, M. S. and Sekhon, G. S. 1978. Effect of zinc and copper application on the yield and micronutrient content of wheat *(Triticum aestivum). J. Indian Soc. Soil Sci.* 26 : 84-86.

Cheng, B. T. and Ouellette, G. J. 1970. Molybdenum nutrition in oats as affected by organic amendments, nitrogen fertilizers and lime stone. *Naturaliste. Can.* 97 : 535-52.

Cheng, B T. and Ouellette, G. J. 1972. Sugarbeets nutrition. *Soil Sci.* 114 : 55-60.

Chopra, S. L. and Kanwar, J. S. 1976. *Analytical Agricultural Chemistry.* 3rd ed. Kalyani Publisher, Ludhiana.

Dokiya, Y., Owa, N. and Mitsui, S. 1968. Comparative physiological study of iron, manganese and copper absorption by plants. *Soil Sci. Plant Nutr.* 14 : 169-74.

Grigg, J. L. 1953. Determination of molybdenum in soils. *N.Z.Jl. Sci. Technol.* 34A : 405.

Gupta, U. C. and Mackay, D. C. 1966. Procedure for the determination of exchangeable copper and molybdenum in podzol soils. *Soil Sci.* 101(2) : 93-97.

Gupta, V. K. and Mehla, D. S. 1979. Copper, manganese and iron concentration in berseem and copper molybdenum ratio as affected by molybdenum in two types of soils. *Plant and Soil.* 51 : 597-602.

Hanger, B. C. 1965. The influence of iron upon the toxicity of manganese, molybdenum, copper and boron in red clover (*Trifolium Pratanse* L.). *J. Aust. Inst. Agric. Sci.* 31 : 315-17.

Kausar, M. A., Chaudhary, F. M., Rashid, A., Latif, A. and Alam, S. M. 1976. Micronutrient availability to cereals from calcareous soils. 1. Comparative zinc and copper deficiency and their mutual interaction in rice and wheat. *Plant and Soil* 45 : 397-410.

Lindsay, W. L. and Norvell, W. A. 1978. Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.* 42 : 421-28.

Misra, S. G. and Dwivedi, R. S. 1977. Effect of copper-phosphate interaction on the availability of nutrients. *J. Indian Soc. Soil Sci.* 25 : 41-46.

Pande, H. K., Singh, V. P. and Manna, G. B. 1976. Effect of copper, zinc, boron, calcium and molybdenum application on yield and nutrients content of rice. *IL RISO.* : 325-332.

Tanner, P. D. 1977. Toxic effects of Mn on maize as effected by calcium molybdenum application in sand culture. *Rhodesian J. of Agric. Res.* 15 : 25-32.

Younts, S. E. and Patterson, Robert, P. 1964. Copper-lime interactions in field experiments with wheat : yield and chemical composition data. *Agron. J.* 56 : 229-32.

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THE INTELLECTUAL DEVELOPMENT OF CHILDREN AND FAMILY ENVIRONMENT

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ABSTRACT

Several serious problems of intelligence among children are directly or indirectly related to their family environment which needs scientific inquiry.

Efforts were made on 30 bright and dull montassari school going children of the age group of 3 to 6 years to find out relationship if any between the children's Intelligence Quotient and their family environment. This study has exemplified the association between the two. This calls for adequate and cordial relationship of parents with their children.

It is implicitly accepted that personality is a result of the interaction of nature and nurture both Whatever the relative importance of natural potentialities may be, the fact cannot be denied that almost all children possess certain undeveloped potentialities. Besides that, serious problem of intelligence in children is a result of varying factors existing in the family environment. The family environment refers to all external conditions within the home of an individual including all material possessions as well as the persons in the home.

Due to conspicuous lack of scientific information as regards the effect of family environment on intelligence under Indian setting, the present investigation was carried out with the major objective to find out the picture of a typical family environment which might give rise to intellegent or dull children. The family environment in this study included educational status of the family, socio-economic status of the family, various facilities provided at home and parent-child relationship. The intellectual development being very wide in scope was restricted to the Intelligent-Quotient in this piece of research.

MATERIAL AND METHODS

Present investigation was carried out on the nursery classes of montassari school attached to M. H. College of Home Science, Jabalpur on the sample of 30 bright and dull students selected by random sampling procedure within the age range of 3 to 6 years.

For measuring the actual intelligence of a child: (i) Knox cube imitation test, (ii) Goddard form board test and (iii) Draw a man tests were selected The

reliability of the tests were tested on 10 children other than the main sample by split-half method and it was found significant. Afterwards, they were administered on the main sample and the Intelligent Quotient of each child was separately calculated for each test. The mean I. Q. was calculated on the basis of all three tests, for each child. Several categories of I. Q's were found out but reduced to four major ones because of lack of frequency recorded against them. Therefore, for the purpose of analysis four categories were formulated, i.e.,

(i) I. Q. less than 80 — dull
(ii) I. Q. 80 to 120 — average
(iii) I. Q. 120 to 160 — bright
(iv) I. Q. 160 and above — very bright

Family environment of the children was determined by interviewing the parents of these 30 children. The questions relating to educational level of parents, socio-economic status, the various facilities provided to the children for new experiences at home and parent-child relationship were categorised as follows :

(i)	Educational status of the parents	High/Medium/Low
(ii)	Socio-economic status of the parents	High/Medium/Low
(iii)	Material facilities provided at home	Many/Some/Little
(iv)	Parent-child relationship	Good/Ordinary/Poor

The data were analysed and the association between the family environment and Intelligent Quotient of children was established by using chi-square test.

For the purpose of chi-square calculations, I. Q. categories were merged into two row categories, i.e., 80 to 120 and 120 and above and all the low categories of environmental variables with that of medium category in the columns (Table 1). Thus, 2×2 tables were formulated and yates correction was applied as frequencies in the cells were less than 5.

RESULTS AND DISCUSSION

The data in Table 1 indicate that educational status of the parents, socio-economic status of the parents, material facilities provided at home and parent-child relationship were significantly associated with Intelligence Quotient of the children, the value of $x^2 = 13.07$, 8.12, 4.10 and 19.21, respectively. The study reveals the fact that parents education, socio-economic status, facilities provided to children and parent-child relationship were significantly associated with children's I. Q. These were found to be in line with Freeman *et al.* (1928), Skodark (1939), Havighurst (1947) and Anastasi (1958).

This implies the fact that if the children were given adequate environmental facilities, their I. Q. would bound to be affected in positive direction. It was quite logical that educated parents with high socio-economic status provided adequate facilities for their children at home and kept healthy relationship with them for their proper mental development, which was bound to have adverse effect on children in reverse situation. The varied reason might be that the uneducated parents would have poor aspiration for their children's education and due to economic constraints on them, lack of facilities were provided at home and all in combination affected the parent-child relationship. Under such circumstances the mental ability of children got

TABLE 1

Intelligence Quotient of children in relation to their family environment

Intelligence Quotient	Parents' education			Socio-economic status of parents			Facilities provided at home			Parent-child relationship		
	High	Low	Total (N=30)	High	Low	Total (N=30)	Many	Little	Total (N=30)	Good	Poor	Total (N=30)
Less than 120	2	15	17	3	14	17	1	16	17	1	16	17
More than 120	9	4	13	8	5	13	8	5	13	10	3	13
Total	11	19	30	11	19	30	9	21	30	11	19	30
X^2 Calculated	13.07*			8.12*			4.10*			19.21*		

*Significant at 0.05 level with 1 d. F.

affected It is, therefore, suggested that parents should provide adequate facilities to children within their available resources and maintain a cordial relationship with them which should provide the scope for free exchange of ideas as changing parents educationat and socio-economic status drastically is not possible. This will go a long way for the all round development of children's personality.

REFERENCES

Anastasi, Anne, 1958. *Differential Psychology*. 3rd Ed, New York, The Macmillon Company, pp 521.

Freeman, F. N., Holzinger K. J. and Mitchall B. C. 1928. *The influence of environment upon intelligence school achievement and conduct of foster children*, 27th year, Book N. SSF. Part 1. Public School, pp 103, 218.

Havighurst, R. J. and Brease, F. H. 1947. *Relation between ability and social status In Mid-Western community*. III. Primary Mental Abilities *J. Educ. Psychol.* 241-47.

Skodark, Marie, 1939. *Children in foster Homes*, a study of Mental Development University Iowastud, Child Welf. No. 1

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IMPACT OF SOCIO-ECONOMIC FACTORS ON THE BORROWINGS OF INSTITUTIONAL CREDIT

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ABSTRACT

The real cost of credit considerably increased both in Co-operative as well as Commercial Banks. This increase was mainly attributed to the factors such as the amount paid to the officials as bribe and fare and incidental expenses. Co-operative Banks had tendency to exploit the small and medium farmers more than the large farmers but reverse was true for Commercial Banks. The attitudinal analysis showed that the questions such as "one has to do large number of formalities" and "wastage of time and money in persuasion of the loan" were the most important factors against the borrowing of institutional credit. In case of non-institutional credit agencies, all the characters considered had equal importance and due to any one or combination of these characters, the borrowers were bias in favour of borrowing from these agencies. The discriminant analysis showed that the borrowers of Co-operative Banks were those who had higher the area under high yielding crop varieties, expenditure on fertilizers and percentage of earning adults to total adults. But the Commercial Banks' borrowers did investment on machines and equipments besides the expenditure on fertilizers and higher area under high yielding crop varieties.

With the introduction of modern technology in Indian agriculture, the role of institutional credit agencies has increased manifold. In this context, both Co-operative and Commercial Banks have started advancing credit to the farmers in order to meet their operational as well as developmental expenses. Besides, the existence of these institutional credit agencies in the region, non-institutional credit agencies are also playing role in a big way. This necessitates to identify the factors which force the borrowers to get credit from the non-institutional credit agencies even though the credit is available at cheaper rate from institutional sources. In addition to this, the knowledge of the borrower's attitude towards the institutional and non-institutional credit agencies will be of great help to the policy makers in order to develop the region. Specifically, the objectives of the present study were as follows :

(i) to examine the real cost of credit in borrowing institutional and non-institutional credit;

(ii) to study the social factors responsible for non-borrowing of institutional credit, and

(iii) to identify the socio-economic characteristics which discriminate the borrowers from non-borrowers.

METHODOLOGY

(i) **Sampling Design and Collection of Data.** Multi-stage random sampling technique was adopted to select the ultimate unit of the sample. Kurukshetra district of Haryana State was purposively selected to represent a case study. Amongst all the tehsils in the district, one tehsil was randomly selected. Of the total villages in the selected tehsil, six villages were randomly selected. All the farmers of these selected villages were classified into two categories, i.e., borrowers and non-borrowers of the institutional credit agencies in that region. Further, these borrowers were also classified as small, medium and large farmers* on the basis of their operational size of holding. A proportionate number of borrowers from each category was randomly selected. In all, 60 borrowers and 30 non-borrowers were selected. The cross section data from these selected farmers were collected for the year 1977-78.

(ii) **Analytical Technique.** The linear discriminant function of the following form was used to discriminate the socio-economic characteristics of the borrowers and non-borrowers :

$$Z=\sum_{i=1}^{9} l_i X_i$$

where, Z=total discriminant score for borrowers and non-borrowers.

X=Caste, High caste=1, Low caste=0

X_2=Literacy, Literate=1, Illiterate=0

X_3=Operational size of holding in acres.

X_4=Area under High Yielding Crop Varieties (HYV) in acres.

X_5=Area under irrigation in acres.

X_6=Expenditure on fertilizers in rupees/acre.

X_7=Investment on machines and equipments in rupees/acre.

X_8=Income from all sources in rupees.

X_9=Percentage of earning adults to total adults.

l_i (i=1, 2,.....9) are the coefficients of the linear discriminant function.

The method seeks to obtain coefficients (l_i's) such that the squared difference between the mean Z score for the one group and the mean Z-score for the other group is as large as possible in relation to the variation of the Z score within the group**.

The zero order correlation coefficients indicated multi-collinearity between operational size of holding, area under high yielding variety and income from all sources and also between area under high yielding varieties and income from all sources. Therefore, operational size of holding and income from all sources were dropped on the basis of their association with the dependent variable and/or economic logic.

RESULTS AND DISCUSSION

I. **Real Cost of Credit.** Table 1 shows the real cost of short term and long term credit to the small, medium and large farmers from different credit agencies. It is evident from Table 1 that

*In the present study farmers were classified as below :
below 5 acres—small, between 5 and 10 acres—medium, above 10 acres—large.

**For details, see, U. K. Pandey and M. A. Muralidharan, "An Application of Discriminant Function in Agricultural Finance". *Indian Journal of Agricultural Economics*, Vol. 32, No. 2, April-June, 1977 pp. 41-51.

TABLE 1

Agencywise and farm size wise real cost of credit (cost per hundred rupees per year)

S. No.	Items of cost	Co-operative Bank						Commercial Bank						Private Money Lenders					
		Small Farms		Medium Farms		Large Farms		Small Farms		Medium Farms		Large Farms		Small Farms		Medium Farms		Large Farms	
		Short term	Long term	Short term	Long term	Short term	Long term	Short term	Long term	Short term	Long term	Short term	Long term	Short term	Long term	Short term	Long term	Short term	Long term
1.	Membership fee	0.99	1.00	0.94	1.99	0.99	1.59	—	—	—	—	—	—	—	—	—	—	—	—
2.	Number of trips made in getting loan	0.17	0.12	0.21	0.16	0.09	0.16	0.30	—	0.30	0.04	0.31	0.03	—	—	—	—	—	—
3.	Fare and other incidental expenses	0.91	0.38	1.24	0.36	0.70	0.63	1.31	—	0.90	0.52	1.71	0.30	—	—	—	—	—	—
4.	Others as amount paid to clerks etc.	6.99	4.41	6.78	1.08	5.93	1.93	1.24	—	1.08	0.91	1.44	1.20	—	—	—	—	—	—
5.	Amount of interest per one year	11.00	10.50	11.00	10.50	11.00	10.50	11.00	11.00	11.00	11.00	11.00	11.00	36.00	—	30.24	—	24.00	—
	Real cost per year	19.89	16.29	19.96	13.83	18.62	14.65	13.55	11.00	12.98	12.42	14.15	12.50	36.00	—	30.24	—	24.00	—
	Percentage increase over annual rate	80.82	55.14	81.45	32.66	69.77	39.52	23.18	—	18.00	13.00	28.63	13.63	36.00	—	30.24	—	24.00	—

although the short term credit annual rate of interest was same both in Co-operative as well as in Commercial Bank but real cost of borrowing was more in case of Co-operative as compared to Commercial Bank. Among the different items of cost, amount paid to clerks etc. and fare and incidental expenses were the items which increase the real cost of the short term credit. In case of Co-operative Banks, these two items constituted more in case of small and medium farms as compared to large farms while it was higher on large farms for Commercial Banks. This clearly reflects that Co-operative Banks had tendency to exploit the small and medium farmers more than the large farmers. In Co-operative Banks, the real cost of credit increased between 69 and 81 % over the actual rate of interest while in Commercial Banks the increase was between 18 and 29 per cent. Among the institutional and non-institutional credit agencies, the borrowing of credit was cheaper in case of Commercial Banks. Likewise, long term credit real cost increased between 33 and 55% and 13 and 14% in Co-operative and Commercial Banks, respectively. This increase in real cost was attributed to the amount paid to clerks as well as to the fare and incidental expenses.

II. **Borrower's Attitude Towards Borrowing.** The borrower's attitude towards credit has been examined in Table 2. The significant chi-square value with regard to the institutional credit indicated that all the nine characters differed significantly from each other. But non-significant chi-square value for non-institutional credit agency was indicative of the fact that all the seven characters did not differ significantly from each other. This means that all the seven characters had equal importance and due to any one or the combination of these characters, the borrowers borrowed credit from non-institutional credit agency. On the basis of the proportion against borrowing the credit from institutional credit agencies (as indicated in Table 2), the five characters in descending order were tested for their significance. The significant chi-square value (17. 22) indicated that all these five characters again differed significantly from each other. This implies that these questions carried much weightage in testing the attitude of the borrowers against borrowing the credit from institutional agencies. Thus, the questions such as "one has to do a large number of formalities" and "wastage of time and money in persuasion of loan", could be considered as the most important factors against the borrowing of institutional credit. But other questions such as "other family members do not like borrowing", "borrowing brings down the social prestige" and "inadequacy of loan" were less effective in testing the attitude towards borrowing. Thus, because of these five questions, the farmers were bias against borrowing. The implications of this finding are social rather than economic.

III. **Characteristics Discriminating Borrowers from Non-borrowers.** The socio-economic characteristics which discriminate borrowers from non-borrowers were also identified both for Co-operative as well as Commercial Banks. The highly significant D^2 value of the fitted discriminant function in case of Co-operative Bank was indicative of the fact that all the seven characteristics considered in the model for discrimina-

TABLE 2

Borrowers' attitude towards borrowing of credit

Sr. No.	Statement	Proportion of yes to total	Sr. No.	Statement	Proportion of yes to total
A.	**Institutional Credit**		B.	**Non-Institutional Credit**	
(i)	To be in debt is bad.	0.57	(i)	No formalities are required (Formalities)	0.89
(ii)	Borrowing brings down the social prestige.	0.71	(ii)	All types of credit at any time (Flexibility)	0 89
(iii)	Borrowing discourages the habit of thrift.	0.52	(iii)	Adjusts the repayment in bad time.	0.95
(iv)	Borrowing often becomes a habit.	0.57	(iv)	No rigidity in repayment.	0 89
(v)	Borrowing induces indiscriminate and lavish spending.	0.70	(v)	Wins the borrower's confidence.	0.95
(vi)	Other family members do not like borrowing.	0.76	(vi)	Loans are also available in odd time.	0.79
(vii)	One has to do a large number of formalities.	0.95	(vii)	No restriction on maximum credit limit.	0.79
(viii)	Wastage of time and money in the persuasion of loan.	0.95			
(ix)	Inadequacy of the loan.	0.71			
	Value of chi-square	40.06		Value of chi-square	9.47

tion were useful. Further, the relative importance of these characteristics indicated that amongst seven characteristics, the expenditure on fertilizers, area under high yielding crop varieties and percentage of earning adults to total adults were the major characteristics which classified the farmers into the groups of borrowers and non-borrowers. Therefore, the following discriminant function was rerun taking only these three characteristics in the equation to see whether or not these characteristics alone could significantly discriminate the farmers into borrowers and non-borrowers.

$Z=0.0543x_4+0.0106x_6+0.0091x_9$

$n=60$ $D^2=4.2895^{***}$

The above equation indicates that higher the area under high yielding crop varieties, expenditure on fertilizers and percentage of earning adults to total adults would contribute to the higher value of Z and, therefore, placing the farmer into the borrowers category otherwise non-borrowers.

The highly significant D^2 value indicates that the three characteristics considered in the model were useful in classifying the farmers into the groups of borrowers and non-borrowers. In order to know the relative importance of these characteristics in their powers to discriminate between the two groups, their percentage contribution to the total

***Significant at one per cent probability level for $F_{0,50}$.

TABLE 3

Percentage contribution of individual characteristics to the total distance measured

Sr. No.	Characteristics of the farmers	Coefficients (li)	Mean difference (di)	Coefficient × Mean difference (li × di)	Percentage
1.	Area under high yielding crop varieties (X_4)	0.0543	1.40	0.0760	3.67
2.	Expenditure on fertilizers in rupees/acre (X_6)	0.0106	185.10	1.9621	94.74
3.	Percentage of earning adults to the total adults (X_9)	0.0091	3.63	0.0330	1.59
	Total			2.0711	100.00

distance measured was calculated and is given in Table 3.

Table 3 indicates that expenditure on fertilizers was the major characteristic which discriminated borrowers from non-borrowers followed by area under high yielding crop varieties and percentage of earning adults to total adults. These characteristics had their respective discriminating powers to the total distance measured as 94 74, 3 67 and 1.59, per cent.

The discriminant function could be used to predict whether a farmer was likely to be a borrower or non-borrower. The mean value (Z_1) for borrowers was calculated by dividing the means of the variables X_4, X_6 and X_9 by their respective standard deviations and then multiplying these weighted values with their respective coefficients and adding them. Similarly, the mean value (Z_2) for non-borrowers was calculated The mean value (Z_1) for borrowers was 2.1860, whereas the same for non-borrowers (Z_2) was 2.1120. The critical mean value ($\bar{Z}$) for the two groups was 2.1490 and had the same variability for both the groups. Now for any individual farmer, his "Z-score" could be calculated by utilizing the numerical values of the variables X_4, X_6 and X_9 multiplying with their respective coefficients (as indicated in Table 3) and adding them. If this value is more than 2.1490, he is predicted to be a borrower otherwise he is likely to be a non–borrower. Thus, high value of "Z" corresponds to the borrower and vice-versa. This can be shown as below :

Mean "Z" score for non-borrowers (2.1120)	"Z" score separating the two groups (2.1490)	Mean "Z" score for borrowers (2.1860)
←non-borrowers→		← Borrowers→

The same analysis was also done to classify the farmers as borrowers and non-borrowers in case of Commercial Banks. The highly significant D^2 value of the fitted discriminant function indicated that these seven characteristics considered in the equation were useful in classifying the farmers into the category of borrowers and non-borrowers.

Further, the relative importance of these characteristics indicated that amongst seven characteristics investment on machines and equipments, expenditure on fertilizers and area under high yielding crop varieties were the major characteristics of the farmers which classified them into the category of borrowers and non-borrowers. Therefore, the following discriminant function was rerun taking only these significant characteristics in in the equation to see whether they by themselves were sufficiently discriminating.

$Z = 0.1024x_4 + 0.0034x_6 + 0.0027x_7$

$n = 60$ $D^2 = 17.6266^{***}$

The above equation indicates that higher the levels of the area under high yielding crop varieties, expenditure on fertilizers and investment on machines and equipments would contribute to the higher value of Z and, therefore, placing the farmer into the borrowers category otherwise non-borrowers.

The highly significant D^2 value indicates that these three characteristics considered in the model were useful in classifying the farmers into the groups of borrowers and non-borrowers. In order to see the relative importance of these characteristics with regard to their powers to discriminate the two groups of farmers, their percentage contribution to the total distance measured was calculated and is given in Table 4.

Table 4 shows that investment on machines and equipments was the major characteristic of the farmers which discriminated them into two groups, i.e., borrowers and non-borrowers, followed by expenditure on fertilizers and area under high yielding crop varieties. These characteristics had their discriminating powers as 75.93, 17.70 and 6.37%, respectively. Thus, it was revealed by the discriminant analysis that whether a farmer was applying for the loan in Co-operative or Commercial Banks, two characteristics, i.e., area under high yielding crop varieties and expenditure on fertilizers were similar to be a borrower but percentage of earning adults and investment on machines and equipments were other factors responsible to be the borrower in Co-operative and Commercial Banks, respectively.

TABLE 4

Percentage contribution of individual characteristics to the total distance measured

Sr. No.	Characteristics of the farmers	Coefficients (li)	Mean difference (di)	Coefficient × Mean difference (li × di)	Percentage
1.	Area under High Yielding Crop Varieties (X_4)	0.1024	2.61	0.2673	6.37
2.	Expenditure on fertilizers in rupees/acre (X_6)	0.0034	218.60	0.7432	17.70
3.	Investment on machines and equipments in rupees/acre (X_7)	0.0027	1180.70	3.1879	75.93
	Total			4.1984	100.00

***Significant at one per cent probability level for $F_{1,53}$.

The above discriminant function could be used to predict whether a farmer was likely to be a borrower or non-borrower. The mean value (Z_1) for borrowers was 3.1220 while the same for non-borrowers (Z_2) was 2.9780. The critical mean value (Z) was 3.0490 which were calculated in the same manner as mentioned earlier in case of Co-operative Banks. Thus, the high value of "Z" corresponds to the borrower while low value to the non-borrower. This can be illustrated as below :

Mean "Z" score for non-borrowers (2.9780)	"Z" score separating the two groups (3.0490)	Mean 'Z" score for borrowers (3.1220)
← Non-borrowers→		← Borrowers →

CONCLUSIONS AND POLICY IMPLICATIONS

The above analysis indicated that the real cost of credit had considerably increased both in Co-operative as well as Commercial Banks. This increase in the real cost of credit was mainly attributed to the factors such as the amount paid to the officials as bribe and fare and incidental expenses. The Co-operative banks had tendency to exploit the small and medium farmers more than the large farmers but reverse were true for Commercial Banks. The attitudinal analysis showed that the questions such as "one has to do large number of formalities" and "wastage of time and money in persuasion of loan" were the most important factors against the borrowing of institutional credit. The questions such as "other family members do not like borrowing", "borrowing brings down the social prestige" and "inadequacy of loan" were also responsible to have the farmer's bias against the borrowing from the institutional credit agencies. In case of non-institutional credit agencies, all the characters considered had equal importance and due to any one or combination of these characters, the borrowers were bias in favour of borrowing from these agencies. The discriminant analysis indicated that the borrowers of Co-operative Banks were those who had higher the area under high yielding crop varieties, expenditure on fertilizers and percentage of earning adults to the total adults. On the contrary, the Commercial Banks borrowers were those who did investment on machines and equipments besides the expenditure on fertilizers and area under high yielding crop varieties.

The policy implications of the findings in this study are that both Government as well as Reserve Bank of India must play active role in checking the increase in real cost of credit. Besides this, the institutional credit agencies must reduce the large number of formalities as well as wastage of time and money in borrowing the credit, so that they can become more popular amongst borrowers. In order to increase the borrowing of institutional credit the extension agencies must play active role in educating the farmers to adopt the improved technology of agriculture.

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EFFECT OF GROWTH REGULATORS AND PRE—PACKAGING ON THE STORAGE LIFE OF OKRA

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ABSTRACT

Post-harvest studies on okra *cv.* Pusa Sawani were carried out using 100 and 250 ppm of GA, ascorbic acid (AA) and cycocel (CCC) alongwith pre-packaging at 32±2°C and 10±1°C. Okra fruits treated with GA and AA alongwith polyethylene-packaging had a shelf-life of 9 days and 12 days at high and low temperature, respectively. Physiological loss in weight was also reduced without imparing the quality and general appearance in storage. Further, it was also noted that GA and AA helped to retain chlorophyll 'a' and 'b' pigments for a prolonged period and thus, delayed the senescence of okra fruits *In vitro*.

Okra fruits, if stored at edible stage at room temperature, deteriorate rapidly owing to the rapid moisture loss, and degradative changes resulting in shrivelling and poor quality of fruits. These degradative changes may be retarded by using growth regulators such as gibberllin (Beevers, 1966; Fletcher and Osborne, 1965 and Singh *et al*, 1970), ascorbic acid (Tonzig and Marre, 1961; Price, 1966 and Garg and Kapoor, 1972), CCC and B 9 (Halevy and Wittwer, 1965 and Singh *et al.*, 1978). Information on methods to prolong the shelf-life of okra is very meager. It was, therefore, considered essential to study the effect of growth regulators and poly-ethylene bagging on harvested okra fruits as a anti-senescent agent to prolong the shelf-life.

MATERIAL AND METHODS

Freshly harvested tender-green okra fruits of uniform age and size (*cv.* Pusa Sawani) obtained from Vegetable Research Farm, Haryana Agricultural University, Hissar, were used for the experiment. Prior to treatment, fruits were washed and excess water was allowed to evaporate from the fruit surface. Following treatments were given as dip for 10 minutes; (i) Control-dipped in distilled water and packed in paper bags; (ii) Polyethylene (100 gauge of thickness)—dipped in distilled water as in control; (iii) and (iv) GA 100 and 250 ppm; (v) and (vi) Ascorbic acid—100 and 250 ppm; (vii) and (viii) Cycocel—100 and 250 ppm, respectively. All these treated fruits were then divided into two equal sub-lots separately treatmentwise. One lot of each treatment was kept at room temperature (32±2°C) and another lot was kept at low temperature (10±1°C). Each treatment was replicated four times with 1 Kg. fruits in each replication. Treated fruits were packed in polyethylene bags and non-

treated fruits of control were kept in same size of bags which were not sealed. General appearance and cumulative loss in weight were recorded at an interval of three days and loss in weight was expressed in percentage. General apperance and consumers acceptability was evaluated subjectively at orbitrary grades ranging from 0 to 5, where 0 was excellent (equivalent to freshly harvested), 1-Good, 2-Fair, 3-Poor, 4-Unacceptable and 5-Badly deteriorated.

Estimation of chlorophyll 'a', 'b' and carotencid (C) was done in okra peel according to the method described by Mahlberg and Venketeswarn (1966) and each component of pigment was calculated by the formulae given by Robbelens (1957). Per cent pigment retention was calculated on initial value at different stages of storage.

RESULTS AND DISCUSSION

General appearance. During storage, shrivelling, yellowing and loss in turgidity followed by dehydration and blackening on ridges of the okra fruits which were kept as control. These changes were observed within 2–3 days, whereas pre-packaged fruits treated with various growth regulators were free from these defects. Severe shrivelling, loss in turgidity and dehydration of fruits were mainly due to higher moisture loss, and yellowing of fruits might be due to degradation of chlorophyll. Whereas fruits packed in polyethylene bags, treated with various growth regulators remained fresh and retained greater percentage of chlorophyll pigments with a shelf-life of 8-9 days (Table 1). Similarly, packaging alongwith various growth regulators also extended the shelf-life up to 12 days when fruits were stored at 10±1°C.

Data presented in Table 2 revealed the significant reduction in per cent cumulative weight loss in all treated and pre-packaged fruits over control at all stages (Table 2). Of various treatments, ascorbic acid 250 ppm alongwith pre-

TABLE 1

Effect of growth regulators and pre-packaging (P) on the general appearance of Okra fruits

Treatments mg/l.	Storage life in days								
	Room temperature (32±2°C)				Low temperature (10±1°C)				
	0	3	6	9	0	3	6	9	12
Control	0	3	5	5	0	0	1	3	4
P	0	1	2	3	0	0	0	2	3
GA 100+P	0	1	2	3	0	0	0	1	2
GA 250+P	0	1	2	2	0	0	0	1	2
AA 100+P	0	1	2	2	0	0	0	1	2
AA 250+P	0	1	1	1	0	0	0	1	2
CCC 100+P	0	1	2	3	0	0	0	2	3
CCC 250+P	0	2	3	3	0	0	1	2	3
Mean	0	1.37	2.50	2.87	0	0	0.12	1.62	2.62

TABLE 2

Effect of growth regulators and pre-packaging (P) on per cent cumulative loss in weight of okra under storage

Treatments mg/l.	Per cent cumulative loss in weight						
	Room temperature (32±2°C) Storage life in days			Low temperature (10±1°C) Storage life in days			
	3	6	9	3	6	9	12
Control	20.60	42.26	61.53	1.56	7.00	16.02	30.90
P	1.86	4.66	9.70	0.85	3.02	5.66	9.16
GA 100+P	1.56	5.00	10.06	0.77	1.90	4.59	6.98
GA 250+P	1.30	6.30	11.60	1.02	2.22	5.14	7.62
AA 100+P	1.53	4.16	9.50	0.81	1.98	4.30	7.43
AA 250+P	1.16	3.90	8.03	1.15	2.43	5.28	7.51
CCC 100+P	0.90	4.70	12.53	0.68	1.79	4.58	7.86
CCC 250+P	1.30	10.13	16.76	0.81	1.85	4.90	7.17
Mean	3.77	9.51	17.46	0.98	2.54	6.30	9.68
C. D. at 5%	Treatment	Days	Treatment×days	Treatment	Days	Treatment×days	
	1.234	0.758	2.136	0.327	0.231	0.656	

packaging reduced the per cent weight loss significantly as compared to GA 250 ppm and pre-packaging (P); CCC 100 ppm+P; and CCC-250 ppm+P. However, other treatments did not bring significant reduction in per cent weight loss. Similar findings of pre-packaging in bean and okra have also been reported by other workers (Anandaswamy and Iyengar, 1961 and Anandaswamy *et al.*, 1963 and Singh *et al*, 1979) Regarding hormones, no such work has been done in relation to loss in weight with reference to vegetables.

A low temperature storage (10±1°C), okra fruits exhibited gradual per cent weight loss and remained in acceptable condition for a longer period than at room temperature in control as well as in various treatments (Table 2). Chemically treated fruits exhibited minimum weight loss significantly over pre-packaged and control.

Pigments. The per cent retention of chlorophyll 'a' and 'b' went on decreasing in control as compared to treated fruits stored at both room and low temperature conditions throughout the storage period (Table 3). Among various treatments, pigments were retained more in AA 250 ppm+P followed by AA 100 ppm+P; GA 100 ppm+P; GA 250 ppm +P; CCC 100 ppm+P and CCC 250 ppm+P, respectively, at both temperatures. Thus, it is quite possible that the presence of CO_2 in polyethylene bags released from fruits and various anti-senescent agents like AA, GA and CCC were an important factor in retention of chlorophyll of okra fruits. Garg and Kapoor (1972) also advocated that ascorbic acid (AA) retarded the leaf senescence of brinjal leaf discs by the arrest of the fall in level of chlorophyll, DNA, RNA and proteins. Fletcher and Osborne (1965) also recorded a retardation in senescence by GA

TABLE 3

Effect of growth regulators and pre-packaging on the per cent retention of various pigments (Y units/g F. W. *okra peel) during storage at room* temperature (32±2°C) and low temperature (10±1°C) conditions

Treatment mg/l.	Storage life in days											
	Room Temperature						Low Temperature					
	3 days			9 days			3 days			12 days		
	Chloro 'a'	Chloro 'b'	C	Chloro 'a'	Chloro 'b'	C	Chloro 'a'	Chloro 'b'	C	Chloro 'a'	Chloro 'b'	C
Control	48.92	45.28	86 86	19.78	28.27	43.79	55.26	48.06	78.61	25 00	27.38	46.71
P	59.37	53.58	83.94	37.76	40.37	49.75	75.28	60.89	70.11	39.98	37.37	52.55
GA 100+P	76.25	82.26	74.89	46.70	52.90	72.99	85.46	76.76	60.49	71.25	52.03	57.94
GA 250+P	74.20	78.49	73.88	46.18	45.35	73.16	78.12	86.69	76.33	71.17	52.83	47.00
AA 100+P	75.25	75.47	66.27	47.25	45.75	64.08	87.94	86.03	80.39	74.37	63.67	87.91
AA 250+P	75 25	73.96	67.47	47.25	53.81	64.37	82.50	89.43	64.89	76.25	70.33	74.45
CCC 100+P	58.72	74.21	65.25	36.90	43.81	62.77	75.62	84.52	69.86	55.03	59.11	72.99
CCC 250+P	56.25	62.77	77.63	32.11	36.83	50.90	75.62	67 93	71.09	51.15	51.29	54.93

Initial Value Chlorophyll 'a' — 160.0Y units/g. F. W. Okra peel.
Chlorophyll 'b' — 132.5Y -do-
Carotenoid C — 68.5Y -do-

in *Taraxum* and they attributed it with the maintenance of DNA as a functional template for DNA dependent synthesis of RNA. Similar reports have also been made by Beevers (1966) in *Nasturtium* discs, Eilati *et al.* (1969) in orange peel, Dostal and Leopold (1967) in tomato. Holl (1977) also reported that gibberellins delayed the degradation of chlorophylls in orange and tomato fruits.

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REFERENCES

Anandaswamy, B. and Iyengar, N. V. R. 1961. Pre-packaging of fresh snap beans *(Pyaseolus vulgaris). Food Sci.* (Mysore) **10** : 279.

Anandaswamy, B., Viraktamath, C. S., Subbarao, K. R., Suryanarayana, B. N., Iyengar, N. V. R. and Srivastava, H. C. 1963. Pre-packaging of fresh produce IV. Okra *(Hibiscus esculentus). Food Sci.* (Mysore) **12** : 332.

Beevers, L. 1966. Effect of gibberellic acid on the senescence of leaf discs of nasturtium *(Tropaeolum majus). Pl. Physiol;* **41** : 1074-76.

Dostal, H. C. and Leopold, A. C. 1967. Gibberellin delays ripening of tomatoes. *Science* **158** : 1579-80.

Eilati, S. K., Goldschmidt, E. E. and Monselise, S. P. 1969. Hormonal control of colour changes in orange peel. *Experimentia* 25 : 209.

Fletcher, R. A. and Osborne, D. J. 1965. Regulation of protein and nucleic acid synthesis by gibberellins during leaf senescence. *Nature* **207** : 1176-77.

Garg, O. P. and Kapoor, V. 1972. Retardation of leaf senescence by ascorbic acid. *J. Expt. Botany* 23 : 699-703.

Halevy, A. H. and Wittwer, S. H. 1965. Effect of growth retardants on longevity of vegetables, mushrooms and cut lowers. *Proc. Am. Soc. Hortic. Sci.* 88 : 582-90.

Holl, W. 1977. Fruit ripening plant Res development 5 : 117-26. (Gibberellins delay degradation of chlorophylls in orange and tomato fruits).

Mahlberg, P. G. and Venketeswarn, S. 1966. Pigment analysis of normal and proliferated genetical strains of *Nicotiana* under cultural conditions. *Bot. Gaz.* **127** : 114-19.

Price, G. E. 1966. Ascorbate stimulation of RNA synthesis. *Nature* **212** : 1481.

Robbelens, G. 1957. Eine Blattfarbmutante chne chlorophyll "b von" *Arabidopsis thaliana* (L.) *Heynth Naturwiss* **44** : 288-90.

Singh, B. P., Bhatnagar, D. K. and Gupta, O. P. 1978. Effect of growth retardants and wax emulsion on the shelf-life of Okra (*Abelmoschus esculentus* (L.) Moench). *Haryana J. Hortic. Sci.* 7 (1-2) : 91-94.

Singh, B. P., Dhankhar, B. S. and Pandita, M.L. 1979. Pre-packaging of Okra. *Haryana J. Hortic. Sci.* (accepted).

Singh, O. S., Gangwar, R. P. and Dhillon, B. S. 1970. Regulation of fruit ripening in guava by gibberellic acid. *Trop. Agriculturist.* 126 : 85-89.

Tonzig, S., and Marre, E. 1961. Ascorbic acid as a growth hormone. In *4th Int. Conf. Plant Growth Regulation.* Iowa State University Press, Ames, Iowa, USA. PP : 725-34.

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POTENTIOMETRIC STUDY OF AMINOPYRIDINES COMPLEXES

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(Received : April 15, 1980)

ABSTRACT

The formation of Be (II), Mn (II) and Cr (III) complexes with aminopyridines have been determined by pH method. Formation constants of the complexes have been calculated by Irving-Rossotti's method. The formation constants have been correlated with the basicities of the ligands. The possibility of π-bonding is also explored.

Be (II), an alkaline earth metal, forms a number of complexes because of its small size. It does not possess any d-orbital. In case of Mn (II), the sub-shell d is half-filled while there are three electrons in case of Cr (III). The present investigation was undertaken to work out the formation constants in a reaction of aminopyridines with Be (II), Cr (III) and Mn (II) to study the effect of $d\pi - p\pi$ M-L bonding.

MATERIAL AND METHODS

The metallic salts were all B. D. H. (A. R. quality) and organic bases were E. Merck (Pure-quality). The purity of the compounds was checked by the usual methods. A Hungarian pH meter type OP 201/1 was used to record pH which read pH upto an accuracy of $\pm$ 0.05. The titrations were carried out at 25°C $\pm$ 0.1°C. The results are recorded in Tables 1 and 2.

TABLE 1

Acid sissociation constants at 25°C

Ligands	Experimental pKa	Literature* values
2-aminopyridine	7.1	7.2
3-aminopyridine	6.6	6.6
4-aminopyridine	8.95	9.9

TABLE 2

Formation constants of complexes at 25°C (Log K values)

Metal ions	Ligands		
	2-aminopyridine	3-aminopyridine	4-aminopyridine
Be (II)	4.4	4.69	6.23
Mn (II)	2.72	3.50	3.85
Cr (III)	4.75	5.30	7.69

RESULTS AND DISCUSSION

Direct potentiometric titrations of the metal salts solutions with aminopyridines showed break at 1 : 1 indicating that for every mole of metal ion one mole of ligand was used. The stabilization of metal ion through coordination with a complexing agent greatly increased its resistance to hydrolysis and made it possible to keep the metal ion at higher pH than would otherwise be possible. After the formation of 1 : 1 complex, further addition of ligand caused hydrolysis.

The acid dissociation constants are quite in agreement with the values already reported. 3-aminopyridine has lesser basicity as it cannot exist in resonating forms as 2— and 4— forms can.

The formation constants of 2-aminopy ridine were lower due to steric effect caused by the amino group. The complexes with 4-aminopyridine had the highest formation constants values. Thus, formation constants were in accordance with the basicities of the ligands. The order of stability was $Cr^{3+} > Be^{2+} > Mn^{2+}$. Cr (III) and Mn (II) belong to the same transition series. But Cr (III) formed more stable complexes than Mn (II) complexes. This might be due to higher charge on the chromium ion. Another possibility was that there could be contribution from the M-L II interaction Because of the resonating structure of pyridine, pyridine and its derivatives had appreciable tendency to accept electrons from the metal ions. In the Cr (III) complexes, therefore, there might be M-L $d\pi$—$p\pi$ interaction. Thus, the synergic effect stabilized the M-L bonds and yielded stable chromium complexes. The π interaction was probably not enough to bring in the required crystal field splitting to overcome the high pairing energy in the half-filled d shell of Mn(II). This accounted for the lower stability of Mn (II) complexes. The smaller size of Be (II) was responsible for greater stability of beryllium complexes over Mn (II) complexes.

REFERENCES

Albert and Goldacre, 1944. *Nature*, 153, 468.

Chemistry of Co-ordination compounds, Bailer, 1956, (American Chemical Society monographs series 131) New York, Reinhold Pub. Co. P 199-202.

Irving and Rossotti, 1954. The calculation of formation curves in Metal Complexes from pH Titrations curves in mixed solvents. *J. Chem.* Soc. 2904.

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RESPONSE OF LATE BARLEY TO LIMITED WATER SUPPLY AND FERTILIZER

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(Received : November 20, 1978; Revised : May 15, 1980)

An experiment was conducted during *rabi* 1975-76 to 1977-78 to study the effect of irrigation and nitrogen-phosphorus fertilization on barley variety, B. G. 105 newly released for late plantings in Haryana. The soil was sandy loam, low in available nitrogen and organic matter, medium in available phosphorus, high in available potash and slightly alkaline in reaction. The average available water per 30 cm soil was 5.4 cm at field capacity.

The treatments comprised of two frequencies of irrigation based on critical stages concept as main plots; (i) irrigation at late tillering designated as I_1, (ii) irrigation at late tillering and flowering designated as I_2 and two levels of NP; (i) two-third recommended 40 kg N+20 kg P_2O_5/ha designated as F_1 and (ii) recommended 60 kg N + 30 kg P_2O_5/ha designated as F_2 as sub-plot treatments. Every year the crop was grown from the last week of December to the last week of March with a pre-sowing irrigation and each post-plant irrigation was 7 cm deep. Growing season precipitation amounted to 3.89, 1.82 and 9.89 cm in the first, second and third year, respectively.

Data in Table 1 show that irrigation both at tillering and flowering always increased the grain yield of barley over the only irrigation at late tillering but the effects were non-significant consistently. However, the 3-year mean grain water-use-efficiency for the I_1, treatment was higher (92 kg/ha cm) as compared to the I_1 treatment which recorded a value of 82 kg/ha per centimetre of water. Irrigation did not influence the nitrogen content of grain.

The low response to irrigation as observed on grain yield could probably be due to sufficient (20 cm) available water in the 120 cm soil profile at seeding and vitiating effect of growing seasons precipitation which provided fairly humid conditions to help the crop in tiding over the period of stress, if any, under the low water regime I_1.

These results do not outwardly contribute much and are of little practical value in raising the level of barley production. However, this work points to the lower water needs of this variety. The findings of Mathur and Singh (1968), Oswal and Singh (1968) also lend support to the view point that

TABLE 1

Grain yield & nitrogen content as influenced by irrigation & fertilizers

Treatment	Grain yield (q/ha)				Grain
1975-76	1975-76	76-77	77-78	Mean	nitrogen (%) 1976-77
Irrigation					
I_1	23.59	19.90	29.91	24.46	1.78
I_2	26.21	22.48	30.67	26.45	1.81
C.D. 5%	N.S.	N.S.	N.S.	—	N.S.
Fertilizer					
F_1	23.49	19.54	29.00	24.00	1.80
F_2	26.30	22.84	31.65	26.93	1.79
C.D. 5%	1.74	2.37	N.S.	—	—

barley can be grown with lesser amount of water.

The results reveal that fertilizer F_2 increased the per hectare grain yields of barley by about 11, 17 and 9 % in the first, second and third years, respectively. The differences between the two fertilizer levels were also significant in the first and second years. The 3-year mean production economics revealed that treatment F_2 covered not only the cost of extra nutrients but also yielded a net profit to the extent of Rs. 123/- per hectare. The two fertilizer levels, however, did not differ in their impact on the nitrogen content of grain.

In conclusion, the three-years work suggests that in the event of 5-10 cm rainfall and on a soil able to hold about 20 cm available water in the 120 cm profile at seeding, only one irrigation at late tillering and an application of 60 kg N with 30 kg P_2O_5 per hectare is sufficient for planting barley variety B. G. 105 towards the end of December. Malik (1975), however, recommended two irrigations for normally planted barley variety C 164.

The work was carried out under the scheme on Water Management and Salinity sponsored by the I.C.A.R. The help is gratefully acknowledged.

REFERENCES

Malik, B. S. 1975. Water and nitrogen for barley. *Har. Farm.* Nov., 1975.

Mathur, N. K. and Singh R. P. 1968. A note on the effect of irrigation with & without nitrogen on the growth, yield & quality of barley. Proc. Sym. Wat Mngt. Indian Soc. Agron and I.C.A.R. pp. 147-150.

Oswal, M. C. and Kanwar Singh 1978. Response of different crops to limited water supply. National Sym. Non-monetary inputs in Field Crop Production. Indian Soc. Agron.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 407—409 (September 1980)

POST-HARVEST LOSSES CAUSED BY PAINTED BUG *(BAGRADA CRUCIFERARUM* KIRK.*)* TO MUSTARD

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Mustard crop is attacked by a number of insects-pests. Painted bug *Bagrada cruciferarum* Kirk. is one of the serious pests of this crop in India. Both, nymphs and adults attack the crop at all stages of its growth. They suck the cell sap from the leaves, stems, pods and seeds. During the year 1974–75, there was heavy attack of the painted bug on the harvested mustard crop *(Brassica juncea)* around Hissar. Both, nymphs and adults were found clustered in thousands on the pods and stems of the harvested crop on the thrashing floor. A study was, therefore, carried out to find the post-harvest losses in the form of reduced seed weight, percentage reduction in oil and other components of the mustard seeds.

During April, 1974–75, when there was a heavy attack of painted bug on mustard variety RL 18, 16 bundles of almost equal size were taken at random. Eight bundles were kept in the field exposed to the attack of painted bug and other 8 bundles were treated with BHC 10% dust. After 20 days, 200 gram of seeds were taken at random from each bundle. The samples halved and rehalved untill small samples of about 1500 seeds were left, and of these 1000 random seeds were counted and weighed to calculate the reduction in seed weight.

During the year 1975–76, two variety of mustard, namely, RL 18 and Parkash were taken. Five bundles of each variety

TABLE 1

Post-harvest losses (weight) caused by *(B. cruciferarum* Kirk.) on mustard variety RL 18 (1974-75)

Samples	Weight of 1000-seeds (gm)		Percentage reduction in seeds weight
	Protected	Damaged	
1.	2.90	2.25	22.41
2	3.05	2.00	34.43
3..	3.16	1.95	38.10
4.	3.55	2.60	26.76
5.	3.45	2.25	34.76
6.	2.95	2.45	16.95
7.	2.45	2.35	4 08
8.	2.65	2.00	24.53
Total	24.15	17.85	—
Average	3.19	2.23	30.09
't' calculated	6 19		
't' table value at 5%	2.145		

TABLE 2

Post-harvest losses due to *B. cruciferarum* on mustard varieties RL 18 and Parkash

Variety	Oil (%)		Protein (%)		Sugar reducing		Total sugars (%)		Allylisothiocunate		Iodine value		F. F. A. (%)	
	H	D	H	D	H	D	H	D	H	D	H	D	H	D
RL 18														
Average	38.75	36.21	25.19	21.90	4.69	3.47	10.12	7.08	0.488	0.488	104	104	0.62	1.74
Average loss	2.54		3.29		1.22		3.04		NIL		NIL		1.12*	
Prakash														
Average	38.94	34.99	25.36	21.52	3.56	4.55	10.10	7.27	0.484	0.496	103.8	103.6	0.61	1.74
Average loss	3.95		3.84		0.99		2.83		0.012		0.20		1.13*	
Average loss in both	3.24		3.56		1.10		2.93		0.006		0.10		1.12*	

*Instead of loss there was increase in free fatty acids percentage.

H=Healthy seed; D=Damaged seeds.

were kept exposed to the pest attack and 5 others were treated with BHC 10 % dust (a thin layer of BHC on the bundles just to keep away the painted bug) as in the previous year. After 20 days of the treatment, 200 gram samples were brought to the oilseeds quality testing laboratory. These were dried at 80°C, grinded and sealed in glass vials. Oil, allylisothiocynate, free fatty acids and iodine values were determined by the methods of A. O. A. C. (1960). Nitrogen was estimated by conventional Kjedhal's method and crude protein was calculated by multiplying the figures for nitrogen content with 6.25. Reducing sugars and total sugars were estimated by the method of Hulme and Narain (1931).

The data for 1974-75 are presented in Table 1. The data showed a significant loss in the weight of the damaged seeds. The average weight of 1000 seeds in protected lot was 3.19 gm as against 2.23 gm in the damaged lot which means a reduction of 30.9 per cent.

The data for the year 1975–76 (Table 2) revealed that the oil content in the protected lots of varieties RL 18 and Parkash was 38.75 and 38.94%, respectively against 36.21 and 34.99 % in the damaged lots. On an average, the damaged seeds had 3.25 % less oil. This observation confirmed the findings of Batra (1958) who reported a loss of 4.5 per cent. The difference in the reducing sugars in the protected and non-protected samples was 1.10 per cent. There was a reduction of 3.56% in protein content and 2.93% in total sugars. Allylisothiocynate remained unaffected which might mean that this component was not taken by the insect. Iodine value also remained unaffected.

Free fatty acids, were estimated as 0.62% in RL 18 and 0.61% in Parkash in healthy seeds as against 1.74% in damaged seeds of both the varieties. This might be due to effect of saliva, released by the bugs during feeding, on the seeds of mustard crop which needs further investigation.

Bagrada cruciferarum Kirk. appeared as a serious pest on the harvested crop of mustard during 1974–75 and 1975–76. Observations were recorded on the weight and chemical constituents of the damaged and healthy grains. On an average the loss was 30.09% in weight of damaged seeds 2.75% in oil content, 3.56% in protein, 1.11% in reducing sugars and 2.93% in total sugars. Allylisothiocynate and iodine value remained unaffected. Free fatty acids increased by 1.12 per cent.

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REFERENCES

A. O. A. C. 1960. *Official methods of Analysis*, 7th Ed. Washington, Association of Official Agricultural Chemist.

Batra, H. N. 1958. Bionomics of Bagrada cruciferarum Kirkldy (Heteroptera : Pentatomidae) and its occurrence as a pest of mustard seeds. *Indian J. Entomol.* 20 : 1930

Hulme, A. C. and Narain, R. 1931. The ferricyanide method for the determination of reducing sugars. A modification of Hegedorn Jensen Homes technique. *Biochem. J.* 25 : 1051.

RESEARCH NOTE

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RECORD OF SOME THRIPS OF HISSAR (HARYANA)

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There is very little information on the thrip fauna of Haryana and so for only *Haplothrips ganglbaueri* has been reported on Sudan grass, *Sorghum sudanese* (Lakra and Bhanot, 1976). Thrips infesting 27 different host plants, representing 15 field and fodder crops, 4 vegetables, 4 fruit trees and 4 ornamental plants, at Hissar were, therefore, collected during the period November, 1972 to February, 1979. The collections were made in glass vials containing 70% alcohol. The intensity of the pest was considered heavy when large thrip populations were observed in each plant/plant part and the adoption of control measures was felt necessary. When small insect populations were present resulting in slight damage to plants/plant parts, the pest intensity was classified as medium. The intensity was considered as negligible to mild when only a few individuals were available from several host plants and there were no symptoms of damage Since, as many as 4 thrip species infested a single host plant, it was rather difficult to determine the intensity of attack of the individual species. The classification of pest intensity, in such cases, represents the cumulative damage by all the thrip species present.

RESULTS AND DISCUSSION

There was a wide variation in the number of host plants attacked by the 19 species of thrips (Table 1), it being 7 for *Megaleurothrips distalis*, 5 for *Thrips hawaiensis* and *Haplothrips ganglbaueri* each, 4 for *Caliothrips indicus* and *Thrips flavus* each, 3 for *Frankliniella schultzei*, 2 for *Aelothrips collaris*, *Anaphothrips sudanensis*, *Rhipiphorothrips cruentatus* and *Scirtothrips dorsalis* each, and 1 for each of the remaining 9 species. Host-wise there were 4 species of thrips on groundnut, hyacinth bean and sunflower each, 3 species on bottle gourd, *moong* bean and *sarson* each, 2 species on cotton, *jaman*, onion and wheat each, and 1 species on each the remaining 17 host plants.

Of the 27 host plants examined, only 4 exhibited medium to heavy intensity of attack by one or the other thrip species. These host plants and the thrips associated with them were grapevine-*Haplothrips ganglbaueri*, maize-*Anaphothrips sudanensis*, onion-*Haplothrips ganglbaueri* and *Thrips tabaci*, hyacinth bean-*Haplothrips clarisetis*, *Megaleurothrips distalis*, *Thrips flavus* and *Thrips hawaiensis*.

TABLE 1

Thrip species collected from different host plants at Hissar (Haryana)

Thrip species	Host plant	Date collected
1	2	3
FAMILY AEOLOTHRIPIDAE		
Aeolothrips collaris Prisener	*Sarson* (inflorescence), *Brassica campestris*	Feb., 1978
	Sunflower (flower), *Helianthus annuus*	March, 1978
FAMILY THRIPIDAE		
Anaphothrips sudanensis Trybom	Wheat (ear), *Triticum aestivum*	April, 1973
	Maize (leaf), *Zea mays*	April, 1973
		May, 1978
Caliothrips indicus (Hood)	Pea (leaf), *Pisum sativum*	Nov., 1972
	Lucern (leaf), *Medicago sativa*	June, 1973
	Groundnut (leaf), *Arachis hypogaea*	Aug., 1973
	Sunflower (flower), *Helianthus annuus*	Aug., 1976
Frankliniella schultzei (Trybom)	*Moong* bean (leaf), *Phaseolus aureus*	July, 1977
	Groundnut (leaf), *Arachis hypogaea*	Aug.,. 1977
	Bottle gourd (leaf), *Lageneria siceraria*	June, 1978
Megalurothrips distalis (Karny)	Hyacinth bean (leaf), *Dolichos lablab*	Feb., 1973
		May, 1976
		April, 1977
		Feb., 1979
	Dhaincha (flower), *Sesbania cannabina*	Jan , 1976
	Pigeon pea (flower), *Cajanus indicus*	Jan., 1976
	China rose (flower), *Hibiscus rosa-sinensis*	March, 1976
	Rose (flower), *Rosa indica*	June, 1976
	Moong bean (leaf), *Phaseolus aureus*	July, 1977
	Groundnut (leaf) *Arachis hypogaea*	Aug., 1977
Microcephalothrips abdominalis (Crawford)	Marigold (flower), *Tagetes erecta*	May, 1976
Rhipiphorothrips cruentatus Hood	Pomegranate (leaf), *Punica granatum*	Dec., 1972
	Jaman (leaf), *Syzygium cumini*	June, 1978
Scirtothrips dorsalis Hood	Groundnut (leaf), *Arachis hypogaea*	Aug., 1977
	Chillies (leaf), *Capsicum frutescens*	Sept., 1978
Sorghothrips jonnaphilus (Ramakrishna)	Sorghum (leaf), *Sorghum vulgare*	June, 1976
Taeniothrips sp.	Castor (leaf), *Ricinus communis*	April, 1977
Thrips flavus Schrank	*Moong* bean (leaf), *Phaseolus aureus*	April, 1974
	Hyacinth bean (leaf), *Dolichos lablab*	April, 1977
	Sarson (inflorescence), *Brassica campestris*	Feb., 1978
	Bottle gourd (leaf), *Lageneria siceraria*	June, 1978
Thrips hawaiensis (Morgan)	Hyacinth bean (inflorescence), *Dolichos lablab*	April, 1977
		Feb., 1979
	Guava (leaf), *Psidium guajava*	April, 1977
	Sarson (inflorescence), *Brassica campestris*	Feb., 1978
	Sunflower (flower), *Helianthus annuus*	March, 1978
	Cotton (flower), *Gossyplum hirsutum*	July, 1978
Thrips, tabaci Lindeman	Onion (flower & leaf), *Allium cepa*	April, 1973
		March, 1977

1	2	3
FAMILY PHLAEOTHRIPIDAE		
Haplothrips sp.	Wheat (ear), *Triticum aestivum*	April, 1973
Haplothrips andresi Priesner	Bottle gourd (Leaf), *Lagenerla siceraria*	June, 1978
Haplothrips clarisetis Priesner	Hyacinth bean (inflorescence), *Dolichos lablab*	April, 1977
Heprothrips euphorbiae Priesner	Sunflower (flower), *Helianthus annuus*	March, 1978
Haplothrips ganglbaueri Schmutz	Sudan grass (leaf), *Sorghum sudanese*	April, 1974
	Onion (flower & leaf), *Allium cepa*	March, 1977
	Grapevine (leaf), *Vitis vinifera*	June, 1978
	Cotton (flower), *Gossypium hirsutum*	July, 1978
	Rice (leaf), *Oryza sativa*	Sept., 1978
Haplothrips Priesnerianus Bagnall	*Berseem* (flower), *Trifolium alexandrinum*	May, 1976
Mallothrips Indicus Ramakrishna	*Jamun* (leaf), *Syzygium cumini*	June, 1978

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REFERENCES

Lakra, R. K. and Bhanot, J. P. 1976. Chemical control of black thrips, *Haplothrips ganglbaueri* Sch. on Sudan grass, *Sorghum sudanese*. *Haryana agric. Univ. J. Res.*, 6 (2) : 89-92.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 413—414 (September 1980)

PLANT-PARASITIC NEMATODES ASSOCIATED WITH VARIOUS CROPS IN HARYANA

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An extensive survey of phytonemic fauna was carried out during 1973-78 to determine the occurrence of different genera, their extent of distribution and incidence in Haryana State.

Soil and plant-root samples were drawn from around apparently healthy as well as unthrifty plants. Samples were taken from the root zone up to a depth of 15 cm in case of vegetable and cereal crops and up to 30 cm in case of fruit trees. An aliquot of 200 g from each composite sample was processed for nematode extraction. Identification was done upto generic level and in some cases upto species. Endoparasites were, similarly, indentified by staining roots.

Eighteen genera, viz., *Tylenchus, Ditylenchus, Anguina, Tylenchorhynchus, Merlinius, Hoplollaimus, Helicotylenchus, Heterodera, Meloidogyne, Pratylenchus, Hirschmanniella, Paratylenchus, Tylenchulus, Rotylenchulus; Hemicriconemoides, Xiphinema, Longidorus* and *Trichodorus*, were identified. The results indicated that the two species, *M. javanica* and *M. incognita*, were among the most important plant-parasitic nematodes around the roots of all types of crops in each district surveyed. However, they caused more severe damage in vegetable crops where they were usually found in very high numbers. *M. incognita* was predominantly prevalent in Mohindergarh district. Its distribution in other districs is yet to be explored. Root-knot nematode around the roots of citrus, guava, grapes, plums and pomegranate fruit plants were observed invariably.

Heterodera avenae, which causes 'Molya' disease of wheat and barley, was recorded in Mohindergarh and Gurgaon districts of State. The occurrence of this species in Mohindergarh district concurs with the observations of Swarup *et al.* (1964). Besides, *H. avenae* infestation was also detected in the areas of Rohtak and Bhiwani districts, contiguous with the border of Mohindergarh district. The intensity of damage was more in Mohindergarh district than in Gurgaon which might be characteristic of the populations of the species in these districts. *H. cajani* was another species of this genus found attacking the roots of 'guar' in Gurgaon, Bhiwani and Sirsa districts. As is evident from representative sampling, this nematode appears to be very widely spread. Bhatti and Gupta (1973) also reported *H. cajani* infestation from Mohindergarh district of Haryana.

Anguina tritici, (casual agent of 'Mamni'), which causes 'Tundu' in association with *Corynebacterium tritici* was found prevalent throughout the wheat growing areas of the State.

Adults and larvae of *Tylenchulus semipenetrans* were found in the soil and root samples, respectively, collected from root zone of citrus trees which were showing dieback symptoms. This important phytoparasitic nematode was found in all the districts surveyed and attacking all the species of citrus grown in these areas.

In two places, larvae of *Rotylenchulus* were found in the soil samples collected from around the roots of cowpea and grape plants from Hissar.

The species, *Hirschmanniella oryzae* was found in abundance in the paddy growing areas of Ambala, Kurukshetra, Karnal, Jind and Hissar districts attacking roots of paddy. Since the populations were high, it was quite likely that the nematode might cause considerable damage to rice crop in the State.

The genus *Merlinius*, which appears to be the first report of the occurrence of this genus in the State, was found in soil around the roots of wheat and sugarcane at Pipli (Distt. Sonepat) and Singhpura (Distt. Rohtak), respectively. *Hemicriconemoides cocophilus* was found only in the samples collected from around roots of citrus and grape plants, which indicated its rather narrow host range and restricted distribution. Same was the case with *Ditylenchus* sp.

Other tylenchid ectoparasites, viz., *Tylenchus, Tylenchorhynchus, Hoplolaimus, Helicotylenchus* and *Paratylenchus* were found varying in their populations and distribution. However, almost all of them were found in the soil samples collected from around the roots of different plants and from every district.

Among the virus-transmitting genera of the order Dorylaimida, species of *Xiphinema* were more commonly encountered attacking the roots of fruit trees in Ambala, Mohindergarh and Hissar districts and in one sample collected from around the roots of sugarcane from Sirsa. Species of *Longidorus* and *Trichodorus* were found attacking the roots of grape fruit in Gurgaon and Hissar districts, suggesting restricted distribution of these genera in the State.

REFERENCES

Bhatti, D. S. and Gupta, D. C. 1973 *Guar* an additional host of *Heterodera cajani*. *Indian J. Nematol.* 3 : 160.

Swarup, G., Sethi, C. L. and Gill, J. S. 1964. Some records of plant-parasitic nematodes in India. *Curr. Sci.* 33 : 593.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 415—418 (September 1980)

EFFECT OF MOLYBDENUM AND SULPHUR ON Mo AND S CONCENTRATION OF BERSEEM *(TRIFOLIUM ALEXANDRINUM)* IN A RECENTLY RECLAIMED SALINE-SODIC SOIL

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Available Mo is very high in saline-sodic soils of Haryana (Dabas and Gupta, 1978). These soils are being reclaimed for cultivation and may produce fodder containing toxic levels of Mo.

Berseem is an important fodder crop. The information with regard to Mo content in berseem fodder after reclamation is quite scanty. Stout *et al.* (1951) and Pasricha and Randhawa (1971) reported an antagonism between Mo and S in plants.

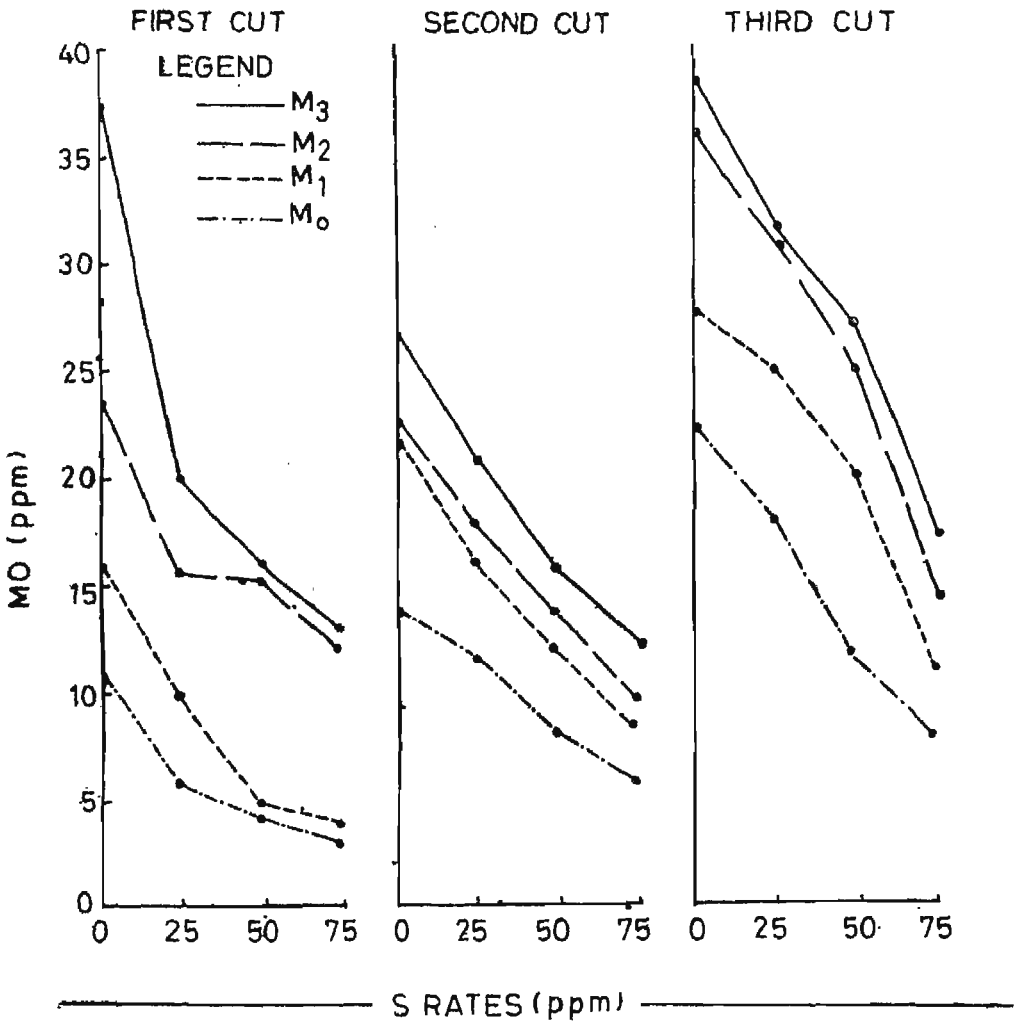
Keeping in view the above facts, it was thought necessary to study the effect of Mo and S on their concentration in berseem at different stages of growth, and to evaluate the level of S applied, to depress the Mo to a safer level from animal health aspect.

For this study, a recently reclaimed saline-sodic soil, loam in texture, pH 7.9, EC 3.0 mmhos/cm, O. C , 0 34 %; $CaCO_3$ 0.45 %, available Mo 0.29 ppm and available S 42.5 ppm was collected from Kurukshetra district of Haryana. Each pot contained 4 kg soil. Molybdenum and S were applied in solution at 0, 0.5, 1.0 and 2.0 ppm Mo (M_0, M_1, M_2 and M_3) and 0, 25, 50 and 75 ppm S (S_0, S_1, S_2 and S_3) from A. R. grade Na_2MoO_4 and K_2SO_4, respectively. All the treatments were replicated thrice, and a basal dressing of 50 ppm P, 25 ppm N and 2.5 ppm Zn was applied in each pot. Ten plants of berseem were grown in each pot. Three cuts were taken after 50, 80 and 110 days of germination. The plants were analysed for Mo and S content using dithiol method (Gupta and Mackay, 1968) and Chesnin and Yein (1950), respectively. The physico-chemical characteristics were determined according to Jackson (1967). Available Mo was extracted by the method of Grigg (1953).

Molybdenum concentration

Molybdenum concentration in all the cuts increased with graded doses of Mo (Fig. 1). Gupta and Cutcliffe (1968) also reported similar results. Results indicated that third cut had higher content

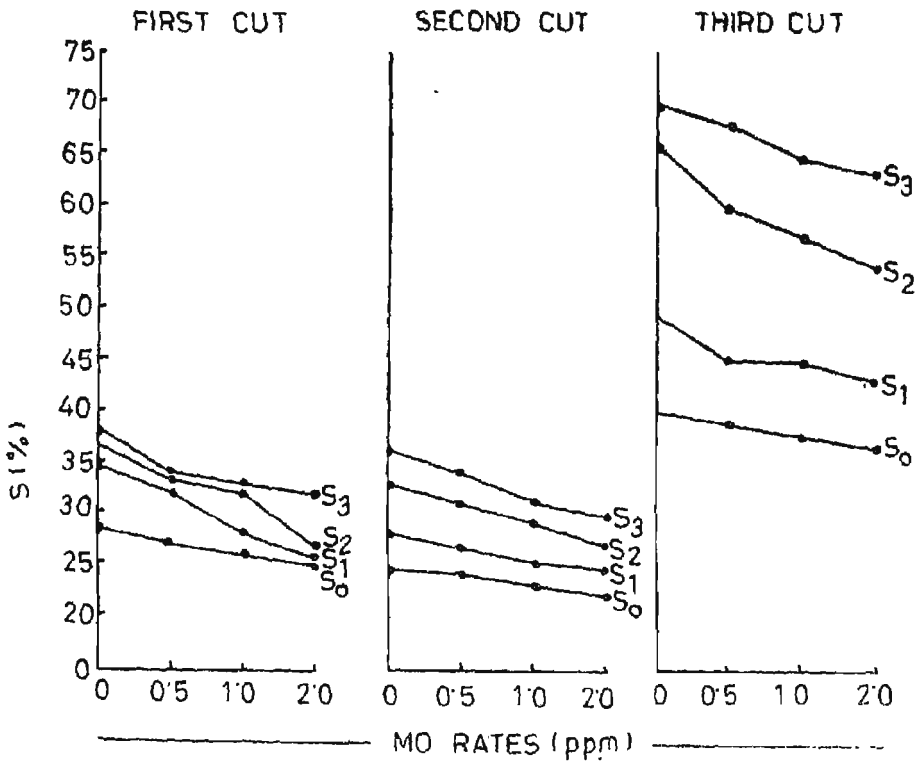
FIG 1 EFFECT OF S AND MO ON THE CONCENTRATION OF MO IN BERSEEM AT 3 STAGES OF GROWTH.



of Mo that the other cuts, which showed that Mo content in berseem increased with growth of plant (Pasricha and Randhawa, 1971). In the absence of added Mo and S, Mo content was 22.5 ppm in the third cut against 11.3 ppm in first cut and 14.0 ppm in second out. It can be concluded that the fodder produced in recently reclaimed saline-sodic soils would be toxic to ruminants as the Mo concentration more than 10 ppm in plants is considered toxic to ruminants.

Application of 75 ppm S depressed the Mo content to 3.2, 6.6 and 8.0

FIG. 2. EFFECT OF S AND MO AN CONCENTRATION OF S IN BERSEEM AT 3 STAGES OF GROWTH.



ppm in the first, second and third cut respectively. This indicated that 75 ppm S application could alleviate the toxic effect of Mo in these soils. The decrease in Mo content with S application was due to similar size and charge of MoO_4^- and SO_4^- ions which perhaps competed at the absorption sites (Stout *et al.* 1951).

Sulphur concentration

Application of 2 ppm Mo decreased S concentration from 0.28 to 0.25 % in the absence of added S in the first cut (Fig. 2). In the presence of 75 ppm applied S, it decreased from 0.38% at 0 ppm Mo to 0.32 % when 2 ppm Mo was applied. In second cut, and third application of Mo reduced S at all levels of applied S. Application of S however, had a favourable effect on S, content at all stages of growth irrespective of Mo application. It was interesting to note that S content in the third cut was higher than the preceeding cuts. The depression in S content due to Mo application was also reported by Shukla and Pathak (1973).

REFERENCES

Chesnin, L. and Yein, C. H. 1950. Trbidimetric determination of available sulphur. *Proc. Soil. Sci. Soc. Am.* 15 : 149-51.

Grigg, J. L. 1953. Determinatian of available molybdenum of soils. *N. Z. J. Sci. Technol.* 34A : 405-14.

Gupta, U. C. and Cutcliffe, J. A. 1968. Influence of phosphorus on molybdenum content of Brussels sprouts under field and green-house conditions and on recovery of added Mo in soil. *Can. J. Soil. Sci.* 48 : 117-23.

Gupta, U. C, and Mackay, D. C. 1968. Crop response to applied Mo and Cu in Podzol soils. *Can. J. Soil. Sci.* 48 : 235-42.

Dabas, D. S. and Gupta, V. K. 1978. Studies on molybdeunm in saline-sodic soils of Karnal. *Fert. Tech.* 15 : 27-29.

Jackson, M. L. 1967. *Soil Chemical Analysis.* Prentice Hall India Private Ltd., New Delhi.

Pasricha, N. S. and Randhawa, N. S. 1971. Available Mo Status of some recently reclaimed saline-sodic soils and its effect on concentration of Mo, Cu, S and N in berseem grown on these soils. *Int. Sym. Soil. Fert. Eval. Proc. I* : 1017-25.

Shukla, P. and Pathak, A. N. 1973. Effect of Mo, P and S on the yield and composition of berseem in acid soils. *J. Indian Soc. Soil. Sci.* 21 : 187-92.

Stout, P. R., Meagher, W. R., Pearson, G. A. and Johnson, C. M. 1951. Molybdenum nutrition of crop plants. Influence of phosphate and sulphate on the absorption of Mo from soil and solution cultures. *Plant Soil.* 5 : 51-87.

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 419—420 (September 1980)

EFFECT OF CRUSHED SEEDS OF CARROT & CORIANDER ON WHEAT PLANT GROWTH AND MULTIPLICATION OF *HETERODERA AVENAE*

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Considerable research work has been done on organic amendments of soil for the control of plant parasitic nematodes (Singh and Sitaramaiah, 1970). Nematicidal action of some plant extracts on plant-parasitic nematodes has also been tested (Hussain and Masood, 1975; Johnson, 1974; Miller *et al*, 1973; Nandal, 1979). The objective of the present study was to confirm a casual observation made by the senior author on beneficial effect of coriander crop residue on wheat crop growth in a field infested with *H. avenae* at village Mokhuta (Distt. Mohindergarh)

The soil naturally infested with H. avenae (35 cysts/kg) was used in 15 cm earthen pots. The crushed seeds of carrot and coriander were mixed with infested soil @ 1, 2 and 4% (W/W) two weeks before sowing. All the treatments, including check, were replicated five times and randomised completely. Wheat *cv* Kalyan was sown on November 19, 1977 and after germination thinning was done to keep one plant/pot. Observations included on plant growth characters and cyst population/pot, are presented in Table 1.

TABLE 1

Effect of crushed carrot and coriander seeds on wheat plant growth and multiplication of *Heterodera avenae*

Treatments	Mean plant height (cm)	Mean number of total tillers	Mean number of effective tillers	Mean weight of grain/pot (g)	Per cent increase/ decrease in cyst number over control
Carrot 1%	62.18	3.2	2.4	1.62	— 6.6
Carrot 2%	66.32	3.6	2.4	3.26	—52.7
Carrot 4%	64.36	4.2	3.2	3.24	—84.8
Coriander 1%	71.26	2.2	2.0	3.62	+16.9
Coriander 2%	70.54	3.0	2.8	3.88	+17.1
Coriander 4%	71.34	3.8	3.2	5.76	—66.4
Control	72.26	1.0	1.0	1.60	—
C. D. at 5%	5.61	0.70	0.76	1.67	

A perusal of data reveals that eventhough addition of crushed seeds of carrots had significantly lower plant height, number of tillers and grain yield/pot was significantly more in all levels of coriander and carrot; exception was only of carrot 1% where grain yield was at par with control. Carrot at all levels and coriander at 4% resulted in reduction of cyst population. In fact, coriander at lower dosages had revealed an increase in cyst population.

Eventhough crushed seed of carrot (2 and 4%) and coriander (4%) have shown good nematicidal effect against *H. avenae*, but in view of the high cost of these seeds they cannot be economical. Therefore, the present studies are being pursued by growing these crops and also studying the effect of their residues both in screenhouse and field conditions.

REFERENCES

Hussain, S. L. and Masood, A. 1975. Nematicidal action of plant extracts on plant-parasitic nematodes. *Geobios*. 2 : 74-76.

Johnson, L. F. 1974. Extraction of oat straw, flax and amended soil to detect substances toxic to the root-knot nematodes. *Phytopathology* 64 : 1471-73.

Miller, P. M., Turner, N. C. and Tomilson, H. 1973. Toxicity of leaf and stem extracts to *Tylenchorhynchus dubius*. *J Nematol*. 5 : 173-77.

Nandal, S. N. 1979. Phytotherapy of root-knot nematode. Ph.D. Thesis submitted to Haryana Agricultural University, Hisar.

Singh, R. S. and Sitaramaiah, K. 1970. Control of plant-parasitic nematodes with organic soil amendments. *Pans*. 16 : 287-97.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 421–423 (September 1980)

EFFECT OF HIGH AND LOW DENSITY PLANTATION ON YIELD AND QUALITY OF GUAVA UNDER SEMI-ARID CONDITIONS

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The rising land cost, uncertainity of labour, high cost of irrigation and weed control problem are the various factors necessitating modification in usual method of cultivation in order to increase yield and lower unit costs particularly in early years of bearing. One method of overcoming this problem is of growing more trees per unit area by close planting with dwarf cultivars. Of several varieties grown at the experimental orchard of Haryana Agricultural University, Hissar, Lucknow 49 was found low growing with spreeding habit. It was observed that this variety was comparatively resistant to wilt (Teaotia, 1967) than other commercial varieties. It was, therefore, decided to study the performance of this cultivar under low and high density plantation under Hissar (semi-arid) conditions.

Under high density, plants were planted at 3.6×3.6 m apart in 0.4 hectare of land giving 771 trees per hectare against the conventional low density planting at 7.5×7.5 m apart giving 177 trees per hectare Modified central leader system was used as a method of training. Plants started bearing at the age of 4 years. Flowers were thinned manually in early years for better growth of the plant. A little pruning consisted of thinning of branches from all round the trees after crop harvest was used to restrict the growth of the trees in 7th year and onwards in trees of high density plantation. Each plant under high density plantation received with two baskets of well rotten farm yard manure and 0.5 kg of calcium ammonium nitrate from the age of 6th year. In low density plantation, each plant received double quantity of farm yard manure and calcium ammonium nitrate. Trees were irrigated just after manuring as usual practice.

Observations were recorded on fruit weight, yield and quality in terms of total soluble solids, acidity, ascorbic acid and reducing sugar from 10 trees under each spacing during 1977 and 1978 and presented in tables 1 and 2.

It is clear from Table 1 that average fruit weight in year 1978 was significantly higher as compared with year 1977 under both low and high density plantation. However, differences in fruit weight between high and low density plantation in 1977 and 1978 were not significant. The higher fruit weight during 1978 might be due to more favourable weather for fruit and tree

TABLE 1

Effect of high and low density plantation on fruit weight and yield of guava cv. Lucknow-49

Planting density	Year	Fruit weight (g)	Yield/plant (kg)	Yield/hectare (Qtls)
High	1977	100.35 b*	31.50 b	242.86 a
	1978	141.50 a	29.00 b	223.59 b
Low	1977	106.85 b	60.98 a	107.93 c
	1978	154.00 a	63.80 a	112.92 c

*Data within a column followed by different letters are significantly different at 5% level.

TABLE 2

Effect of high and low density plantation on quality components of guava cv. Lucknow-49

Planting density	Year	TSS (%)	Acidity (%)	Ascorbic acid mg/100g	Reducing sugar (%)
High	1977	10.87 b*	0.45 a	169.26 b	4.11 a
	1978	12.50 a	0.58 a	215.20 a	4.26 a
Low	1977	11.15 b	0.42 a	172.57 b	3.96 a
	1978	13.30 a	0.54 a	203.10 a	4.21 a

*Data within a column followed by different letters are significantly different at 5% level.

growth as compared with the year 1977. The trees under low density plantation gave significantly higher yield per plant in both years as compared with high density plantation but total yield per hectare was significantly higher under high density plantation in both the years. The higher yield per tree under low density planting was due to more number of fruits per tree, whereas total yield per hectare under high density planting was owing to more number of trees per hectare. The findings of Boswell (1977) in Navel orange also support the contention that denser planting increased total yield per acre.

Quality components of fruit under high and low density planting did not differ significantly in year 1977 as well as in 1978. However, total soluble solids and ascorbic acid content of the fruits were significantly higher in year 1978 as compared with year 1977. There was also slight increase in acidity and reducing sugar in year 1978 but the effect was not significant. The better quality of fruit in 1978 might probably be due to better growth of the fruit, as it is evident from present finding.

The performance of the trees under high density planting is very well so far. Therefore, growers can obtain considerably high yields at least in early years by high density planting. In future, crowding can be expected in such plantation. When this situation will occur the trees

of alternate row and every other tree in the row can be removed so that number of plants per hectare may remain same as in conventional spacing.

REFERENCES

Boswell, S. B. 1977. High density for early yield. *Citrograph* 62 : 182.

Teaotia, S. S. 1967. Guava : chief varieties in India. *Indian Hortic* 12 : 15-16, 33-34.

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 424—426 (September 1980)

VARIABILITY AND INTER-RELATIONSHIPS BETWEEN YIELD AND YIELD COMPONENTS IN POTATO

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Execution of any breeding programme depends on the magnitude of genetic variability and the degree of transmission of character Besides, a knowledge of inter-relationship between yield and its components and among the components themselves is necessary if selection for simultaneous improvement in these characters is to effective. Singh *et al.* (1979), Sidhu and Pandita (1979), Gaur *et al.* (1978), Davis (1969), Dayal *et al.* (1972), Patel *et al.* (1973) and Sandhu *et al.* (1970) have studied the genetic variability and correlation studies in potato. Such information would be useful for accelerating the progress of potato breeding programme. In the present experiment, attempt was made to study variability and association of 81 genotypes of potato under Hissar condition.

Eighty one genotypes of potato were grown in Randomised Block Design with three replications during 1978-79. The planting was done on 6th Oct., 1978 and plot size used for each treatment was 5.28 sq. m. Observations were recorded on six metric characters. The statistical analysis was done for variability, heritability and correlation coefficient (Burton and De Vane, 1953).

The range, general mean, "F." values, coefficients of genetic variation, herit ability and genetic advance are given in Table 1. A wide range of gross variation was noticed in all the characters. The significant mean squares at 1% for all the characters indicated that the genotypes studied differed significantly for yield as well as other yield components. The maximum coefficient of variation was recorded in a number of tubers closely followed by yield per plant. The characters showing high range of variation have more scope for improvement. Plant height and final plant stand showed the maximum genotypic and phenotypic variances. The lowest genotypic and phenotypic variance was observed in average tuber weight. It is clear from the table that height of plant, weight of tuber, number of stems per hill and final plant stand were markedly influenced by the environment as genotypic variation was less as compared to environment.

The coefficient of variation ranged from 15 95 to 24.91 per cent. Maximum variability was observed for final plant stand. The estimates of heritability ranged from 25.59 to 47.52 per cent

TABLE 1

Variability and genetic parameters for six characters in 81 varieties of potato

Parameters	Total yield per plant (kg)	Number of tubers per plant	Average weight of tuber (gm)	Height of plant (cm)	Number of stems per hill	Final plant stand (%)
Range	0.347— 1.181	5.567— 17.000	0.046— 0.134	29.667— 74.733	2.100— 5.200	25.000— 89.813
General mean±S. E.	0.684± 0.153	9.082± 2.111	0.079± 0.016	49.465± 7.073	3.448± 0.5444	53.784± 11.494
"F" values	2.016**	2.022**	2.472**	3.866**	3.075**	3 717**
C. V. (%)	27.410	28.471	25.249	17.513	19.336	26.174
Phenotypic variance	0.047	8.963	0.0006	146.737	0.752	377.623
Genotypic variance	0.012	2.277	0.0002	71.691	0.307	179.449
Error variance	0.035	6.686	0.0004	75.046	0.445	198.174
P. C. V.	31.710	32.960	30.830	24.490	25.150	36.130
G. C. V.	15.950	16.620	17.690	17.120	16.080	24.910
Heritability (%)	25.290	25.410	32.920	48.360	40.880	47.520
Genetic advance	0.170	0.170	0.210	0.250	0.210	0.350
Genetic advance (%) of mean	24.850	1.870	265.820	0.510	0 .090	0.650

**Significant at 1% level.

TABLE 2

Correlations among different characters in potato

Characters		Number of tubers per plant	Average weight of tubers (gm)	Height of plant (cm)	Number of stems per hill	Final plant stand (%)
Total yield per plant (kg)	P	0.5287	0.4142	0.0912	0.0005	—0.3875
	G	0.2929	0.6165	0 1333	0.1268	—0.4333
	E	0.6088	0.3337	0 0702	0.0622	—0.3790
Number of tubers per plant	P		—0.4446	0.0138	0.1568	—0.2834
	G		—0.5571	0.1548	0.4181	—0.2135
	E		—0.4007	—0.0660	0.0332	—0.3344
Average weight of tuber (gm)	P			0.0585	—0.1701	—0.1434
	G			0.0348	—0.5822	—0.2307
	E			0.0760	0.0691	—0.0880
Height of plant (cm)	P				0.2654	0.3015
	G				0.4867	0.4783
	E				0.0871	0.1371
Number of stems per hill	P					0 4334
	G					0.7359
	E					0.1958

High estimates of heritability was found for height of plant followed by final plant stand and number of stems per hill. Rest of the characters also showed moderate to high heritability. For these characters the selection of superior genotypes on the basis of phenotypic performance would be effective. Yield per plant and average tuber weight exhibited high heritability with high genetic advance (9% of mean). The predicted improvement in such characters seems to be encouraging.

Genotypic, phenotypic and environmental correlation between tuber yield and yield contributing characters are presented in Table 2. High positive correlation of yield per plant with number of tubers and average tuber weight were observed. Therefore, selection for these characters could go a long way in improving the yield per plant. Similar results were also reported by Patel *et al.* (1973) and Singh *et al.* (1979). There was a strong positive correlation of number of tubers with number of stems and weak association with plant height but high negative correlation with tuber weight and final plant stand. This could be expected as each stem added to number of tubers in a hill. Tuber weight was negatively correlated with final plant stand and number of stems per hill which could be ascribed to the competition for space and nutrients among tubers borne by multistemmed plants. Furthermore, the number of stems were strongly and positively associated with plant height and number of tubers. This indicates that vegetative growth increased the number of tubers but not tuber weight. The attempt made to increase the yield by decreasing the stem number per plant is likely to adversely effect the yield. In breeding, therefore, the emphasis should be on quick vegetative growth prior to the tuberization phase.

REFERENCES

Burton, G. W. and Devane, E. H. 1953. Estimating heritability in tall fescue *(Festuca arund inacea)* from replicated clonal material. *Agron. J.* **45** : 478-80.

Davis, H. T. 1969. The influence of stem thinning on tuber size. *Amer. Potato J.* 46 : 287-90.

Dayal, T. R., Upadhya, M. D., Malhotra, V. P. and Mehra, K. L. 1972. Heritability and correlation in yield and other quantitative characters in potato *(Solanum tuberosum* L.*)* *Indian J. Agric. Sci.* **42** : 464-66.

Gaur, P. C., Kishore, H. and Gupta, P. K. 1978. Studies on characters association in potatoes. *J. Agric. Sci., Camb.* 90 : 215-19.

Patel, O. P., Patel, R. M., Mandloi, K. K. and Sikka, L. C. 1973. Genetic variability and correlation studies in potato. *Haryana J Hortic. Sci.* **2** : 72-75.

Sandhu, H. S., Cheema, S. S. and Padda, D. S. 1970. Correlation studies in potato. *Indian J. Hortic.* **27** : 164-66.

Sidhu, A. S. and Pandita, M. L. 1979. Genetic variability and correlation studies in potatoes *(Solanum tuberosum* L.*)*. *Journal of Indian Potato Association,* **6** : 103-108.

Singh, S. P., Mittal, R. K. and Singh, H. N. 1979. Biometerical association in *Solanum tuberosum* L. *Indian J. Agric. Res.* **13** : 123-26.

VETERINARY AND ANIMAL SCIENCES

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 427 – 432 (September 1980)

INFLUENCE OF INBREEDING ON ADDITIVE GENETIC VARIATION (LINE FORMATION) AND COVARIATION AMONG VARIOUS PERFORMANCE TRAITS IN HARIANA AND SAHIWAL CATTLE

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ABSTRACT

Influence of inbreeding on additive genetic variance and covariance was studied in the closed herds of 247 Hariana (63 inbred, 184 non-inbred) and 157 Sahiwal (55 inbred, 102 non-inbred) cows. The average inbreeding coefficient in the inbred group of two herds was 6.96 and 14.03 %, respectively. Heritabilities estimated by Half-sib correlation were corrected for inbreeding before comparison. The comparison of correlation estimates was carried out by 't' test after computing the 'Z' variate for each correlation coefficient.

Between sires variation (R^2%) was significantly high in inbreds as compared to the non-inbreds for some characters (Viz., AFC, LP, LL) in Hariana herd. Heritability estimates were higher for inbred group in case of moderately heritable traits, i.e., lactation production (0.48 vs 0.29 in Hariana herd) and lactation length (0.24 vs 0.13 in Hariana and 0.16 vs 0 03 in Sahiwal herd). The differences between correlation coefficients among various traits for inbred and non-inbred groups were non-significant in most cases. However, it was generally observed that the magnitude of correlation for those traits were high in inbreds, that had high association viz.-calving interval with service period (0.98 vs 0.94 in Sahiwal) and lactation production with lactation length (0.47 vs 0.40 in Hariana and 0.81 vs 0.48 in Sahiwal).

It was postulated by Lerner (1964) that when a population is subjected to inbreeding, it undergoes a process of fractionization into a series of non-interbreeding groups or lines. Within each line the additive genetic variation decreases, while between lines it increases. As the decrease in within line variation proceeds, it is concurrently accompanied with a tendency of various alleles towards fixation. Krasil-ni-Kova (1971) reported that the heritability of milk yield as 0.10, 0.42, 0.61, 0.35 and 0.03 for out-bred Kostroma cattle and with inbreeding levels of 12.5 to 25.6, 3.21 to 9.4, 0.78 to 1.56 and 0.39 %, respectively. Heritability estimates of milk yield of 0.47 and 0.28 were obtained for herds produced by assortative and disassortative matings, respectively (Grigor'ev and Dedov, 1972). The objective of the study was to conduct sirewise analysis of variance; heritability estimates were computed to test the theoretical hypothesis that the additive genetic variation (i.e., due to sires) increases with inbreeding, initiating the process of line formation.

MATERIAL AND METHODS

The data for the present investigation were collected from the History-cum-pedigree sheets of Experimental herd of Hariana cattle for the period from 1956 to 1974, and on Sahiwal cattle for the period from 1965 to 1976, for the herd maintained at the Government Livestock Farm, Hissar. The inbreeding coefficient of the inbred individuals was estimated both by Wright's method of path coefficients and Cruden's genic covariance chart method. Both the methods are shown to give same inbreeding coefficient (Khanna and Kanaujia, 1979). The average inbreeding in the inbred herd of Hariana and Sahiwal cattle was 6.96 and 14.03 %, respectively. Milk production was standardized for 300 days by the formula used at the Indian Military Farms Minimum lactation length and lactation yield for standardization were fixed as 100 days and 200 Kg. in Hariana and 160 days and 300 Kg. in Sahiwal, respectively.

The half-sib analysis of variance and covariance were carried out to estimate heritability and simple correlation coefficients for various economic traits.

The heritability estimates for the inbred herd (h^2f) were corrected by the formula :

$$h^2 = \frac{h^2f}{1+F-Fh^2f}$$ (Lerner, 1964)

The comparison of R^2 values and correlation coefficients from inbred and non-inbred group was done by computing the Z-variate for each correlation as $Z = 1.1513.\log \frac{1+r}{1-r}$, and then the difference between the two Z-values was tested by student 't' test.

Selection differential was estimated as ; $S = \bar{X}$ selected $- \bar{X}$ population. Selected individuals were the dams that contributed to the next generation of inbred or non-inbred individuals.

RESULTS AND DISCUSSION

Analysis of variance for various traits in non-inbred and inbred groups of Hariana and Sahiwal are presented in Table 1. In Hariana herd, variance due to sires was significant for all the traits in non-inbreds; while, in inbreds, it was significant only in case of age at first calving and lactation production. In Sahiwal, it was non-significant for all the traits in both the inbred and non-inbred herds. Maximum variation due to sires was found for age at first calving in case of inbred herd both in Hariana and Sahiwal cattle (50.00 and 17.22%, respectively), and the minimum variation was 4.77 % for lactation length in non-inbred Hariana and 1.52 % for age at first calving in Sahiwal herd. The comparison of 'R^2' values among non-inbred and inbred groups revealed that variation due to sires was more than double for all traits in inbreds as compared to non-inbreds except for calving interval in Sahiwal herd and for calving interval and service period in Hariana herd. Maximum increase in due to sires variation was recorded for age at first calving; while, it was minimum for calving interval in both the cases. Differences of 'R^2' values of various traits in non-inbred and inbred group were statistically significant for age at first calving, lactation production and lactation length ($P<0.05$), in Hariana herd,

TABLE 1

Per cent variation due to sires (R^2) and heritability estimates and selection differentials (SD) of economic traits in inbred and non-inbred herds of Hariana and Sahiwal cattle

Trait	Non-Inbred						Inbred					
	N	K	F	R^2(%)	h2(HSC)	S. D.	N	K	F	R^2(%)	h^2(HSC)	S. D.
Hariana												
Age at first calving (AFC) days	184	9.58	1.78*	15.47	0.30±0.23	—20.59	60	3.92	3.21*	50.00	1.00	53.62
Service period (SP) days	518	29.56	2.72*	7 56	0.22±0.12	14.97	146	8.52	0.99	10.99	—0.02±0.17	—34.53
Calving Interval (CI) days	519	29.56	3.04*	8.31	0.26±0.13	13.94	146	8.52	0.98	10.87	—0.01±0.17	—31.99
Lactation Production (LP) Kg	616	33.28	3 64*	8.88	0.29±0.13	42.16	151	8.81	2.28*	21.45	0.48±0.29	—137.43
Lactation Length (LL) days	621	33.56	1.88*	4.77	0.13±0.08	5.52	163	9.51	1.66	15.41	0.24±0.22	—17.68
Dry Period (DP) Days	519	29.56	3.58*	9.67	0.32±0.08	12.07	142	8.28	1.69	17.83	0.29±0.26	—27.13
Sahiwal												
Age at first calving (AFC) days	88	7.77	0.20	1.52	—0.36±0.01	20.74	35	6.68	1.55	17.22	0.27±0.60	—58.90
Service Period (SP) days	182	14.92	0.99	3.29	—0.002±0.15	—4.35	51	9.81	0.77	6·34	—0.08±0.25	25.81
Calving Interval (CI) days	159	12.31	1.20	4.54	0.07±0.22	3.13	30	5.71	0.45	6.73	—0.38±0.29	—23.46
Lactation Production (LP) Kg	159	15.49	0.75	2.49	—0.06±0.12	23.61	44	8.33	0.86	8.10	—0.06±0.30	—118.71
Lactation Length (LL) days	195	15.98	0.89	2.79	—0.03±0.13	—0.28	51	9.81	1.45	11.22	0.16±0.40	1.40
Dry Period (DP) days	157	12.28	1.33	5.06	0.11±0.24	2.08	30	5.71	0.82	11.62	—0.11±0.46	15.98

*$P<0.05$; h^2 (HSC)—Heritability estimate by half-sib correlation method.
N—Number of observations, K—Average number of observations per sire.
F—Variance ratio, R^2(%)—Per cent contribution to total variation.
SD—Selection differential.

while in Sahiwal herds difference was not significant for any trait. Absence of any contribution of inbreeding to the additive genetic proportion of variability in Sahiwal herd might be attributed to the non-significant differences among the sire families implying that additive genetic variance had already exhausted in the herd.

The heritability estimates of various traits both for non-inbred and inbred herds of Hariana and Sahiwal cattle are presented in Table 1. It is observed that age at first calving, lactation production and dry period had moderate heritability; while, service period, calving interval and lactation length had low or almost zero estimates of heritability. All the 'h^2' estimates except for age at first calving and lactation length in inbred herd were negative or low in case of Sahiwal cattle. Low and non-significant estimates of heritability in Sahiwal cattle might be because of sampling error due to lesser number of observations per sire and absence of differences in performance of different sire families. In Hariana cattle, the heritability estimates were higher in case of inbreds as compared to non-inbreds for age at first calving, lactation production and lactation length. Higher estimates of heritability among inbred herds have been reported for age at first calving by Stonaker (1953) and for milk yield by Grigor'ev and Dedov (1972). Krasilni-Kova (1971) obtained an increase in heritability of milk yield with increasing inbreeding coefficient of the herd and all the inbred groups having inbreeding above 1% had higher heritability than that of outbred group.

Nothing could be inferred on the basis of results from Sahiwal herd because of their low precision. From comparison of inbred and non-inbred Hariana groups it is observed that there was increase in additive genetic variance for characters having high to moderate heritability, viz., age at first calving and lactation production. It may further be revealed that inbreeding had marked effect in initiation of the line formation, by increasing the sire-line differences, only for those characters originally possessing a higher proportion of this variance.

Selection differentials for various characters for all the groups are presented in Table 1. As observed, the magnitude of selection dfferential, positive, or negative, was high in inbred group for all the traits. Considering the contribution of sires constant for the two groups within a population, selection of dams in closed herd breeding, would be expected to reduce the variability. Besides that, increase in variability in inbreds as compared to non-inbreds might be supportive of the influence of inbreeding on variability towards the process of sire-line formation. Thus, the traits with medium tc high heritability might be improved through inbreeding by selecting highly improved sire families.

Association among various traits were established by calculating correlation coefficients (Table 2) ; and the estimates from inbred and non-inbred herds were compared for significant differences. However, no study depicting the influence of inbreeding on association among various performance traits could be available in the literature.

TABLE 2

a. Correlations among various economic traits in Hariana herd (Inbred and Non-inbred)

		AFC	SP	CI	LP	LL	DP
AFC	a		0.04	−0.03	−0.25*	0.02	−0.05
	b		±0.08	±0.08	±0.08	±0.08	±0.08
SP	a	0.09*		0.99*	0.01	0.28	0.85*
	b	±0.04		±0.01	±0.09	±0.08	±0.05
CI	a	0.10*	0.99*		0.01	0.29*	0.84*
	b	0.04	±0.01		±0.08	±0.08	±0.05
LP	a	0.01	0.14*	0.14*		0.47*	−0.22*
	b	±0.04	±0.04	±0.04		±0.07	±0.08
LL	a	0.08	0.48*	0.48*	0.40*		0.30*
	b	±0.04	±0.03	±0.03	±0.04		±0.08
DP	a	0.08	0.84*	0.85*	±0.02	−0.003	
	b	±0.04	0.02	±0.02	±0.04	±0.04	

b. *Correlations among various economic traits in Sahiwal herd* (Inbred and Non-inbred)

AFC	a		0.23	0.27	−0.03	0.02	0.17
	b		±0.14	±0.18	±0.15	±0.14	±0.19
SP	a	0.15*		0.98*	0.12	0.28*	0.87*
	b	±0.07		±0.04	±0.16	±0.14	±0.09
CI	a	0.17*	0.94*		0.14	0.47*	0.91*
	b	±0.08	±0.03		±0.20	±0.17	±0.03
LP	a	−0.16*	0.13	−0.15		0.81*	0.05
	b	±0.07	±0.08	±0.08		±0 09	±0 20
LL	a	0.07	0.27*	0.34*	0.48*		0.14
	b	±0.07	±0.07	±0.07	±0.06		±0.19
DP	a	0.15	0.87*	0.75*	−0.36*	−0.04	
	b	±0.08	±0.04	±0.05	±0.07	±0.08	

a) Coefficient of correlation b) Standard error.

*P < 0.05

1. Upper diagonal values are coefficient of correlation in inbred herd, while lower diagonal ones in Non-inbred herds.

Age at first calving had low phenotypic association with all production and reproduction traits and could be improved independent of all other traits. Calving interval had a significant high and positive correlation with service period, lactation length and dry period, while lactation production and lactation length had high positive association. Comparison of correlation coefficients in inbred and non-inbred groups indicated non-significant differences for low to moderately associated traits while, for highly associated traits, the coefficient was high in inbreds than in non-inbreds (significant for service period and dry

period with calving interval and lactation production with lactation length, in case of Sahiwal herd). It is inferred that the magnitude of association was high in inbreds for the traits that had high correlation coefficient (viz., calving interval with service period, dry period and lactation length ; lactation production with lactation length), indicating that inbreeding might have enhanced the correlation among highly associated traits.

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REFERENCES

Grigor'ev, Y. N. and Dedov, M. D. 1973. Heritability and variability of traits under homogenous and hetero-geneous selection. *Rhivotnovodstove* 34 : 5861 (Anim. Breed. Abstr. 41 : 531)

Khanna, A. S. and Kanaujia, A. S. 1979. Inbreeding in closed herds of Hariana and Sahiwal cattle. The incidence of inbreeding and its measurement. *Live. Adviser IV (V)* : 25-30.

Krasil-ni-Kova, L. N. 1971. Results of inbreeding in selected Kostroma cattle at the Proteterial State Breeding Farm. *Eivotnovodstva* 22 : 18-22 (*Anim. Breed. Abstr.* 42 : 960).

Lerner, I. M. 1964. *The genetic basis of selection.* Third print. John Wiley and Sons, Inc., London.

Stonaker, H. H. 1953. Estimates of genetic changes in an Indian herd of Red Sindhi dairy cattle. *J. Dairy Sci.* 36 : 688-97.

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HISTOLOGICAL AND CERTAIN HISTOCHEMICAL STUDIES ON THE EXCURRENT DUCT SYSTEM OF GOAT TESTIS IN DIFFERENT SEASONS OF THE YEAR

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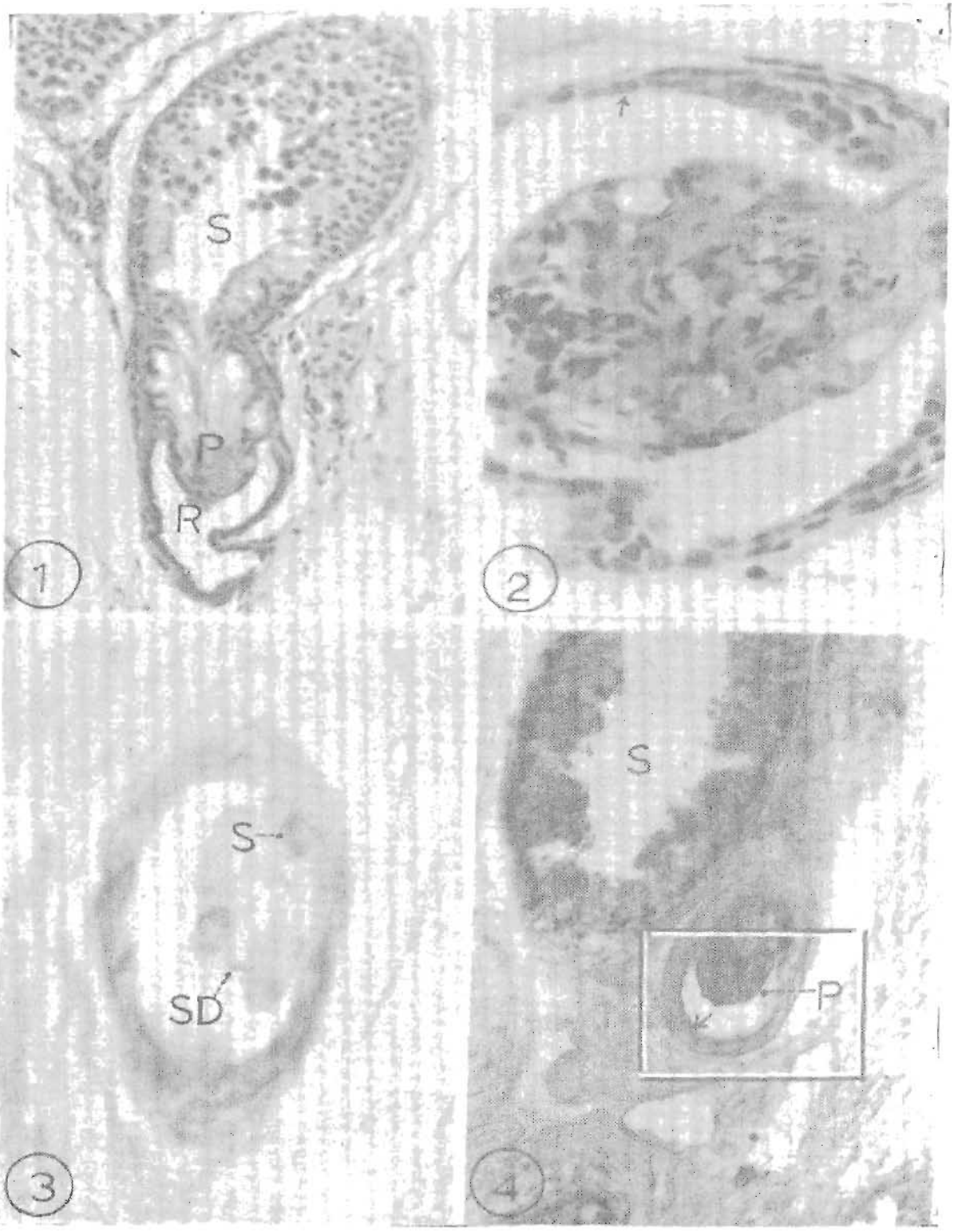
ABSTRACT

The excurrent duct system of goat testis comprised of transition zone, receptacles and straight tubules, and rete tubules. The transition zone consisted mostly of Sertoli cells which gave positive reaction for alkaline phosphatase, carbohydrates and fats. The receptacles were lined with simple squamous epithelium whose luminal borders gave a positive light reaction for alkaline phosphatase, acid phosphatase, carbohydrates and fats. The straight and rete tubules were lined with a single layer of flattened to low cuboidal epithelium whose apical border demonstrated similar histochemical reactions as those of the receptacles. The rete was axially placed in the testis and established connection with the efferent ductules at the caputal extremity.

The excurrent duct system of testis has been the subject of great interest because of its importance in reproduction of domestic and laboratory animals. A lot of literature is available on this system in laboratory animals (Cavazos and Melampy, 1954; Dhingra and Barnwal, 1977; Dym, 1972, 1974; Fawcett and Dym, 1974; Kormano, 1977; Marin-Padilla, 1964; Roosen-Runge, 1961; Vitale-Calpe and Aoki, 1969). Though, enough has been recorded on the seminiferous tubules, the seat of spermatogenesis, the literature on the structure and function of different segments of the excurrent duct systems is sparse and scattered in domestic animals (Dellmann and Wrobel, 1976; Dhingra, 1977; Goyal and Dhingra, 1973; Marin-Padilla, 1964; Nicander, 1957; Nickel *et al.*, 1973; Renzoni, 1957; Singh, 1970; Trautmann and Fiebiger, 1957; Trotter, 1959). This paper deals with the histology and histochemistry of excurrent duct system of testis of sexually mature goats in different seasons of the year.

MATERIAL AND METHODS

Studies were conducted on 20 adult sexually mature bucks of two to three years of age. The animals were grouped in five and the four; groups thus, formed were used for tissues collections in September/October (Group I), December/Jan. (Group 2), March/April (Group 3) and June/July (Group 4). The testes were collected in the normal saline solution by the open castration method during the above months. Small


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pieces of testicular tissues from the area of the mediastinum testis were collected in different fixatives for general histological studies (Luna, 1968) and special histochemical studies, i e. McManus method for glycogen (PAS), PAS reaction for glycogen with saliva treatment (Drury and Wallington, 1967), Best's carmine method for glycogen, Sudan black B method for fat (Luna, 1968), calcium-cobalt method for alkaline phosphatase, lead method for acid phosphatase and Nile blue staining technic for lipids (Thompson, 1966).

Anglicised terminology from Nomina Anatomic Veterinaria (NAV, 1973/1975) has been used. Each term when introduced for the first time in the text is followed by its Latin equivalent. Other anatomical terms, which have been used in this text, have been taken from the well entrenched literature on the subject.

RESULTS

The excurrent duct system[1] of goat testis was a system of passage-ways which connected the seminiferous tubules *(Tubuli seminiferi contorti)* to the efferent ductules *(Ductuli efferentis testis)*. It was arbitrarily divided into transition zone[2], receptacle[3] and straight tubule *(Tubuli seminiferi recti)* and rete tubules *(Rete testis)* for the convenience in description.

Transition Zone

The seminiferous tubules tapered as they approached the straight tubules. Here the cells of the spermatogenic series were replaced by cells resembling the Sertoli cells (Figs. 1, 2) which were lined on a Schiff reactive basement membrane. The latter also gave moderate reaction for alkaline and acid phosphatases but was lightly sudanophilic. The

Fig. 1 Tangential section passing through the seminiferous tubule (S) and receptacle (R) of the straight tubule. The transition zone is seen to contain cells resembling Sertoli cells. The plug (P) is seen occluding the connection between the seminiferous tubule and the straight tubule. A single layer of flattened cells lines the receptacle. PAS-haematoxylin stain, X 150.

Fig. 2 Tangential section passing through the plug and receptacle. The plug consists of Sertoli cells and other cells of spermatogenic series. Flattened cells (arrow) line the receptacle. H-E. Stain. X 600.

Fig. 3 Tangential section passing through the plug showing PAS positive cytoplasm of the Sertoli cells (S) and acrosomal cap of spermatid (SD). The receptacle demonstrates PAS positive luminal border and basement membrane of its epithelial lining. McManus method for glycogen (PAS). X 1000.

Fig. 4 Tangential section passing through the seminiferous tubule (S), plug (P) and receptacle showing distribution of lipids. Fat particles are seen scattered in the plug, presumably in the cytoplasm of the Sertoli cells. The luminal border of the receptacle also demonstrates lipids (arrow). Nile blue staining. X 160.

[1]The term "excurrent duct system" of the testis has been taken from Dym (1977).

[2]The term "Transition Zone" has been taken from Dym (1974).

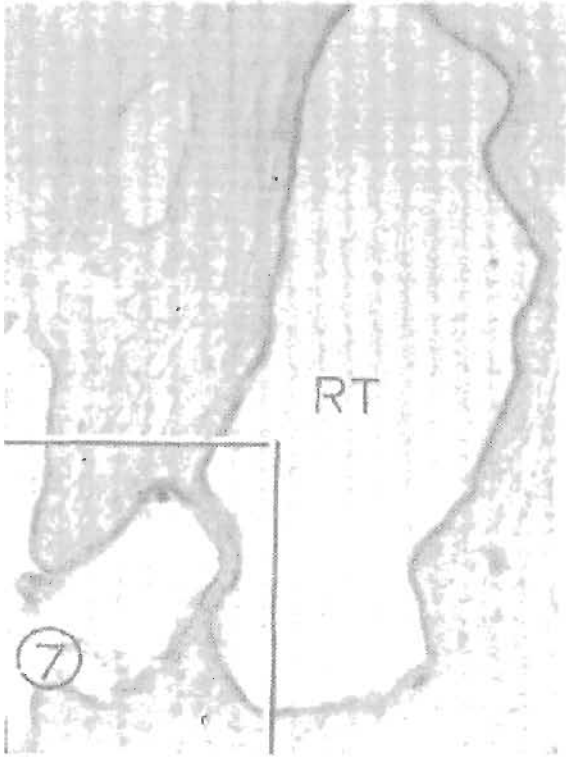
[3]The "term receptacle" has been taken from Marin-Padilla (1964).



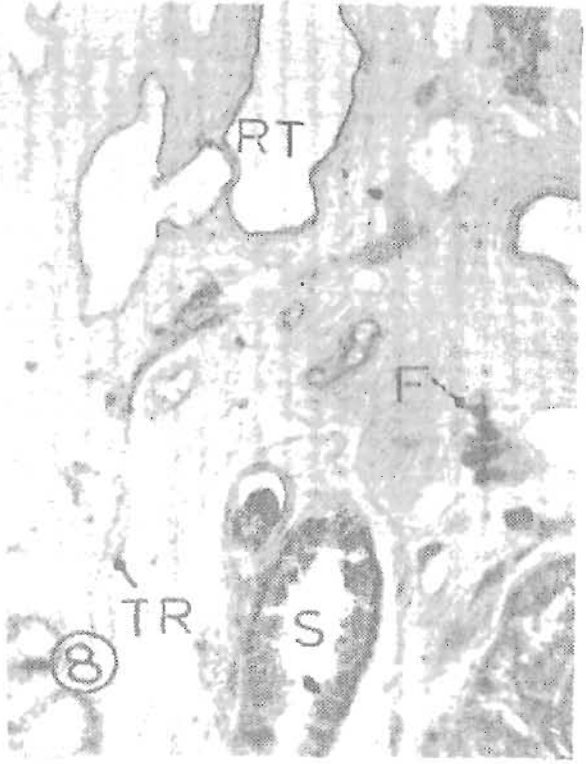
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⑧

Sertoli cells lining this zone demonstrated PAS positive glycogen granules and sudanophilic droplets of upto 9 μ in diameter (Figs. 3, 4). Dust-like fat particles were also observed along with fat droplets in many of the Sertoli cells lining this zone. Perey *et al.* (1961) reported that the intermediate zone (transitional zone) in rat, was lined exclusively by the Sertoli cells. The Sertoli cells and spermatogonia often contain glycogen (Cavazos and Melampy, 1954; Nicander, 1957) and so may store the substrate from the blood to provide a source of reserve carbohydrates for other tubular cells (Free, 1970).

Receptacles and Straight Tubules

The receptacles were the dilated ends of the straight tubules and received the tapered ends of the seminiferous tubules (Fig. 1). In tangential or oblique planes of sections passing through the junctions of seminiferous tubules and receptacles, plugs consisting mostly of Sertoli cells and also other cells of spermatogenic series (Fig. 2) were seen to occlude the connection between the germinal tubules with the excurrent duct system of the testis (Figs. 1, 4). The Sertoli cells of the plug contained PAS positive glycogen granules (Fig. 3) and fat droplets (Figs. 4, 9), similar to the cells lining the transition zone. Similar plugs have been described in rabbit (Dhingra and Barnwal, 1977), monkey (Dym, 1974) and guinea pig (Fawcett and Dym, 1974). The impression of the plug occluding the lumen of the transition zone was thought to be due to the oblique and tangential planes of sections passing through this zone of the excurrent duct system of the testis as had been expressed by Dym (1974). A single layer of flattened cells lined the receptacle (Figs. 1, 2). Its nuclei were moderately alkaline phosphatase positive but its luminal border was lightly Schiff reactive (Fig. 3), sudanophilic (Figs. 4, 9) and weakly positive for alkaline and acid phosphatase. Marin-Padilla (1964), in man and some mammals, reported that the epithelium of the receptacles consisted of compact arrangement of cuboidal or low columnar cells. In camel, they are lined by low columnar cells with vacuolated cytoplasm (Singh, 1970). The main segment of the straight tubule consisted of flattened to low simple cuboidal epithelium which rested on a basement membrane and demonstrated histochemical reactions like that of the receptacle (Figs. 10, 11).

Fig. 5 Longitudinal section of the rete testis showing alkaline phosphatase positive luminal border (arrow). The nuclei of the rete epithelium are moderately reactive, whereas those of the fibroblasts lying close to the basement membrane are intensely reactive. Calcium-Cobalt method for alkaline phosphatase. X 400.

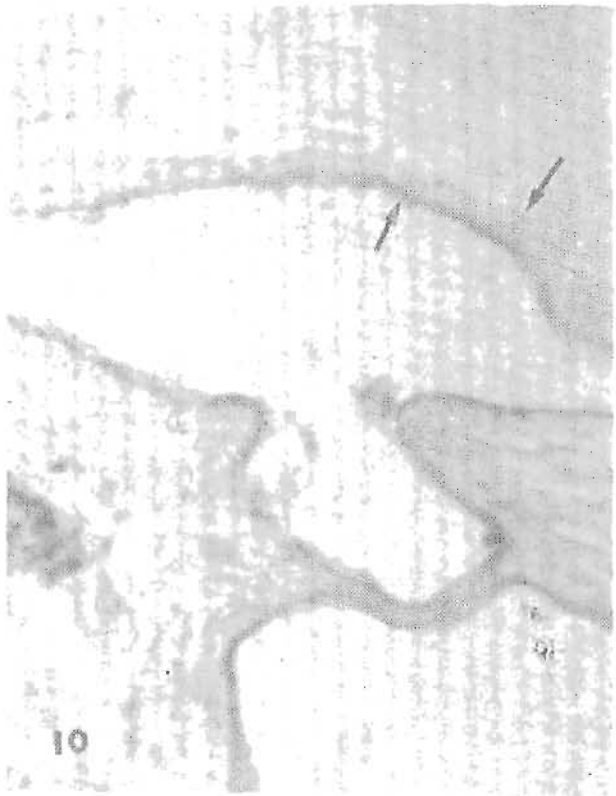
Fig. 6 Longitudinal section of the rete testis showing the presence of acid phosphatase (arrow) at the apical border of the epithelium. Lead method for acid phosphatase. X 400.

Fig. 7 Longitudinal section of the rete testis (RT) showing the distribution of lipids at the luminal border and basement membrane of the rete epithelium. Nile blue staining. X 400.

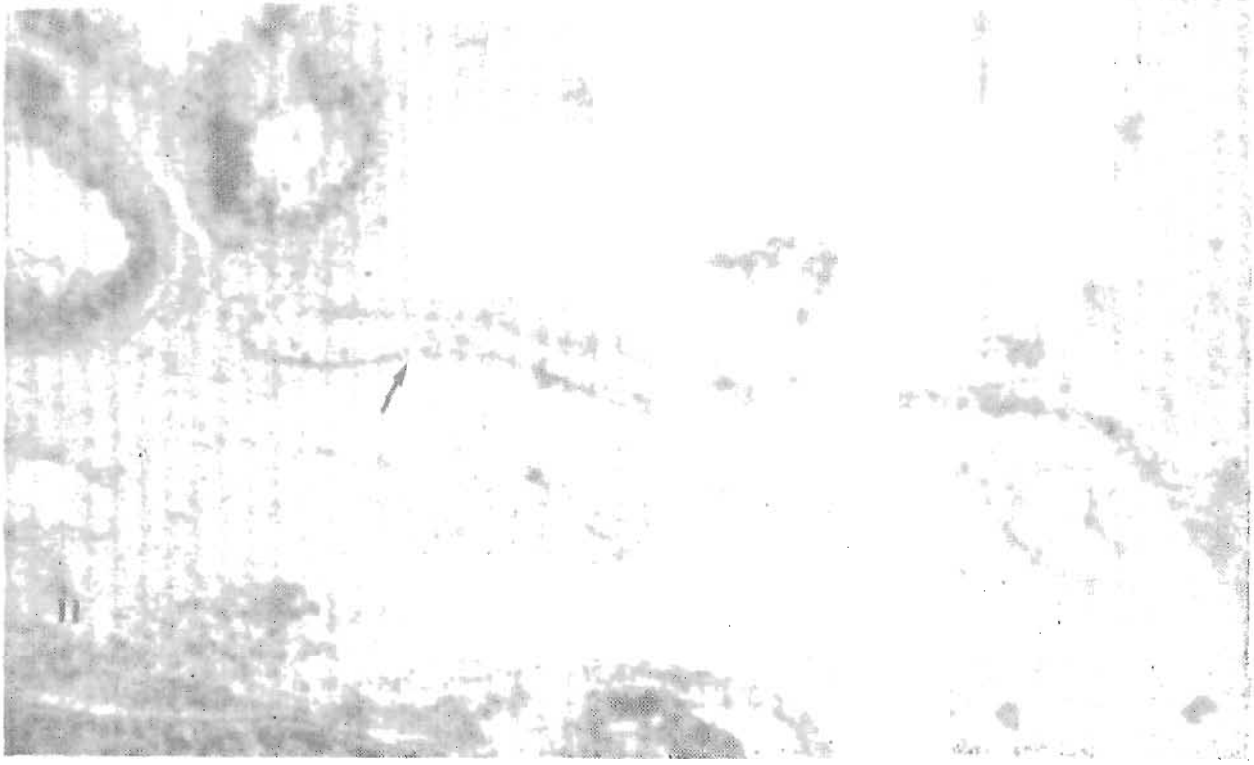
Fig. 8 Tangential section passing through the seminiferous tubule (S), straight tubule (TR) and rete testis (RT). The straight tubule demonstrate lipids at the luminal border. Fat droplets (F) are seen scattered in the mediastinum testis. Nile blue staining. X 60.



9



10



11

Similar cuboidal epithelium has been reported in straight tubules of man (Warwick and Williams, 1973), horse, armadillo, white tailed deer, dog cat, hamster, woodchuck (Marin-Padilla, 1964), camel (Singh, 1970), rabbit (Dhingra and Barnwal, 1977) and other domestic animals (Dellmann and Wrobel; 1976; Trautmann and Fiebiger, 1957). However, Sertoli cells have also been reported to line the straight tubules of bull (Trotter, 1959) and man (Glenister, 1976). Schiff positive granules of glycogen have been demonstrated in the epithelium of straight tubules in man (Montagna, 1952), camel (Singh, 1970) and guinea pig (Fawcett and Dym, 1974). However, rat, monkey and ram contained little or no intraepithelial glycogen (Dym, 1972, 1974).

Rete Tubules

The rete testis was axially situated and extended from the caputal extremity *(Extremitas capitata)* upto two thirds or three fourths the length of the testis towards the caudal extremity *(Extremitas caudata)*. It consisted of highly complicated passageways which traversed the mediastinum testis. It was lined with flattened to low cuboidal epithelium (Fig. 5) which rested on a Schiff positive and sudanophilic basement membrane. Its luminal border demonstrated a light reaction for alkaline and acid phosphatases (Figs 5, 6). It was also reactive for carbohydrates and neutral fats (Figs. 6, 7, 10). Fat droplets of upto 20 μ in diameter (Nile Blue sulfate reactive) were present in the connective tissues of the mediastinum testis in between the retial spaces (Fig. 8). In most mammalian species the rete is lined with simple low columnar epithelium (Dym, 1972; Marin-Padilla, 1964). Dellmann and Wrobel (1976) reported that the rete was lined by a simple squamous epithelium in domestic animals. They further reported that in bull, it might be a pseudostratified cuboidal epithelium. In man, the rete is lined by a flattened epithelium (Warwick and Williams, 1973) or simple cuboidal or low columnar epithelium (Glenister, 1976) with short microvilli and a single long flagellum (Dym, 1977) which rests on a PAS positive basement membrane (Montagna, 1952). Intraepithelial glycogen is present in the rete testis of buffalo (Goyal and Dhingra, 1973), bull (Nicander, 1957; Renzoni, 1957), stallion (Dellmann and Wrobel, 1976; Nicander, 1957), guinea pig (Fawcett and Dym, 1974) and man (Montagna, 1952). No appreciable difference in the histology of different segments of the excurrent duct system of goat could be observed in different seasons of the year.

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Fig. 9 The inset of fig. 4 magnified to show lipids (Arrows) in the plug on the luminal border of the receptacle. Nile blue staining X 640.

Fig. 10 The inset of fig. 7 magnified to show distribution of lipids (Arrows) at the luminal border and basement membrane of rete tubules. Nile blue staining X 1600.

Fig. 11 The inset of fig. 8 magnified to show straight tubules with lipids at their luminal border (Arrow). Nile blue staining. X 240.

REFERENCES

Cavazos, L. F. and Melampy, R. M. 1954. A comparative study of the periodic acid reactive carbohydrates in vertebrate testis. *Am. J. Anat.* 95 : 467-95.

Dellmann, H. D. and Wrobel, K. H. 1976. *Male reproduction system.* In "Textbook of Veterinary Histology" (H. D. Dellmann and E. M. Brown eds.) PP. 293-317, Philadelphia : Lea and Febiger.

Dhingra, L. D. 1977. *Mediastinum testis.* In "The Testis IV" (A. D. Johnson and W. R. Gomes eds.). PP 451-60, New York : Academic Press.

Dhingra, L. D. and Barnwal, A. K. 1977. Histological studies of the testicular efferent duct system of rabbit. *Haryana agric. Univ. J. Res.* 7(1-2) : 73-80.

Drury, R. A. B. and E. A. Wallington. 1967. *Carleton's Histological Technique.* Fourth Edition. New York/Toronto : Oxford University Press.

Dym, M. 1972. The mammalian rete testis. *Anat. Rec.* 172 : 304. Abstract.

Dym, M. 1974. The fine structure of the monkey Sertoli cells in the transitional zone at the junction of the seminiferous tubules with the tubuli recti. *Am. J. Anat.* 140 : 1-26.

Dym, M. 1977. *The Male reproductive system* In "Histology" (L. Weiss and R. O. Greep eds.), 4th edn. PP. 979-1038. New York : McGraw-Hill Book Company.

Fawcett, D. W. and Dym, M. 1974. A glycogen-rich segment of the tubuli recti and proximal portion of the rete testis in the guinea pig. *J. Reprod. Fertil.* 38 : 401-09.

Free, M. J. 1970. *Carbohydrate Metabolism in the Testis.* In "The Testis" (A. D. Johnson, W. R. Gomes, and N. L. VanDemark eds.) PP. 125-192. New York : Academic Press.

Glenister, T. W. 1976. *Urogenital system.* In "Textbook of Human Anatomy" 2nd edn. (W. J. Hamilton ed.) P. 468 London : The MacMillans Press Ltd.

Goyal, H. O. and Dhingra, L. D. 1973. Postnatal study on the histology and histochemistry of mediastinum testis in buffalo *(Bubalus bubalis).* from birth to one year. *Acta. Anat.* 86 : 65-70.

Kormano, M. 1977. *The Rete testis.* In "The Testis IV" (A. D. Johnson and W. R. Gomes eds.) PP. 461-79, New York : Academic Press.

Luna, L. G. (ed). 1968. *Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology.* 3rd edn. PP. 36, 79, 87, 157-58, New York : McGraw-Hill Book Company.

Marin-Padilla, M. 1964. The mesonephric testicular connection in man and some mammals. *Anat. Rec.* 148 : 1-7.

Montagna, W. 1952. The distribution of lipids, glycogen and phosphatase in the human testis. *Fertil. Steril.* 3 : 27-32.

Nomina Anatomica Veterinaria. 1973/1975. Adolf Holzhausen's Successors, Vienna.

Nicander, L. 1957. A histological study on the glycogen in the testis of domestic and laboratory animals with special reference to the variations during spermatogenic cycle. *Acta. Morph. Neerl. Scand.* 1 : 233-40.

Nickel, R., Schummer, A., and Seiferle, E. 1973. *The Viscera of the Domestic Mammals* (translated and revised by W. O. Sack) PP. 305, 307, 340 : Berlin : Verlag Paul Parey.

Perey, B., Clermont, Y., and Leblond, C. P. 1961. The wave of seminiferous epithelium in the rat. *Am. J. Anat.* 108 : 47-77.

Renzoni, A. 1957. Secretory epithelium of the rete testis in bull. Atti. Della Societa. *Italiana Della Scienze Veterinarie* 10 : 502-05.

Roosen-Runge, E. C. 1961. The rete testis in the Albino rat. Its structure, development and morphological significance. *Acta. Anat.* 45 : 1-30.

Singh, U. B. 1970. Gross, histology and certain histochemical observations on the testis and poll gland of camel *(Camelus dromedarius)* during different phases of sexual cycle, Ph.D. Thesis, University of Udaipur, India.

Thompson, W. R. 1966. *Selected Histochemical and Histological. Methods.* PP. 374, 629-30, 639. Illinois : Charles C. Thomas Publisher.

Trautmann, A. and Fiebiger, J. 1957. *Fundamentals of the Histology of Domestic Animals* (translated and revised by R. E. Habel and E. L. Biberstein) PP. 258-65. Ithaca : Comstock Publishing Associate.

Trotter, D. M. 1959. Histological observations of the genitalia of immature, the castrated and mature bovine male. *Am. J. Vet. Res.* 20 : 213-22.

Vitale-Calpe, R. and Aoki, A. 1969. Fine structure of the intratesticular excretory pathway in the guinea pig. *Z. Anat. Entwicklungsgesch.* 129 : 135-53.

Warwick, R. and Williams, P. L. (eds.). 1973. *Gray's Anatomy* 35th edn. PP. 1337-41. Edinburgh : Longman.

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STUDIES ON THE EFFECT OF CERTAIN IN SUMMER MANAGEMENTAL PRACTIES ON LACTATING MURRAH BUFFALOES : 3. PHYSIOLOGICAL REACTIONS AND SOME ATTRIBUTES OF BLOOD[1]

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ABSTRACT

A study was conducted during summer on 20 lactating Murrah buffaloes to study the effect of (i) showering, (ii) provision of cooled drinking water; and (iii) showering plus provision of cooled drinking water, on their physiological reactions, haematocrit value and certain blood metabolites. In treated groups, provision of thermal protection had effectively lowered the magnitude of respiration rate (2.8—7.8 counts), pulse rate (4.5– 8.5 beats), and body temperature (0.1-0.44°C) to a level considered approximately normal, whereas in control group, respiration rate increased by 19 counts. There was reduction in the levels of haemoglobin (8%), haematocrit (9%), serum Na^+ and K^+ (17%) and plasma biocarbonate (27%) in control group. In treated groups either the levels were more or less stable or only slightly reduced.

In buffaloes Minnet (1947), Mullick and Kehar(1952), Raghavan and Mullick (1961), Ramachandra *et al.* (1966), Mehta and Gangwar (1978) have studied the physiological reactions and blood metabolites to explain the effects of different methods of cooling the body of buffaloes on their thermal balance. All these studies indicate that measures such as wallowing, showering etc. are effective in reducing the thermal stress to some extent in buffaloes during summer and thus, permitting them to grow, produce and reproduce better in this season.

The present study was aimed at evaluating such measures as showering and providing cooled drinking water as aids in reducing thermal stress on a lactating buffaloes during summer.

MATERIAL AND METHODS

Twenty normal lactating buffaloes were selected from the buffalo herd of the University for the purpose of the experiment. The experiment was conducted from 15th May to 9th July, 1978, covering the hottest part of the summer.

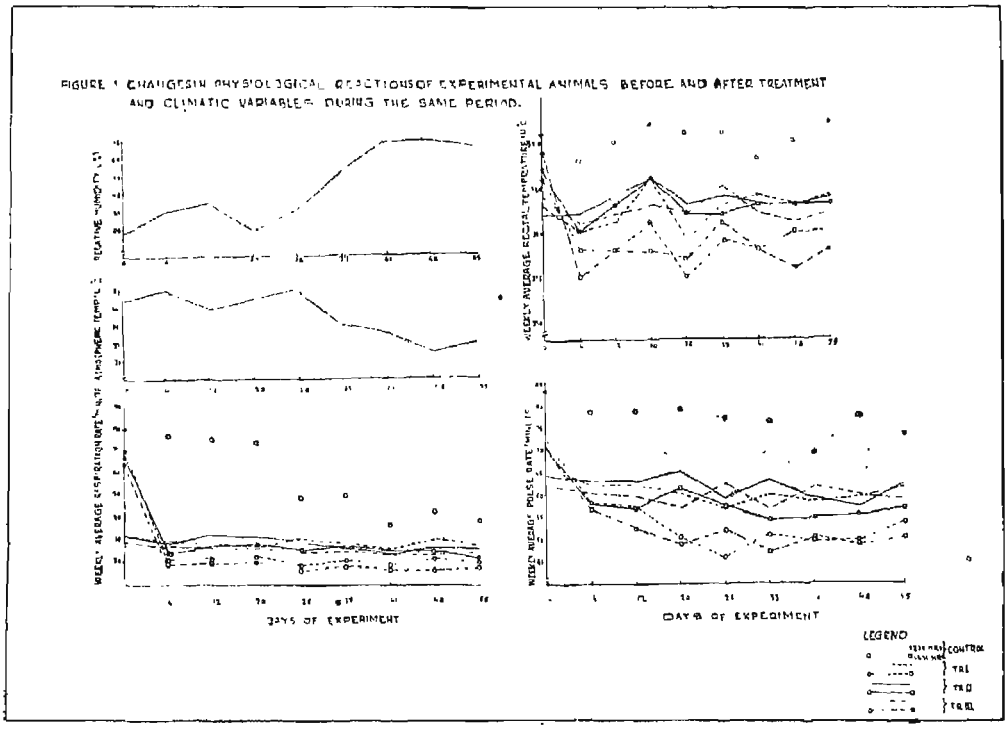
[1]Present study forms part of the Ph.D. thesis of the first author, submitted to the H.A.U.

Radadia *et al* (1979) have described the details of the experiment, which is a randomised block design, with five buffaloes under each treatment group. The different treatment groups were : a) control-housed in loose house with no showering or provision of cooled drinking water, b) treatment I, showering twice for 30 minute duration between 1200 and 1430 hours; c) treatment II, provision of *ad libitum* drinking water cooled to 20.5°C between 1200 and 1450 hours; and d) treatment III, showering as in treatment I with provision of cooled drinking water as in treatment II. The cooled drinking water was provided only during the hottest part of the day.

Body temperature, pulse rate and respiration rate of all the animals were recorded once a week just before applying cooling treatments and within half an hour after implementing cooling treatments. Blood samples were taken to determine haemoglobin (Sahli's method), haematocrit value (micro-haematocrit method), plasma bicarbonate level (Van Slyke's method) and serum sodium and potassium concentration (flame photometry). Blood samples were collected with EDTA from Jugular vein of animals early in the morning before offering feed and water. For estimation of biocarbonate, blood was collected under liquid paraffin.

RESULTS AND DISCUSSION

The change in magnitudes of physiological reactions and blood parameters are shown in Figures 1 and 2, respectively.



Physiological reactions :

Mean values for respiration rate, body temperature (°C), and pulse rate, after the treatments were : 55.4±2.45, 38.99±0.08 and 76.4±0.48 in control group; 20.8±1.07, 37.85±0.07 and 51.8 ±0.37 in treatment I; 25.6±0.47, 38.21 ±0.01 and 57.0±1.07 in treatment II, 18.8±0.44, 37.74±0.01 and 50.8±0.74 in treatment III. The difference in respiration rate, body temperature and pulse rate before and after the treatments were statistically significant ($P<0.01$).

There was a reduction by 7.8, 2.8 and 6.6 counts in respiration rate after treatments I, II and III, respectively, whereas it increased by counts in control group. Similarly, the body temperature fell by 0.35, 0.1 and 0.44°C in treatments I, II and III respectively, whereas it increased by 0.52°C in control. Application of treatments caused a reduction of 8.2, 4.5 and 8.5 pulse beats per minute in treatments I, II and III, whereas in control group, it increased by 7.6 beats at 1430 hours.

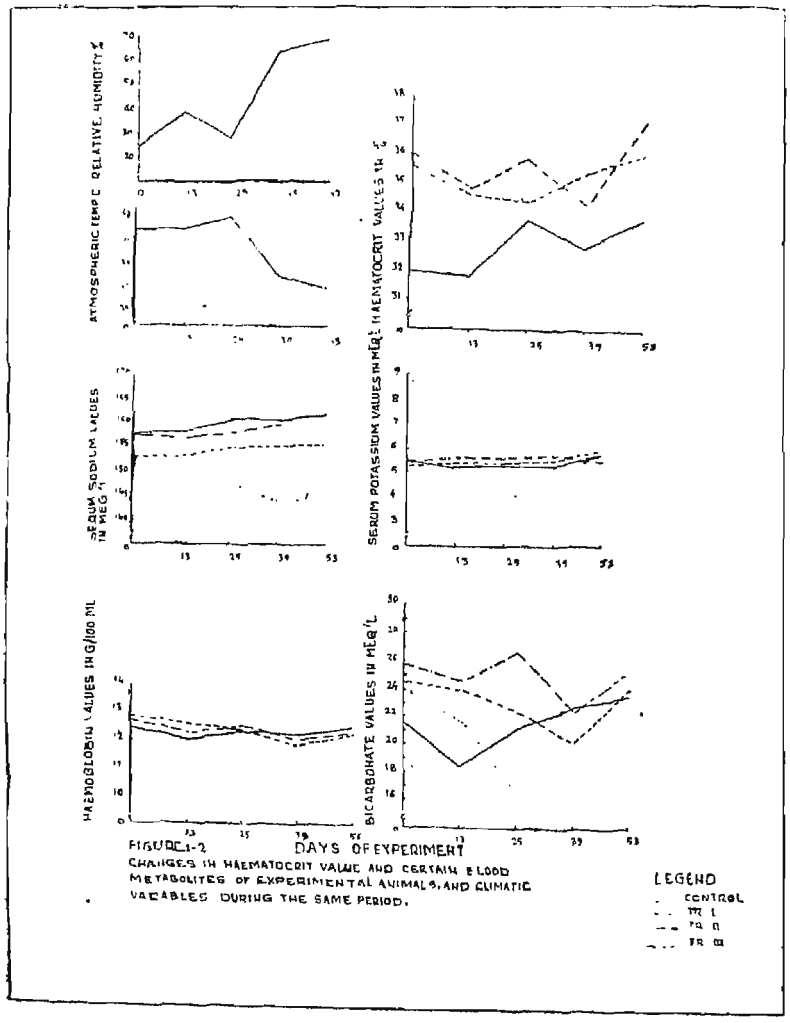


FIGURE 1-2
CHANGES IN HAEMATOCRIT VALUE AND CERTAIN BLOOD METABOLITES OF EXPERIMENTAL ANIMALS AND CLIMATIC VARIABLES DURING THE SAME PERIOD.

Ambient temperature had a positive correlation (r=0.234—0.768) with respiration and pulse rates of buffaloes of all the four groups. Almost exactly the reverse was the trend observed as regards correlations between relative humidity and the three physiological reactions (r=—0.115 to —0.823). The magnitude of partial coefficients of correlation calculated between ambient temperature on one hand and physiological reactions on the other was smaller, which indicated that either of the climatic variable individualiy might not be having as pronounced an effect on the thermal balance of buffaloes as both of them together could have.

The respiratory process helps animals in getting off the body heat load by increased pulmonary evaporative loss. Such loss had to be greater in the control group. On the other hand, those animals which were showered and provided with cooled water for drinking maintained their respiratory rate at a fairly low level which is considered approximately normal for cool weather. The measures taken were, thus, beneficial in providing thermal comfort to animals not necessitating their respiration activity to be subjected to severe test. These results agree with Askar *et al.* (1952).

Miller *et al* (1951), Taneja and Bhatnagar (1960), Gomila *et. al* (1973), Sastry *et. al* (1973) and Mehta and Gangwar (1978) had demonstrated that sprinkling of water or showering of cattle and buffaloes during hot weather lowred the respiratory counts which is in agreement with the present work.

While pulse rate increased in the control animals during the period from 1200 hours to 1430 hours, the tre-ı ments had the effect of reversing that trend thereby reducing the pulse rate to various degrees. It is clear from Figure I that the pulse rate was highest in control and lowest in the treatment III which was very near to normal rate. The normal pulse rate in buffaloes reported by Mullick and Kehar (1951) is 41.

Blood Paramaters

Mean values of blood haemoglobin were 10.48±0.17, 10.25±0.28, 12.28±0.09 and 12.58±0.14 g/100 ml in control, treatments I, II and III, respectively. Mean haematocrit percentages in blood were 33.8±0.67, 34.6±0.61, 33.05±0.64 and 35.55±0.60 in control, treatment I, II and III, respectively. Mean values for blood plasma bicarbonate, serum sodium and potassium were 18.2±0.71, 146.26±2.25, 4.51±0.15 (mE q/L) in control; 22.65±0.44, 155.76±0.88, 5.57±0.20 in treatment I; 21.45±0.19, 161.8±1.26, 5.54±0.15 in treatment II; 24.7±0.46, 159.96±1.23, 5.59±0.12 in treatment III. Treated groups differed significantly ($P<0.01$) from control group for all the characteristics excepting haemoglobin (Fig. 2).

During the hot season when humidity was also raised, the buffaloes in control group which relied upon increased surface evaporation for thermolysis could not do so effectively and, as a consequence, increased their respiratory activity. This was reflected in plasma bicarbonates showring a reduction of 28.6% in control (due to "blowing off" of Co_2) while the animals in treatment groups did not show much reduction (Dale and Brody, 1952; Bianca, 1962; Tomar *et al.*, (1969).

During the hot season serum Na^+ and K^+ level were greatly reduced in control

group. It was also observed that bicarbonates level was reduced to a greater extent in control. The increased respiration rate (Fig. I) resulted in reduced plasma bicarbonates, serum Na^+ and K^+ (Bianca, 1955; Georgie *et al.*, 1970; Sondhi and Singh, 1978).

The decrease in haematocrit and haemoglobin values observed in the control group in the present study might be due to haemodilution caused by a shift inbody water from the intracellular and interstitial spaces (Razdan, 1965) as a consequence of the effect of hot conditions (Shetty *et al* 1977). Whereas higher values of haematocrit in animals under the three treatments is stated to be an index of good adaptability of buffaloes to hot environment (Pandey and Roy, 1969).

REFERENCES

Askar, A. A. Ghany, M. A. and Ragab, M. T. 1952. Effect of exposing cattle and buffaloes to sun during summer in Egypt. *Indian J. Dairy Sci.* 5 : 171.

Bianca, W. 1955. The effect of repeated short exposures to heat on the volume and hydration of the blood of the calf. *Br. Vet. J.* 113 : 227.

Bianca, W. Findlay, J. D. and Macon, R. M. 1962. Respiration and acid-base status in calves. *Res. Vet. Sci.* 3 : 34.

Dale, H. H. and Brody, S. 1952. Thermal hyperpnoea and acidbase balance in dry cattle *J. Anim. Sci.*, 11 : 790.

Georgie, G. C. Sastry, N. S. R. and Razdan, M. N. 1970. Studies on the work performance of crossbred cattle. II. Responses of some chemical constituents of blood of brown-swiss XSahiwal (F_1) and Sahiwal bullocks to exercise during different seasons. *Indian J. Anim. Production* 1. 116 : 19.

Gomila, L. F, Roussel, J. D. and Baetty, J. F. 1973. Influence of partial zone cooling on milk yield, thyroid activity and stress indicators *J. Dairy Sci.*, 56 : 310.

Mehta, S. N. and Gangwar, P. C. 1978. Effect of cooling on reproductive efficiency and certain blood constituents of buffaloes. *Indian Vet. J.* 55 : 501.

Miller, G. D., Frye, J. B. Jr., Buch,, B. T. Jr., Handarson, P. J. and Rusoof, L. L. 1951. *J. Anim. Sci.* 10 : 961.

Minnet, F. C. 1947. Effect of artificial showers, natural rains and wallowing on the body temperature of animals. *J. Anim. Sci.* 6 : 35.

Mullick, D. N. and Kehar, N. D. 1951. Comparative heat tolerance test in cattle and buffaloes. *J. Anim. Sci.* 10 : 1078-79.

Mullick, D. N. and Kehar, N. D. 1952. Climate and animal health I. Seasonal variation in pulse rate, respiratory rate, body temperature, body weight and haemoglobin in normal Indian cattle. *Indian J. Vet. Sci,* 22 : 61.

Pandey, M. D. and Roy, A. 1969. Studies on adaptability of buffaloes to tropical climate II. Seasonal change in body temperature cardio-respiratory and haematological attributes in buffalo cows. *Indian J. Anim. Sci.*, 39 : 378.

Radadia, N. S., Pal, R. N. Juneja, I. J. and Sastry, N. S. R. 1979. Studies on the effect of certain managemental practices on lactating murrah buffaloes in summer season. I. Feed and Water intake. *Haryana Agric. Uni. J. Res.* 10(7) : 144-51.

Raghvan, G. V. and Mullick, D. N. 1961. Effect of air temperature and humidity on the pulse rate, respiration rate and rectal temperature in buffalo bulls. *Indian Vet. J.* 38 : 391.

Ramachandra Rao. Mullick, D. N. and Mahadeva, V. 1966. The level of some minerals in the sera of growing buffalo calves. *Indian Vet. J.* 43 : 55-60.

Razdan, M. N. 1966. Studies on physiological reactions of dairy cattle under different environmental conditions. D. Phill. Thesis. Calcutta Univ.

Sastry, N. S. R., Thomas, C. K., Tripathi, V. N. Pal, R. N. and Gupta, L. R. 1973. Effect of shelter and water sprinkling during summer and autumn on some physiological reactions of Murrah buffaloes heifers. *Indian J. Anim. Sci.* 43:95.

Shetty, S. N., Gowda, D. K. V., Kumar, B. J., Gowda, H. and Dayalu, E. 1977. The blood picture of male buffalo calves. *Indian Vet. J.* 54 : 940.

Sondhi, S. P. S. and Singh, A. 1975. Blood plasma volume changes in the electrolyte content under stress and normal conditions in buffalo calves. *Indian J. Anim. Sci.* 44 : 305.

Taneja, G. C. and Bhatnagar, D. S. 1960. Thermoregulatory mechanism in buffalo calves. *Indian J. Dairy Sci.* 13 : 170.

Tomer, O. S., Dhillon, J. S. and Razdan, M. N. 1969. Studies on the performance of cross-bred dairy cattle. I. Effect of shelter and differential environmental conditions on water metabolism and body water distribution of Sahiwal × Brown-Swiss (F_1) and pure bred Sahiwal cattle. *Indian J. Dairy Sci.* 22 : 73.

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STAPHYLOCOCCOSIS IN TURKEYS

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ABSTRACT

An outbreak of Staphylococcosis in turkey poults, resulting in 24.76% mortality has been described. The important lesions observed were suppurative pneumonia, pleuritis, airsacculitis and mild fibrinous pericarditis. The isolate, *Staphylococcus aureus*, was β hemolytic, Coagulase positive and could cause mortality in chicks when inoculated experimentally. The gross and histopathology of the disease in experimentally infected birds has been presented. The organism was sensitive to ampicillin and tetracycline, but not to penicillin, streptomycin, kanamycin, chloremphenicol and nitrofurantoin.

Staphylococcal infection has been reported to occur in chicken, as is evidenced by the reports of Seetharaman and Sharma (1949), Balanco and Vindell (1955), Bootes and Slennet (1964), Horiuchi *et al.* 1969), etc. There are, however, a few reports of this infection in turkeys; the only reports available on its pathology are those of Solana *et al.* (1964) and Smart *et al.* (1968). This communication places on record its occurrence in turkeys and describes briefly the pathology of the disease.

MATERIAL AND METHOD

During the month of March, 1972, a disease out-break occurred causing mortality in the turkey poults kept by the department of Livestock Production and Management, Haryana Agricultural University, Hissar. Attempt was made to investigate the cause of illness/mortality, using conventional methods of investigation of disease outbreak. On post-mortem examination, pieces of tissues from lungs, air sacs, heart, kidneys, spleen, liver, duodenum and pancreas were collected in 10% formol saline for histopathological examination. The paraffin sections of the tissues were stained by hematoxylin and eosin technique as well as by Taylor's method (Taylor, 1966) for demonstration of bacterial organisms in the tissues. Bacterial isolations were attempted from heart blood, lungs and air sacs of five representative cases. The isolates were tested for antibiotic sensitivity using standard procedures.

The pathogenicity of the organism *(Staphylococcus aureus)* isolated from these cases was also tested in albino Swiss mice and White Leghorn chickens.

OBSERVATIONS

Of 307 turkeys (207 Beltsville and 100 Broad Breasted Bronze) of 1-6 weeks age group, 76(24.76%) turkeys (42 Beltsville and 34 Broad-Breasted

Bronze) died during the course of outbreak. Majority of the birds were reported to suffer from acute respiratory distress before death.

PATHOLOGY

Gross lesions. At the time of postmortem examination, most of the turkey poults showed emaciated condition. On opening the carcases, almost all the internal organs were found to be congested. Lungs were pneumonic having small necrotic foci. Thoracic and abdominal air sacs were thickened and also had pin-head sized necrotic foci. In most of the cases, the pericardium was thickened due to fibrinous deposits; it was also adherent to the underlying myocardium.

Microscopic Pathology. There were extensive areas of consolidation, with haemorrhages in the air vesicles and larger bronchioles. Most of the tertiary bronchioles were filled with exudate consisting of necrotic tissue debris, heterophils and red blood cells (Fig. 1). The air vesicles in the consolidated area were filled with exudate consisting of heterophils and macrophages. At times confluence of mononuclear cells was seen. In some sections (Taylor's stain), microcolonies of the gram positive organisms were also seen. The pleura was thickened due to infiltration of heterophils and mononuclear cells (Fig. 2). At times, changes of acute suppurative air sacculitis, associated with the infiltration of heterophils and mononuclear cells, were observed (Fig. 3).

The hepatic cells were undergoing hydropic degeneration; at places these were associated with necrotic and fatty changes. Mild pericarditis, associated with myocarditis characterised by the presence of moderate number of heterophils and mononuclear cells and fibrin deposits, could be observed. Subepicardial haemorrhages and degeneration of sarcolemma (myocardium) were also observed. Congested blood vessels were conspicuous in other organs.

Bacteriological findings

Staphylococcus aureus β hemolytic and coagulase positive strains were isolated from heart blood, lungs and air sacs of five representative cases. The organism was found to be highly sensitive to ampicillin and tetracycline but resistant to penicillin, streptomycin, kanamycin, chloremphenicol and nitrofurantoin. These organisms could also be reisolated from the experimentally inoculated birds.

Experimental Studies

The details of transmission experiments carried out in White Leghorn chicks and albino Swiss mice are given in Table 1.

All the birds inoculated with 0.5 ml of 6 hours old broth culture, with and without administration of cortisone, died within 24 hours of inoculation except one which died within 36 to 48 hours. On postmortem examination the visceral organs, i. e., liver, lungs and kidneys were found to be congested. Histologically, liver, lungs, heart and kidneys showed acute vascular changes characterized by congestion and petechial haemorrhages. The changes of acute pericarditis, associated with heterophilic infiltration, were present (Fig. 4). Focal areas of coagulative necrosis were also noticed in the myocardium.

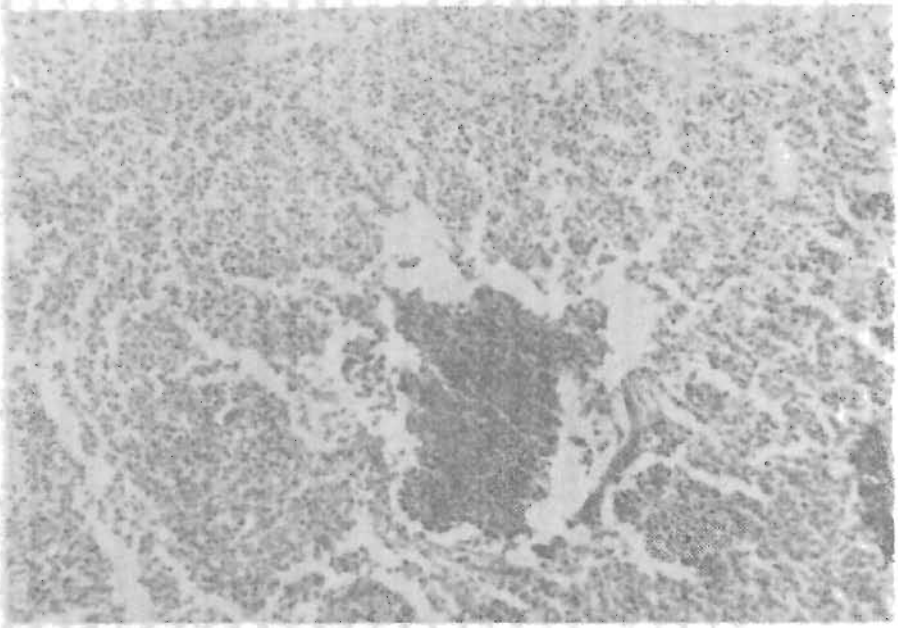


Fig. 1. Lung-tertiary bronchiole filled with tissue debris, heterophils and red blood cells. Adjoining airvesicles show consolidation. H & E X 70.

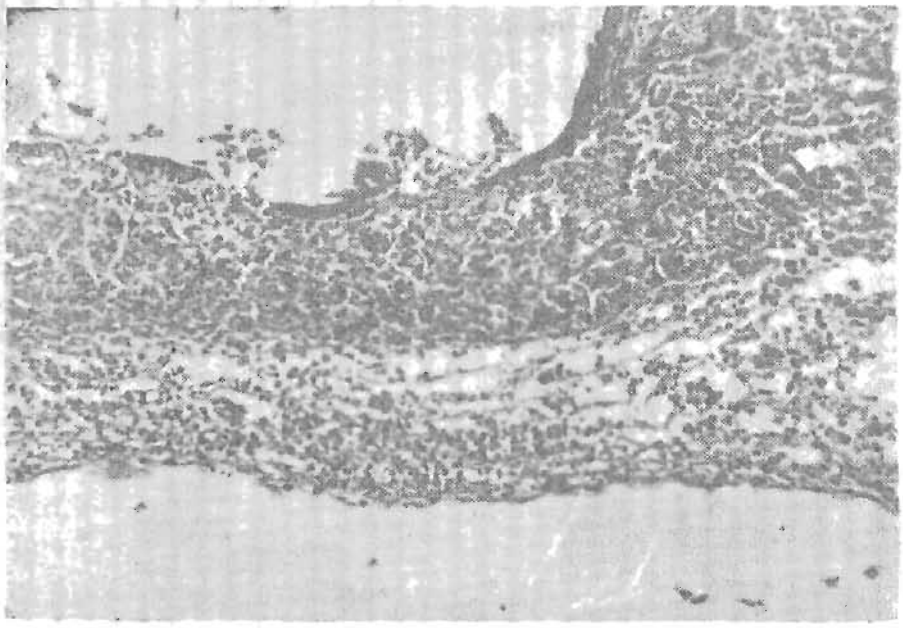


Fig. 2. Pleura in thickened due to infiltration of numerous heterophils and mononuclear cells. H & E X 70.

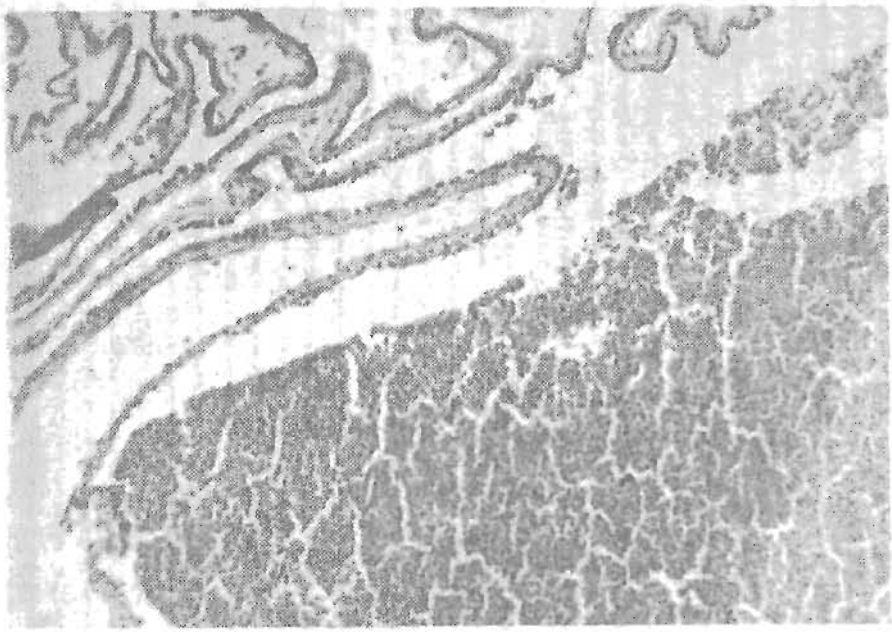


Fig. 3. Airsac showing infiltration of heterophils and mononuclear cells. H & E X 70.

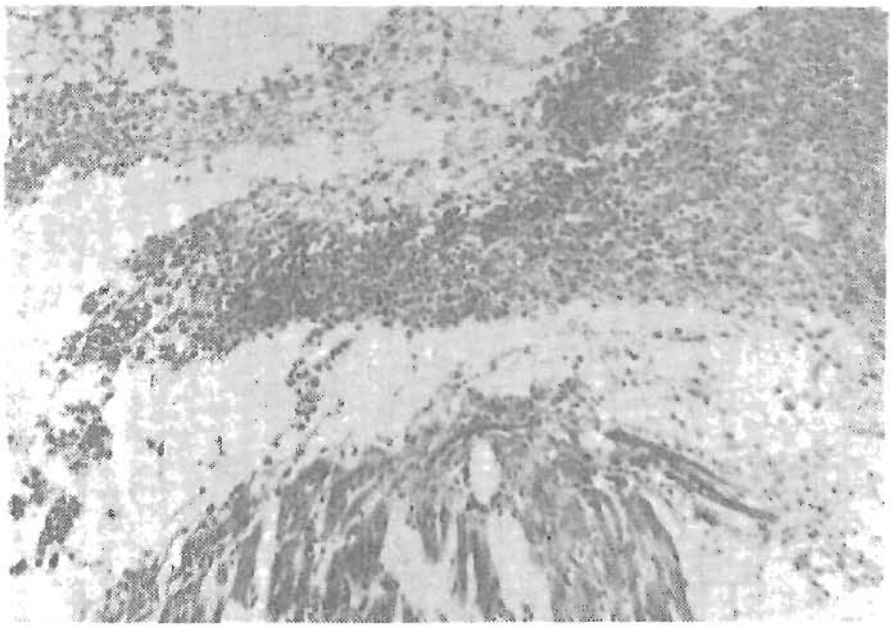


Fig. 4. Pericardium showing infiltration of heterophils. H & E X 70.

TABLE 1

Transmission experiments with Staphylococcus aureus

Group	Age of birds/mice used	Inoculum	Dose & route of inoculation	Results	Gross lesions
I	3 W. Leghorn chicks (12 weeks)	6 hour old broth culture	.5 ml i/p	2 died within 24 and 1 within 36-48 hours	Congestion in internal organs
II	3 W. Leghorn chicks (12 weeks) given cortisone s/c 24 hour earlier to culture inoculum	6 hour old broth culture	.5 ml i/p	All died within 24 hours	Congestion in internal organs
III	3 W. Leghorn chicks (12 weeks)	6 hour old broth culture	.2 ml i/p	2 died within 60-72 hours	Congestion of visceral organs
				1 destroyed after 15 days	Fibrinous deposits over pericardium and liver
IV	3 W. Leghorn chicks (12 weeks)	6 hour old broth culture	.1 ml i/p	1 died within 60-72 hours	Congestion of visceral organs
				One each destroyed after 15 and 21 days	Fibrinous deposits over pericardium and liver
V	3 W. Leghorn chicks (12 weeks) —Control	Nutrient broth	.5 ml i/p	No death. 1 after 15 and 2 after 21 days destroyed	No significant changes
VI	3 albino Swiss mice	6 hour old broth culture	.5 ml i/p	No death	—
VII	3 albino Swiss mice (Control)	Nutrient broth	.5 ml i/p	No death	—

Two of the three chicks inoculated with 0.2 ml of culture referred to above and one of the three chicks given 0.1 ml of inoculum died within 60-72 hours of inoculation. The remaining birds were destroyed 15 and 21 days postinoculation (PI). The chicks which died earlier, i.e., 60-72 hours PI, showed congestion of the visceral organs. Histologically, predominant vascular changes characterised by congestion and petechial haemorrhages could be observed in the lungs, liver and kidneys. The hepatic lobules in addition showed necrobiotic changes. The pericardium was mostly oedematous and at places showed changes of fibrinous pericarditis with infiltration of heterophils.

The chicks destroyed 15 and 21 days PI revealed fibrinous deposits over the pericardium and liver. In the heart sections, changes of fibrinous pericarditis, alongwith infiltration of mononuclear cells and macrophages, were predominantly present. In the hepatic lobules, focal areas of coagulative necrosis, associated with infiltration of mononuclear cells and macrophages, could also be seen. Occasionally a layer of fibrin was noticed over the liver surface.

In the control birds, which were destroyed 15 and 21 days PI, nothing significant could be observed grossly as well as microscopically.

None of the mice showed any sign of illness following experimental infection.

DISCUSSION

During the course of present outbreak of staphylococcosis in turkey poults, one fourth of the population died of the disease. These figures are comparable to those of Williams and Daines (1942), who reported losses upto 30% in young turkeys due to staphylococcosis. In the present studies, the important lesions observed in turkeys were septicaemia, followed by development of suppurative pneumonia, pleuritis, airsacculitis and mild fibrinous pericarditis, with necrotic areas in the heart and liver. In an outbreak of staphylococcal infection in chicken, Horiuchi *et al.* (1969) found necrotic foci in the liver and spleen alongwith granulomatous lesions in the lungs. The presence of fibrinous pericarditis, as observed in the present study has also been reported by Hinshaw (1965).

No involvement of the joints was noticed during the course of present study, though there are reports of occurrence of arthritis in staphycoccal infections (Jungherr, 1933; Smart *et al.* 1968. Balanco and Vindell, 1955). It might possibly be due to the strain differences. The observations of the present study in the acute form of the experimentally induced disease were more or less similar to those of Balanco and Vindell (1955), who also noticed septicaemia in acute cases. Earlier, Gross and Domermuth (1962) in experimental studies in turkey poults, found bactermia in this disease followed by infarcts in liver, spleen and myocardium. Since there was no mortality in experimentally infected mice, this particular stain might not be pathogenic for this species of animal.

The resistance of the isolates to various antibiotics, as determined on antibiotics sensitivity test, might be due to their indiscriminate use for therapeutic purposes and/or low level intake in feed and water as a preventive measure against the bacterial infections.

REFERENCES

Balanco Loizelier, A. and Vindell Caurin, J A. 1955. Staphylococcal infection in fowls. Rev. Patron. *Biol. Anim.* 1 : 157-64. (V. B. 25 : 3096).

Bootes, B. W. and Slennet, G. 1964. Staphylococcosis in chickens. *Aust. Vet. J.* 40 : 238-39.

Gross, W. B. and Domermuth, C. H. 1962. Bacterial endocarditis of poultry. *Am. J. Vet. Res.* 24 : 320-28.

Hinshaw, W. R. 1965. from chapter *Diseases of the turkey in Diseases of Poultry* Ed. Biester and Schwarte. 5th Ed., Iowa, The Iowa State University Press.

Horiuchi, T., Nonomura, I., Shoya, S. and Soto, S. 1969. Visceral lesions in chickens infected with *Staphylococcus aureus*. *Natn. Inst. Anim. Hlth. Qt., Tokyo* 9 : 174-80 (V. B. 40 : 3282).

Jungherr, E. 1933. Staphylococcal Arthritis in turkeys. *J. Am. Vet. Med. Assoc.* 82 : 243-49.

Seetharaman, C. and Sharma, G. L. 1949. Staphylococcus infection in chicks. *Indian J. Vet. Sci.* 19 : 215-17.

Smart, R. A., Miner, M. L. and Davis, R. V. 1968. Pathogenesis of Staphylococcal synovitis in turkeys. Cultural retrieval in experimental infection. *Avian Diseases* 12 : 37-46.

Solana, P., Anderson, D. P., Frey, M. L. and Hanson, R. P. 1964. Epizootiological study of *Staphylococcus aureus* infection in turkeys. *Poult. Sci.* 43 : 1364.

Taylor, R. D. 1966. Modification of the Brown and Brenn Gram Stain for the differential staining of Gram-positive and Gram negative bacteria in tissue section *Am. J. Clin. Pathol.* 46 : 472-74.

Williams, R. B. and Daines, L. L. 1942. The relationship of infectious omphalitis in poults and impetigo staphylogenes in man. *J. Am. Vet. Med. Assoc.* 101 : 26-28.

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EFFECT OF RESTRICTING FEED INTAKE OF BROILERS ON THEIR INTERNAL BODY ORGANS AND RETENTION OF NITROGEN AND ENERGY

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The effect of restricting feed intake of broilers on their growth, efficiency of feed conversion and economics of production have already been reported by Sunaria and Sharda (1979). The present study was conducted to find the effect of restricting the feed intake of birds on their organ development and efficiency of energy and nitrogen retention.

Four hundred day old chicks of commercial broiler used in the study were wing banded, weighed and randomly distributed into 20 groups of 20 chicks each. There were ten dietary treatments with two replications for each (T_1=control; T_2, T_3, T_4=5% restriction for 2, 3 and 4 weeks; T_5, T_6, T_7=10% restriction for 2, 3 and 4 weeks; and T_8, T_9, T_{10}=15% restriction for 2, 3 and 4 weeks, respectively). The chicks were fed the starter ration from 0–5 weeks and finisher from 6–10 weeks (Table 1). The feed ingredients and mixed feeds were analysed for proximate composition according to AOAC (1970) methods.

The metabolic trials were conducted to study the nitrogen and energy balance at the end of 7th, 8th, and 9th week of feeding with control chicks and restricted group of chicks, 6th week with chicks of control group and 10th week with chicks of all the groups. For nitrogen estimation, samples were preserved in 20% sulphuric acid. Toshniwal bomb calorimeter was used to determine gross energy. Seven birds from each group were sacrificed at the end of 10th week. Dressed birds were eviscerated and organs (heart, liver, pancreas, spleen and gizzard) separated and their weights recorded. Mortality during the period was recorded. The data were analysed by the method of Steel and Torrie (1960).

The weights of heart, liver, pancreas, spleen and gizzard (Table 2) as a per cent of the body weight were found to be 0.47, 2.16, 0.19, 0.23 and 2.52 per cent, respectively. The liver and heart weights of chicks fed the restricted diets were found to be larger than of those fed the control diet. The differences among the treatment means were, however, significant only in case of T_9 for heart and T_4 in the case of liver ($P<.05$). The findings of Osbourn and Wilson (1960) are in agreement and those of Rostango and Featherston (1970) contrary to that of the present study in so far as liver weight is concerned.

TABLE 1

Composition of diets (%)

Ingredient	Starter	Finisher
Maize	53.0	60.0
Maize gluten meal	10.0	5.0
Groundnut cake	22.5	20.5
Fish meal	10.0	9.5
Lard	2.0	2.5
Limestone	0.5	0.5
Biomindif	2.0	2.0
Rovimix	25 g	25 g
Rovimix	25 g	25 g
Bifuran (coccidiostat)	40 g	40 g
*Protein (%)	23.0	20.0
*Metabolizable energy/g diet (calculated)	3200 cal.	3200 cal.
Protein : ME ratio	1 : 135	1 : 166

*Determined values.

TABLE 2

Organ weights per cent body weight

Organs	Treatment identification										CD
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	(P<.05)
Level of feeding (%)	100	95	95	95	90	90	90	85	85	85	
Duration of restriction (wks)	0	2	3	4	2	3	4	2	3	4	
Heart	0.47	0.50	0.49	0.52	0.52	0.52	0.54	0.52	0.53	0.52	0.06
Liver	2.16	2.18	2.29	2.40	2 22	2.20	2.33	2.20	2.14	2.28	0.24
Pancreas	0.19	0.19	0.18	0.20	0.20	0.20	0.20	0.21	0.16	0.18	0.03
Spleen	0.23	0.18	0.21	0.21	0.20	0.24	0.20	0.21	0.18	0.20	0.04
Gizzard	2.52	2.40	2.66	2.46	2.28	2.45	2.35	2.44	2.31	2.44	0.28

The feed restriction decreased the weights of spleen and pancreas in case of chicks fed 95% of *ad lib* feeding for 2 weeks and 85% for 3 weeks in case of spleen and 85% of *ad lib* feeding for 3 weeks in case of pancreas. These results, however, need further investigation.

Metabolizable energy (ME) values are given in Table 3. The estimated values were higher than the calculated ones. Such results were also obtained by Baldini (1960), Sibbald *et al* (1960), Thakur (1973) and Saxena (1973). The ME values of chicks on *ad lib* feeding remained unaffected as the age of the birds advanced. There was, however, a progressive decrease in ME values as the level and duration of restriction was increased. Yoshida and Hoshii (1968) reported contrary to this finding, whereas findings of Vaidya *et al.* (1974) are in agreement with the present observations.

TABLE 3

Effect of feeding restriction on the ME value (K cal/g) of feed

Treatments	6th week	7th week	8th week	9th week	10th week
T_1	3.46	3.43	3.30	3.43	3.52
T_2	—	3.48	—	—	3.58
T_5	—	3.30	—	—	3.49
T_8	—	3.34	—	—	3.41
T_3	—	—	3.34	—	3.48
T_6	—	—	3.30	—	3.41
T_9	—	—	3.06	—	3.49
T_4	—	—	—	3.24	3.37
T_7	—	—	—	3.27	3.48
T_{10}	—	—	—	3.35	3.36

TABLE 4

Effect of restricted feeding on nitrogen retention

Treatments	6th week		7th week		8th week		9th week		10th week	
	NR*	PNR**	NR	PNR	NR	PNR	NR	PNR	NR	PNR
T_1	1.33	58.7	1.21	57.7	1.08	48.0	1.85	51.6	1.76	66.6
T_2	—	—	0.95	50.5	—	—	—	—	1.66	68.4
T_5	—	—	0.90	50.5	—	—	—	—	1.52	58.2
T_8	—	—	0.90	58.9	—	—	—	—	1.64	62.9
T_3	—	—	—	—	1.20	56.9	—	—	1.65	56.5
T_6	—	—	—	—	1.16	58.1	—	—	1.68	62.6
T_9	—	—	—	—	1.91	47.8	—	—	1.51	61.1
T_4	—	—	—	—	—	—	0.94	43.2	1.55	65.2
T_7	—	—	—	—	—	—	0.80	38.4	1.61	61.2
T_{10}	—	—	—	—	—	—	0.99	50.7	1.55	58.9

*Nitrogen retention in g/bird/day.

**Per cent nitrogen retention.

The results of the nitrogen balance studies are presented in Table 4. The values are expressed as nitrogen retained/bird/day and their respective per cent values. The results of the present study indicated that restriction of feed intake during the finishing period did not improve the nitrogen retention of broilers compared to those kept on *ad lib* feeding throughout 10 weeks feeding period. The results of this study are in agreement with the findings of Vaidya *et al.* (1974) and contrary to those of Yoshida and Hoshii (1968).

REFERENCES

A. O. A. C. 1970. *Official methods of Analysis.* Association of Official Agricultural Chemists, Washington, D. C.

Baldini, J. T. 1960. The effect of dietary deficiency on the energy metabolism of chicks. *Poult. Sci.* 39 : 1232.

Osbourn, D. F. and Wilson, P. N. 1960. Effects of different patterns of allocation of a restricted quantity of food upon the growth and development of Cockerels. *J. Agric. Sci. Camb.* 54 : 278-89.

Rostagno, H. S. and Featherston, W. R. 1970. Influence of protein intake, fasting and refeeding on liver size and composition in chicks. *Poult. Sci.* 49 : 1719-27.

Saxena, V. P. 1975. Effect of levels and sources of protein and energy on broiler performance. Ph. D. Thesis. Haryana Agricultural University, Hissar.

Sunaria, K. R. and Sharda, D. P. 1979. Effect of restricting feed intake of broilers on their growth, efficiency of feed conversion and economics of production. *Haryana Agric. Univ. J. Res.* 9(1) : 79-86.

Sibbald, J. R., Summers, J. D. and Slinger, G. L. 1960. Factors effecting the metabolizable energy content of poultry feeds. *Poult. Sci.* 39 : 544-56.

Steel, R. G. D. and Torrie, J. H. 1960. *Principles and procedures of statistics with special reference to biological experiments.* McGraw-Hill Book Co. Inc., New York.

Thakur, R. S. 1973. Studies on guar meal *(Cyamopsis tetragonoloba* L.) inclusion in broiler rations. M.Sc. thesis. Haryana Agricultural University, Hissar.

Vaidya, S. V., Sathe, B. S. and Netke, S. P. 1974. Studies on the effect of restricted feeding on nutrient utilization in white Leghorn pullets. *Indian J. Poult. Sci.* 9 : 119-23.

Yoshida, M. and Hoshii, H. 1968. Effect of restriction of feeding time of extremely high or low energy diet on the growth of chicks. *Jpn. Poult. Sci.* 5 : 202-10.

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CLINICAL AND HAEMATOLOGICAL CHANGES DURING EXPERIMENTAL *BABESIA BIGEMINA* INFECTION IN SPLENECTOMISED CROSS-BRED CALVES

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With the introduction of cross-breeding programme on a large scale in India, the haemoprotozoan diseases have gained great importance because of more susceptibility of exotic and cross-bred cattle than indigenous stock (Gautam, 1978). This paper reports clinical and haematological findings observed during experimental *Babesia bigemina* infection in splenectomised cross-bred calves.

Twelve male cross-bred calves (Red Kandhari × Jersey and Deoni × Holstein-Friesian) having a blood level of 50% each, in the age group of 8-12 months, were used in this study. The calves were kept under uniform conditions of housing and feeding and the sheds were sprayed regularly with 0.5% Sumithion (Tata Fison) to keep them free from ticks. Each of the 12 splenectomised calves was inoculated intravenously (i/v) with 150 ml of blood obtained from a clinical case of babesiosis in a cow showing 5% parasitaemia. For studying different parameters, the cross-bred calves were splenectomised as per the technique of Singh and Gautam (1972). Clinical and haematological observations before and after *B. bigemina* infection were recorded in all the calves. The per cent parasitaemia was counted in Giemsa stained smears and expressed as number of parasitised erythrocytes per unit of 100 erythrocytes. The haematology were done according to the procedures of Schalm *et al.* (1975). The fragility of erythrocytes in apparently healthy and *B. bigemina* infected calves was done by the method of Dacie and Lewis (1968).

The first rise of temperature coincided with the appearance of parasitised erythrocytes in peripheral circulation after 3-8 days following infection. Roychoudhary (1973) and Pandey and Mishra (1978) reported incubation period of 3-5 days, and 2-3 days, respectively, in indigenous calves.

Clinical signs of fever, anorexia, depression, anaemia, haemoglobinuria and jaundice in terminal stage of the disease seen are in agreement with the observations recorded by Reik (1968), Roychoudhary (1973), Dwivedi *et al.* (1976) and Pandey and Mishra (1978). The temperature declined at the onset of haemoglobinuria which was a constant finding in

all the calves. Nine calves died between 13-33 days after infection showing parasitaemia range of 1-8.3% with severe anaemic changes.

There was a severe anaemia in all calves as evaluated by low values of haemoglobin (2.3-5.4g%), packed cell volume (11-21%) and total erythrocyte count (3.1-6.27m/cmm)and are in agreements with the results of Neitz (1938), Wright (1971), Gautam and Roychoudhary (1972), Dwivedi (1975) and Pandey and Mishra (1977). The neutropenia and lymphocytosis recorded in the present studies are contrary to the findings of Roychoudhary (1973) and Pandey and Mishra (1978). There were no significant changes in total leucocyte count during the course of the disease.

The red blood cells (RBC) parasitised with *B. bigemina* were significantly larger in size having a little bluish tinge haemoglobin than non-parasitised RBC. This is in confirmity with the work of Wright (1972) and Schalm *et al.* (1975). This characteristic would prove very helpful in diagnosis of this disease.

There was a significant increase in the osmotic fragility of infected erythrocytes and haemolysis occurred even in 0.80% sodium chloride solution at peak of the disease as compared to 0 20 to 0.70% recorded in healthy calves. This is in agreement with the results of Wright (1973a), Kreier (1977) and Bauer *et al.* (1974).

REFERENCES

Bauer, J. D., Ackerman, P. G. and Toro, G. 1974. *Clinical Laboratory Methods.* 8th ed. Saint Louis : The C. V. Mosby Company.

Dacie, J. V. and Lewis, S. M. 1968. *Practical Haematology.* 4th ed. New York : Grune and Stratton.

Dwivedi, S. K. 1975. Studies on serodiagnosis, immunity, pathology and therapy of *Babesia bigemina* in cattle. Ph. D. Thesis, Haryana Agricultural University, Hissar.

Dwivedi, S.K., Sharma, S. P. and Gautam, O.P. 1976. Babesiosis : Clinical cases in exotic and cross-bred cattle. *Indian Vet. J.* 54 : 469-72.

Gautam, O. P. 1978. Babesiosis in India. Paper presented at staff course on "Control of Livestock Diseases" held at Dept. Vet. Med., H. A. U. Hissar, 1-10 March, 1978.

Gautam, O. P. and Roychoudhary, G. K. 1972. Babesiosis. Paper presented at 'First All India Conference on Blood Protozoan Diseases' held at Hissar, February, 1972.

Kreier, J. P. 1977. *Parasitic Protozoa* Vol. IV, New York : Academic Press.

Neitz, W. O. 1938. Classification, transmission and biology of piroplasms of domestic animals. *Ann. N. Y. Acad. Sci.* 64 : 56-111.

Pandey, N. N. and Mishra, S. S. 1977. Studies on haematological changes and blood glucose level in *Babesia bigemina* infection in indigenous cow-calves. *Indian Vet. J.* 54 : 880-83.

Pandey, N. N. and Mishra, S. S .1978. Studies on clinical symptoms and percentage of parasitaemia in experimental *Babesia bigemina* infection in cow-calves. *Indian Vet. J.* 55 : 139-43.

Riek, R. F. 1968. Babesiosis. In : *Infectious Blood Diseases of Man and Animals.* By Weinman and Ristic, Vol. II, New York : Academic Press, pp. 219-68.

Roychoudhary, G. K. 1973. Studies on some aspects of bovine babesiosis. Ph. D. Thesis, Haryana Agricultural University, Hissar.

Schalm, O. W., Jain N. C. and Carroll, E. J. 1975. *Veterinary Haematology*, 3rd ed. Philadelphia : Lea and Febiger.

Singh, B. and Gautam, O. P. 1972. Splenectomy technique in cattle sheep and goat. *Tripura Vet. Bull.* 3 : 1-4.

Wright, I. G. 1971. A study of the morphology and pathology of experimentally induced *Babesia argentina* and *Babesia bigemina* infections in cattle and *Babesia canis* infection in the dog. Ph. D. Thesis, Univ. Queensland, Brisbane, Australia.

Wright, I. G. 1972. Studies on the pathogenesis of *Babesia argentina* and *Babesia bigemina* infections in splenectomised cow-calves. *Z. Parasitkde* 39 : 85-102 (Cited by Aragon 1976). Bovine babesiosis : a review *Vet. Bull.* 46 : 903-17.

Wright, I. G. 1973a. Osmotic fragility of erythrocytes in acute *Babesia argentina* and *Babesia bigemina* infections in splenectomised Bastaurus calves. *Res. Vet. Sci.* 15 : 299-305.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 3, pp. 462—463 (September 1980)

UTILIZATION OF AGRO-INDUSTRIAL BY-PRODUCTS BY LIVESTOCK AND POULTRY

IV. NUTRITIVE VALUE OF MALT SPROUT IN SHEEP

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Malt sprout, a byproduct obtained during malting process of barley consists of plumule and radicle of barley. As the byproduct is fibrous in nature and rich in protein, it could not be utilized by poultry (Khirwar *et al.*, 1979). The availability of this byproduct has increased tremendously with the growing number of breweries. Therefore, an attempt was made to assess its nutritive value in adult sheep.

Twelve adult rams of Nali breed of approximately same age and body weight (30 kg) were selected and distributed into two comparable groups of 6 rams each. These rams were housed in hygienic pens having arrangements for individual feeding and watering. The animals were dewormed before the start of experiment and once in the mid of the experiment. The rams under control group were fed on an average berseem hay @ 1 kg/day and under experimental group they were fed on an average 350g berseem hay and 530 g malt sprout. These rations were supplemented with common salt, minerals and vitamins. The rams were fed according to the requirements prescribed for maintenance (NRC 1968). The experimental feeding continued for 95 days including a collection period of 5 days. The records of daily feed intake and feces were maintained. The animals did not loose any weight. The samples of feeds and feces were analysed for proximate principles (AOAC, 1970).

The chemical composition of berseem hay and malt sprout on dry matter basis was 18.02 and 25.97% crude protein, 1.38 and 0.69% ether extract, 30.56 and 12.81% crude fibre, 9.32 and 7.55% total ash and 40 72 and 52.98% nitrogen free extract, respectively.

The dry matter intake per 100 kg body weight was 2.81 ± 0.03 and 2.51 ± 0.04 kg in control and experimental groups, respectively. The digestibility coefficients of malt sprout were calculated by difference method and presented in Table 1. On the basis of digestibility coefficients, malt sprout was found to contain 17.28% digestible crude protein (DCP) and 61.74% total digestible nutrients (TDN). Lotha and Arora (1979) reported that malt sprout when offered to crossbred cattle revealed 14.51% and 61.11% DCP

TABLE 1

Digestibility coefficients of proximate principles (on DM basis)

Proximate principles	Berseem hay	Berseem hay + Malt sprout	Malt sprout (By difference)
DM	55.98±1.52	61.65±2.36	63.68±3.86
CP	63.77±3.11	64.86±2.72	66.55±4.92
EE	41.11±4.13	44.06±3.75	47.74±7.88
CF	49.00±1.62	48.10±2.48	32.28±5.99
NFE	63.68±2.40	71.38±2.15	74.70±3.09

and TDN, respectively. The difference in DCP content might be explained on the basis of crude protein content (21.0%) of the malt sprout used by these authors. While in the present experiment, malt sprout was found to contain 25.97% CP. On the basis of figures of DCP and TDN, it could be inferred that malt sprout could successfully be incorporated in the ration of growing lambs.

REFERENCES

AOAC 1970. *Official Methods of Analysis.* 11th ed. Association of Official Agricultural Chemists, Washington, D C.

Khirwar, S. S., Paliwal, V. K. and Pradhan, K. 1979. Utilization of agro-industrial by-products by livestock and poultry-I. Effect of malt sprout and pea waste on broilers. *Haryana agric. Univ. J. Res.* 10 (I) : 101-09.

Lotha, C. and Arora, S. P. 1979. Nutritive value of malt sprout and its effect of feeding on growth rate. *Indian Vet. J.* (In press).

NRC. 1968. *Nutrient Requirement of Domestic Animals.* Nutrient requirements of sheep. National Academy of Sciences, National Research Council, Washington, D. C.

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EFFECT OF LYSINE SUPPLEMENTATION OF LOW PROTEIN DIETS ON THE PERFORMANCE AND CARCASS QUALITY OF PIGS

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Since lysine is the most limiting amino acid in practical swine diets, the present study was undertaken to find the effect of lysine supplementation on the performance and carcass quality of exotic pigs under Indian conditions.

Ten Middle White Yorkshire pigs of about 16 kg body weight were randomly divided into two groups of 5 pigs each. The composition of experimental diets is given in Table 1. The feed ingredients and feeds used in the study were analysed by the method described by AOAC (1970). One group of pigs (A) was fed 14–12% C. P. unsupplemented diets while the second group (B) was fed 14–12% C. P. diets supplemented with 0.1% synthetic L-lysine. Pigs of both the groups were offered feed and water *ad lib.* Their growth (ADG) and feed efficiency (F/G ratio) were determined during the growing, finishing and combined periods. The pigs were slaughtered when they reached a body weight of 70-75 kg. The slaughtering procedure was the same as described by Sharda and Pradhan (1976). The data were analysed by analysis of variance as suggested by Steel and Torrie (1960).

The ADG of pigs fed the supplemented diet were 569 and 646 g during the growing and finishing periods, respectively. These were larger than those fed unsupplemented 14% diet, viz., 487 and 546 g, respectively. The differences among the treatment means were found to be statistically significant ($P < 0.05$). These results are consistent with the findings of Ostrowski (1969).

The feed/gain ratio was not different for the pigs fed the supplemented and unsupplemented diets. Ostrowski (1969), however, reported that the feed per unit of gain was less by 13.5% when lysine was added in the diet. Amino acid supplementation increased the dressing per cent of the pigs fed this diet ($P < 0.05$ Table 2). Other carcass traits were not influenced by lysine supplementation of low protein diet.

The organ weights expressed as a per cent of kill weight were not influenced by lysine supplementation except the heart weight which were significantly larger for pigs fed supplemented diet compared to those fed the unsupplemented one ($P < 0.05$). The results of the

TABLE 1

Experimental diets (%)

Ingredient	Growing Phase		Finishing Phase	
	A	B	A	B
Maize	86.2	86.2	90.5	90.5
Groundnut cake	5.3	5.3	1.0	1.0
Fish meal	6.0	6.0	6.0	6.0
Mindlf[a]	0.5	0.5	0.5	0.5
Limestone	1.0	1.0	1.0	1.0
Bone meal	1.0	1.0	1.0	1.0
Rovimix[b]	15g	15g	15g	15g
Rovibe[c]	25g	25g	25g	25g
Lysomix[d]	—	100g	—	100g
C. P. %	14	14	12	12
C. F.%	2.45	2.45	2.98	2.98
ME Kcal/kg	3169	3167	3169	3167
Lysine	0.56	0.66	0.50	0.60
Wt. gain (g)	487	569	546	646
Feed/gain ratio	3.29	3.22	4.30	4.05

[a] Mindif 'pig' contained : 25% calcium : 9% phosphorus : 30% sodium chloride : 0.5% iron : 0.05% iodine : 0.08% copper : 0.1% manganese : 0.15% cobalt and 0.15% sulphur.

[b] Rovimix contained vitamin A 40,000 I. U., vitamin B_2 20 mg and vitamin D_3 5,000 I. U. per g supplement.

[c] Rovibe contained vitamin B_1 4 mg : vitamin B_6 8 mg; vitamin B_{12} 40 mg : niacine 16 mg : calcium pantothinate 40 mg and vitamin E 40 mg per g supplement.

[d] Lysomix Aries contains L-lysine hydrochloride in pure form.

TABLE 2

Effect of lysine supplementation of low protein diets on carcass traits

Item	Diet		CD (P <0.05)
	A	B	
Kill weight (kg)	80.2	72.6	6.7
Dressing per cent	66.0	70.8	3.9
Length (cm)	68.8	69.2	5.9
Avg. back fat thickness (cm)	3.88	4.18	0.89
Longissimus dorsi area (cm^2)	33.5	33.7	11.7
Lean cut %	63.2	61.3	3.5
Primal cut %	71.1	69.6	4.3
Ham+loin %	49.3	48.0	2.3
Colour score	1.9	1.8	0.64
Firmness score	2.4	2.9	0.48
Marbling score	2.4	3.2	0.64

present study indicated that the quality of low protein diets could be improved by supplementation with L-lysine, which is the most limiting amino acid for swine.

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REFERENCES

AOAC. 1970. Official Methods of Analysis. 11th Ed. Association of Official Agricultural Chemists, Washington, D. C.

Ostrowski, H. 1969. The effects of dietary supplementation with lysine and methionine on body and tissue composition in pigs. *Anim. Prod.* 11 : 521-32.

Sharda, D. P. and Pradhan, K. 1976. Growth and carcass quality of pigs fed diets containing damaged sorghum grains. *Haryana agric. Univ. J. Res.* 6 (34) : 212-17.

Steel, R. G. D. and Torrie, J.H. 1960. *Principles and Procedures of Statistics*. 99-128, New York, Toronto and London. Mc. Graw Hill Book Co. Inc.

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INHERITANCE OF KERNEL WEIGHT IN WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

Griffing's analysis of an 8×8 diallel set revealed that both additive and non-additive type of gene actions determined kernel weight in wheat. The gca : sca ratio indicated preponderance of additive genetic variance. Sonalika was found to be the best general combiner for boldness. The use of array means in place of gca effects and *per se* performance instead of sca effects has been advocated. Sonalika × Agra local in high fertility and Sonalika × UP 301 in low fertility were found to be the best crosses. Hayman's approach also indicated the importance of both additive and non-additive types of gene action. Two gene pairs appeared to determine kernel weight. Dominant genes were responsible for higher kernel weight. Use of recurrent selection for the exploitation of both types of gene action has been suggested.

Grafius (1956) has suggested the possibility of working with yield components which are likely to be more simply inherited than is yield itself. Since then "component breeding" rather than direct selection on yield has commonly been practiced. It is in this context that genetical studies on yield components attain special significance. Such studies elucidate the breeding behaviour and thus, help in framing a pragmatic breeding programme. Therefore, understanding the genetic architecture of important yield components like kernel weight is obviously pre-requisite for any crop improvement effort. In the present paper, the results of different genetical studies on kernel weight in wheat using various breeding approaches have been reported.

MATERIAL AND METHODS

Eight wheat varieties both of Mexican (Sonora 64, Sonalika, Kalyansona, PV 18, Lerma Rojo) and Indian (Agra Local) origin as well as their derivatives (Hira, UP 301), including different height and maturity groups and having various seed sizes, were crossed in all possible ways, excluding reciprocals. The 8×8 diallel set, thus prepared, was grown under two fertility levels (high and low) at University Farm. Sowings were done in 3 m long rows spaced 30 cm apart with a

plant to plant distance of 15 cm. Data were recorded on five randomly selected plants on 100 grain weight. Diallel analysis was done according to the method proposed by Hayman (1954). Narrow-sense heritability was calculated as $\frac{1}{4}D/(\frac{1}{4}D+\frac{1}{2}H_1-\frac{1}{4}F+E)$ following Crumpacker and Allard (1962). Combining ability analysis was carried out following Griffing's (1956) method 2 model 1.

RESULTS AND DISCUSSION

Analysis of variance for combining ability is presented in Table 1. The mean squares due to gca and sca for kernel weight were highly significant under high as well as low fertility levels revealing thereby that both additive and non-additive type of gene actions were involved in the inheritance of this trait. The gca : sca ratio was more than one, suggesting predominance of additive genetic variance. The present findings are in close agreement with the earlier reports (Kronstad and Foote, 1964; Paroda and Joshi, 1970; Walton, 1971; Bains and Gupta, 1972; Nanda *et al.*, 1974).

The estimates of gca effects are given in Table 2. Sonalika had maximum gca effects under both the environmental conditions. Sonalika, Agra Local and Sonora 64 under high fertility and Sonalika, Sonora 64 and Hira under low fertility conditions were found to be good general combiners for higher kernel weight. The information on gca effects could also be obtained from array means and even from the F_2 generation (Table 3). Jatasra and Paroda (1979) have also suggested the use of array means in place of gca effects. Further, crosses selected on the basis of *per se* performance and sca effects were not the same. This is because sca effects are merely a measure of the deviation of F_1 performance, so that for a given hybrid performance the sca effects may or may not be high depending upon the performance of parental lines. Thus, high sca and high heterosis over better parent need not necessarily mean a high performance by the hybrid as well. Therefore, the estimation of sca effects seems rather of limited value. On the other hand, the best crosses selected on the basis of *per se* performance and heterosis over

TABLE 1

Mean squares for general combining ability and specific combining ability for kernel weight in wheat using Griffing's (1956) methods 2 and 4

Source	d. f.	Method	Mean squares		F	
			High fertility	Low fertility	High fertility	Low fertility
General combining ability	7	2	0.872**	0.185**	37.91	12.33
	7	4	0.686**	0.116**	25.41	7.73
Specific combining ability	28	2	0.083**	0.093**	3 61	6 20
	20	4	0.053**	0.091**	1.96	6.07
Error	70	2	0.023	0.015		
	54	4	0.027	0.015		
gca : sca ratio		2	10.510	1.990		
		4	12.940	1.270		

**Significant at 1% level.

TABLE 2

Estimates of gca effects for kernel weight computed from F_1 and F_2 generations using methods 2 and 4

Variety	Method	High fertility		Low fertility	
		F_1	F_2	F_1	F_2
Hira	2	−0.11	0.01	−0.01	−0.01
	4	−0.21	−0.01	0.03	0.03
Sonora 64	2	0.05	0.02	−0 01	−0.01
	4	0.07	0.03	0.03	0.04
Sonalika	2	0.61	0 46	0.33	0.33
	4	0.69	0.45	0.30	0.29
Kalyansona	2	−0.23	−0.12	−0.07	−0.05
	4	−0.23	−0.05	−0.07	−0.05
PV 18	2	−0.25	−0.17	−0.07	−0.09
	4	−0.23	−0.09	−0.04	−0.06
Lerma Rojo	2	−0.05	−0.07	−0.06	−0.02
	4	−0.10	−0.13	−0.03	0.03
UP 301	2	−0.24	−0.04	−0.05	0.00
	4	−0.28	0.06	−0.18	−0.10
Agra Local	2	0.28	−0.10	−0.06	−0.14
	4	0.28	−0.24	−0.03	−0.17
C. D. 5%	2	0.080	0.064	0.064	0.063
(gi−gs)	4	0.113	0.090	0.083	0.079

TABLE 3

Three best parents and cross combinations for kernel weight selected on the basis of different criteria

Criterion	High fertility			Low fertility		
	First	Second	Third	First	Second	Third
Parents						
Per se performance	3	8	1	3	7	4
Array mean	3	8	2	3	2	1
GCA effect (F_1)	3	8	2	3	2	1
GCA effect (F_2)	3	2	1	3	2	1
Cross combinations						
Per se performance	3×8	2×3	3×5	3×7	3×6	2×3
Heterosis over better parent	1×8	2×6	4×7	4×8	2×8	1×8
Heterosis over check	3×8	2×3	3×5	3×7	3×6	2×3
SCA effect (F_1)	1×8	3×5	2×6	3×8	5×6	3×7
SCA effect (F_2)	3×7	5×7	4×5	2×8	1×6	3×7

1. Hira 2. Sonora 64 3. Sonalika
4. Kalyansona 5. PV 18 6. Lerma Rojo
7. UP 301 8. Agra Local

check were identical. The choice of best cross combinations, therefore, could be based on either of these parameters. Sonalika × Agra Local under high fertility and Sonalika × UP 301 under low fertility environments were identified to be the best crosses for this attribute. Interestingly, parents of these crosses were also good general combiners. Hence, these hybrids could be exploited more profitably in the varietal breeding programme. The best three crosses selected on the basis of sca effects calculated from F_1 and F_2 generations were not similar. Hence, it may be inferred that information on sca effects could not be gathered from the F_2 data.

The estimates of the components of genetic variation (D, H_1, H_2, F) along with their ratios are presented in Table 4. The estimates of t^2, b and $H_2/4H_1$ fulfilled the assumptions of the diallel. The D and H_1 components were found to be statistically significant in both the environments revealing thereby that both additive and non-additive type of gene actions were involved in the inheritance of kernel weight.

The estimated degree of dominance was more than one, suggesting over-dominance and thus, preponderance of non-additive gene action. Symmetry in the proportion of the positive and negative genes was indicated by the ratio $H_2/4H_1$. The estimate of the ratio $(4DH_1)^{\frac{1}{2}}+F/(4DH_1)^{\frac{1}{2}}-F$ which gives the relative estimate of dominant and recessive alleles, did not give consistant results in the two environments. The negative correlation between parental order of dominance and the parental measurements indicated that the positive genes, i. e., those for heavier kernel weight were mostly dominant. The ratio h^2/H_2 indicated that two genes or gene groups exhibited dominance out of all the genes controlling kernel weight. However, this ratio appeared to have been underestimated under low fertility conditions. It is because of the fact that most of the genotypes were from high yielding Mexican wheats which show

TABLE 4

Estimates of the genetic components of variation for kernel weight in wheat

Genetic components of variation	High fertility	Low fertility
D	0.217±0.009	0.119±0.011
H_1	0.244±0.021	0.210±0.026
H_2	0.221±0.017	0.118±0.023
F	−0.130±0.021	0.011±0.026
E	0.023±0.003	0.015±0.004
Heritability (%)	20.15	31.42
$(H_1/D)^{\frac{1}{2}}$	1.06	1.33
$H_2/4H_1$	0.22	0.22
$(4DH_1)^{\frac{1}{2}}+F/(4DH_1)^{\frac{1}{2}}-F$	0.56	1.07
h^2/H_2	2 02	0.91
r	−0.95*	0.17
b±Sb	1.02±0.173	0.99±0.319
t^2	1.23	0.77

*Significant at 5%.

their genetic potential fully only under high fertility conditions. Narrow-sense heritability was moderate under high as well as low fertility conditions.

From the foregoing discussion it is now clear that both additive and non-additive types of gene effects were responsible for the inheritance of 100 kernel weight in wheat. The breeding plan such as recurrent selection which can exploit both the fixable and non-fixable components of gene action is suggested. Further more, the handling of this trait for genetic manipulations appeared to be easier since it was governed by a few genes (probably two) and heavier kernels were dominant over lighter ones. Moreover, environmental influence was relatively low.

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REFERENCES

Bains, K. S. and Gupta, V. P. 1972. Variation of yield and its component traits in six bread wheat crosses. *Genet. Agrar.* 26 : 21-32.

Crumpacker, D. W. and Allard, R. W. 1962. A diallel analysis of heading date in wheat. *Hilgardia* 32 : 275-318.

Grafius, J. E. 1956. Components of yield in oats, a geometric interpretation. *Agron. J.* 48 :419-23.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.* 9 : 463-93.

Hayman, B. I. 1954. The theory and analysis of diallel crosses. *Genetics* 39 : 789-809.

Jatasra, D. S. and Paroda, R. S. 1979. Heterosis and combining ability analysis for synchrony traits in wheat. *Indian J. Genet.* 39 (3) : 378-83.

Kronstad, W. E. and Foote, W. H. 1964. General and specific combining ability estimates in winter wheat *(T. aestivum* vill., Host.). *Crop Sci.* 4 : 616-19.

Nanda, G S., Gill, K. S. and Sharma, S. K. 1974. Combining ability in wheat. *Genet. Agrar.* 28 : 307-16.

Paroda, R S. and Joshi, A. B. 1970. Genetic architecture of yield and components of yield in wheat. *Indian J. Genet.* 30: 298-314.

Walton, P. D. 1971. Genetics of yield in spring wheat *(T. aestivum* L.). *Can. J. Genet. Cytol.* 13 : 110-14.

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STUDIES ON THE CHEMICAL CONTROL OF *HELIOTHIS ARMIGERA* HUBNER (NOCTUIDAE: LEPIDOPTERA) ON PIGEONPEA (*CAJANUS CAJAN* (L.) MILLSP.)

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ABSTRACT

An insecticidal trial of spraying monocrotophos 0.04%, quinalphos 0.07%, formothion 0.05% phosalone 0.07%, fenitrothion 0.05%, dimethoate 0.03%, trichlorophen 0.01%, phenthoate 0.075%, and endosulfan 0.07%, was carried out during 1977 for the control of pod borer, *Heliothis armigera* (Hubner) on an early maturing variety (Prabhat) of pigeonpea. Another treatment of dusting with carbaryl 5%, quinalphos 1.5%, phosalone 4%, endosulfan 4%, malathion 5% and toxaphene 10% was also given for the control of the pod borer. Spray material of each insecticide was used @ 750 l/ha, while all the dusts in their commercial formulations were applied @ 25 kg/ha. Although all the insecticidal treatments proved better in reducing pod borer incidence yet spraying of endosulfan, phenthoate, and monocrotophos, and dusting of endosulfan, carbaryl, and malathion were considered to be the most effective, both for reducing pod borer infestation and improving yield of the crop significantly.

Pod borer, *Heliothis armigera* (Hubner) is a serious pest of pigeonpea. It was effectively controlled by three sprayings of endosulfan 0.07%, carbaryl 0.01%, and chlordimeform 0.07%, at 15 days interval commencing from blossom stage (Sangappa *et al.*, 1977). No work had, however, been carried out to develop effective control of this borer in Haryana. Experiments were, therefore, conducted to evolve suitable chemical measures for controlling this serious borer pest.

MATERIAL AND METHODS

Two experiments were carried out during 1977 for the control of *H. armigera* on pigeonpea. In one experiment, 10 different insecticides in spray formulation (Table 1) and in another experiment, 6 different insecticides in dust formulation (Table 2) were included. Both the experiments were conducted on an early maturing variety (Prabhat) of pigeonpea, in randomised block design, each replicated three times with plot size 5.0 × 4.5 m. The row to row distance was 50 cm. Sowing of the crop was done on 30th June 1977. Two insecticidal treatments were given. First at a stage when 50% pods were formed (in the second week of October) and second 15 days after the first treatment. In case of liquid formulation of insecti-

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TABLE 1

Comparative efficacy of different insecticides applied as spray for the control of *H. armigera* on pigeonpea

Treatments	Pods damaged (%)	Grain damaged (%)	Yield (q/ha)	Increase over control (%)
Monocrotophos 0.04%	7.3(15.32)	5.1(12.24)	17.809	11.0
Carbaryl 0.1%	13.7(21.17)	5.8(13.82)	16.770	4.6
Quinalphos 0.07%	8.7(17.26)	3.1(9.64)	16.067	0.2
Formothion 0.05%	13.9(21.78)	7.7(15.93)	17.758	10.7
Phosalone 0.07%	11.5(19.72)	6.6(14.83)	16.722	4.3
Fenitrothion 0.05%	14.6(22.50)	5.9(13.95)	16.722	4.3
Dimethoate 0.03%	14.4(21.81)	5.1(12.92)	17.529	9.3
Trichlorophen 0.01%	9.8(18.10)	5.4(13.30)	17.520	9.3
Phenthoate 0.075%	6.1(14.71)	3.8(11.12)	17.804	11.0
Endosulfan 0.07%	3.2(9.78)	1.4(6.60)	18.841	17.3
Control (no treatment)	17.3(34.64)	8.2(16.66)	16.036	—
SE(m)	(1.40)	(1.72)	0.427	
C. D. (P=0.05)	(4.13)	(5.08)	1.262	

Figures in parenthesis are means of angular transformation.

TABLE 2

Comparative efficacy of different insecticides applied as dust for the control of *H. armigera* on pigeonpea

Treatments	Pods damaged (%)	Grain damaged (%)	Yield (q/ha)	Increase over control (%)
Carbaryl 5%	4.9(12.60)	2.1(8.18)	20.768	34.4
Endosulfan 4%	7.2(15.43)	1.7(7.44)	21.400	38.4
Malathion 5%	9.1(17.53)	3.8(11.17)	20.690	33.7
Quinalphos 1.5%	9.3(17.74)	3.5(10.50)	15.373	—0.6
Phosalone 4%	6.6(14.45)	3.2(10.14)	18.122	17.1
Toxaphene 10%	7.5(15.84)	2.7(9.48)	16.651	1.2
Control (no treatment)	18.5(25.80)	10.4(18.82)	16.460	—
SE(m)	(1.01)	(1.09)	1.071	
C. D. (P=0.05)	(3.11)	(3.97)	3.300	

Figures in parenthesis are means of angular transformation.

cides, spray material were used @ 750 l/ha, while commercial formulations of dusts were applied @ 25 kg/ha. Observations were recorded at the time of crop harvest. For recording incidence of *H. armigera* to pods, six plants were randomly selected from each plot. All the healthy and damaged pods present on them were counted to estimate the percentage of pods damaged. Grains eaten by the larvae of *H. armigera* were also calculated. For this purpose, all the healthy and damaged pods present on the six randomly selected plants were picked up and number of expected grains and actually eaten grains were counted to calculate the percentage grain loss. Grain yield in all the plots was also recorded.

RESULTS AND DISCUSSION

i) Comparative efficacy of different liquid formulations of insecticides

As evident from Table 1, the plots sprayed with endosulfan recorded significantly lesser infestation of pod borer (3.2%) than all the remaining treatments including control. The other effective insecticides were phenthoate and monocrotophos which recorded significantly lower incidence (6.1% and 7.3%, respectively) than all the remaining insecticides except quinalphos and trichlorophen which were almost equally effective. Carbaryl, formothion, dimethoate and fenitrothion were found ineffective as the incidence in plots treated with these insecticides were almost equal (13.7-14.6%) to untreated plots (17.3%).

The percentage grain eaten by *H. armigera* in endosulfan treated plots was significantly lesser (1.4%) than all remaining treatments. In quinalphos and phenthoate sprayed plots, grain damage was recorded to be 3.1 and 3.8%, respectively. Per cent grain damage in other treatments including control varied from 5.1 to 8.2% and differences among them were non-significant.

The grain yield in endosulfan sprayed plots was highest (18.84 q/ha). The yield recorded in endosulfan, monocrotophos, phenthoate, formothion, dimethoate, and trichlorophen treated plots was significantly higher than control (Table 1). In all other treatments, yield was almost equal to control. Per cent increase in yield over control was highest (17.3%) in endosulfan followed by monocrotophos and phenthoate (11.0%). In other treatments, increase in yield varied from 0.2–10.7 per cent.

From the above experiment it could be concluded that almost all the insecticidal treatments were found effective than control both for reducing incidence of pod borer and improving yield of the crop. Endosulfan was, however, found to be the best treatment followed by phenthoate and monocrotophos. Dimethoate, carbaryl, quinalphos and trichlorophen formed the next effective group while formothion, phosalone and fenitrothion gave inconclusive results. The spraying of 0.07% endosulfan was also reported to be the most effective treatment in controlling *H. armigera* on pigeonpea by Sangappa *et al.* (1977).

ii) Comparative efficacy of different dust formulations of insecticides

Data in Table 2 show that all the plots treated with dust formulations of all the six different insecticides recorded significantly lower pod borer infestation (4.9-9.3%) than control (18.5%). Plots dus-

ted with carbaryl recorded lowest borer incidence (4.9%) followed by phosalone (6.6%), endosulfan (7.2%), toxaphene (7.5%), malathion (9.1%) and quinalphos (9.3%). The grain damage varied from 1.7 to 3.8% in insecticides dusted plots as compared to 10.4% in untreated plots. Yield in endosulfan, carbaryl and malathion treated plots was significantly higher than untreated and quinalphos and toxaphene treated plots. The per cent increase in yield in endosulfan, carbaryl and malathion treated plots was recorded to be 38.4%, 34.4% and 33.7%, respectively, while in phosalone and toxaphene, it was only 17.1 and 1.2%, respectively. Quinalphos treated plots gave slightly lesser yield (0.6% decrease) than the control. Dusting with endosulfan or carbaryl proved to be very effective both for reducing pest damage and improving the yield of crop. Dusting of malathion was found to be equally effective in enhancing the grain yield.

Dusting of endosulfan and carbaryl which were found to be very effective treatments in the present trial were also reported to be the most effective for controlling *H. armigera* on gram (Balasubramaniam *et al.*, 1974 ; Doval *et al.*, 1976).

Endosulfan which was found to be most effective treatment as spray was also proved equally effective in dust formulation for controlling *H. armigera*. Carbaryl, which gave very good control of pod borer in its dust formulation was found slightly less effective as spray in the present trials. Spraying and dusting with quinalphos gave satisfactory reduction in damage by this borer but yield of the crop was either just equal or slightly lesser than the control. This low yield, even after giving satisfactory control of the pest, indicate that this insecticide either adversely affected flower or fruit setting or caused flower shedding but this needs further studies.

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REFERENCES

Balasubramaniam, G. and Mohamed Hanifa, A., Leela David, A. and Subramaniam, T. R. 1974. Chemical control of pod borer on bengal gram. *Madras Agric. J.* 61: 232-33.

Doval, S. L., Bohra, O. P. and Sharma, S. K. 1976. Studies on chemical control of *Heliothis armigera* (Hb.) on gram *(Cicer arietinum). Indian J. Plant Prot.* 4 : 6 8.

Sangappa, H. K., Musthak. Ali, T. M. and Balaraju, B. S. 1977. Efficacy of insecticides in controlling the pod borers of redgram (*Cajanus cajan* Sprangal). *M,sore J. Agric. Sci.* 11 : 397-400.

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HETEROSIS AND COMBINING ABILITY IN BRINJAL (*SOLANUM MELONGENA* L.)

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ABSTRACT

Six cultivars of brinjal were crossed in a diallel fashion and six parents alongwith 15 F_1 hybrids were evaluated to study the extent of heterosis and combining ability effects. Significant differences among genotypes were observed for all the characters studied except plant height. Crosses $P_2 \times P_4$, $P_2 \times P_6$, $P_3 \times P_6$ and $P_1 \times P_5$ exhibited significant heterosis for most of the characters. The magnitude of gca variance was higher than sca for all the characters except yield, indicating the importance of both additive and non-additive gene action. Crosses $P_1 \times P_5$, $P_1 \times P_3$, $P_2 \times P_4$ and $P_3 \times P_6$ exhibited 30.25, 12 02, 11.51 and 7.57% heterosis over best check, respectively. The parents P_1(PPL), P_3(BR112) and P_4(Aushey) were the best combiners for most of the characters. Crosses $P_1 \times P_5$, $P_2 \times P_4$, $P_3 \times P_6$ and $P_2 \times P_3$, $P_1 \times P_4$, $P_4 \times P_6$ were the best specific combiner for number of fruits, yield and earliness, respectively.

In India, the presence of heterosis in vegetable crops has been reported by Gill *et al.* (1976), and Swarup and Pal (1966). In brinjal, Pal and Singh (1946), Tiwari (1966), Thakur *et al.* (1968), Singh *et al.* (1974), and Singh *et al.* (1978) reported a considerable degree of heterosis for economic characters. Study of general combining ability helps in selecting the suitable parents, while specific combining ability helps in selecting the suitable hybrids. However, formulation of certain breeding programme also depends on combining ability. Study of heterosis and combining ability needs further assessment since there is no utilization of heterosis at commercial scale, although brinjal has a great advantage of producing a large number of seeds in a cross. Keeping this idea in view, this experiment was set up to study heterosis and combining ability of a diallel cross involving six parents.

MATERIAL AND METHODS

Six cultivars, namely, Pusa Purple Long (P_1), Pusa Kranti (P_2), BR-112 (P_3), Aushey (P_4), R-34 (P_5) and Sel. 26 (P_6) were crossed in all possible combinations excluding reciprocals. Five weeks old seedlings of 15 F_1 hybrids along with their parents were transplanted in a randomized block design with three replications at the Vegetable Research Farm. Recommended cultural practices were followed during the course of experimentation.

Observations were recorded on randomly selected five plants from each

replication on number of days to flowering, number of flowers per cluster, plant height, fruit length, fruit girth, number of fruits per plant, average weight of fruit and total yield per plant. Heterosis was calculated over mid, better parents and best check.

Combining ability effects were estimated according to the method 2, model 1 followed by Griffing (1956).

RESULTS AND DISCUSSION

Significant differences among treatments for all the characters presented in Table 1 suggested the presence of wide variability. Mean values of parents and F_1's are presented in Table 2.

Heterosis over mid parent, better parent and best check were calculated and are given in Table 3. Hybrid $P_2 \times P_3$ was found to be the earliest followed by $P_1 \times P_5$ and $P_1 \times P_3$. Regarding number of flowers per cluster, significant difference was found only in one cross ($P_2 \times P_4$) that too over mid parent. Maximum positive heterosis for length of fruit was exhibited by the cross $P_2 \times P_6$ but cross $P_1 \times P_6$ was the best when heterosis was considered over best check. Tiwari (1966) also reported similar findings. For girth of fruits only one cross, viz., $P_2 \times P_6$ exhibited positive heterosis over the best parent.

For number of fruits per plant, $P_1 \times P_5$ cross showed significant positive heterosis over mid (37.49%), better and best check (26.45). Only two crosses, $P_1 \times P_5$ and $P_2 \times P_4$ exhibited positive increased yield over mid parents although the results were non-significant over better parents. Crosses $P_1 \times P_5$, $P_1 \times P_3$, $P_2 \times P_4$ and $P_3 \times P_6$ exhibited 30.25, 12.02, 11.51 and 7.57% heterosis over best check, respectively. After confirmation, hybrid $P_1 \times P_5$ can be used at commercial scale. In general, crosses showing high degree of heterosis for yield also showed heterosis for number of fruits. Therefore, increase in yield might be due to increase in the number of fruits per plant which was one of the major yield component. These results are in conformity with the results of Singh *et al.* (1974), Pal and Singh (1946) and Tiwari (1966).

Analysis of variance for gca and sca presented in Table 4 showed highly significant differences for all the characters under study except for yield per plant for gca and for number of flowers per cluster and girth of the fruit for sca, thereby, indicating the importance of additive and non-additive gene action. Yield is controlled by more of non-additive gene action. Superiority of non-additive gene action was evident for characters like days to flowering, number of flowers per cluster, fruit length, fruits per plant, weight of fruit and yield as their δ^2s was higher than δ^2g.

The general and specific combining ability effects are presented in Table 5. None of the parents showed significant positive gca effects for all the characters, however, P_1 (PPL) was found to be the good general combiner for days to flowering, number of flowers per cluster, fruit length, number of fruits and yield per plant. High gca effects for yield was shown by varieties P_1, P_5 and P_3. Parents P_1 and P_5 exhibited high gca for number of fruits also. Parents P_3 and P_4 showed significant positive gca effects for fruit weight and fruit girth.

Three hybrids had significant negative sca for days to flowering (earliness),

TABLE 1

Analysis of variance for different characters in brinjal

Source of variation	d. f.	Mean sum of squares							
		Days to flowering	Number of flowers per cluster	Plant height (cm)	Fruit length (cm)	Fruit girth (cm)	No. of fruits per plant	Average wt. of fruit (g)	Total yield per plant (g)
Replications	2	4.00	0 25	69.67	107.16**	44.61**	143.45**	0.20	648378.38**
Treatments	20	45.69**	0.62**	112.45**	66.33**	42.34**	154.92**	836.25**	209307.80*
Error	40	6.65	0.14	121.03	8.91	2.69	22.43	110.83	95202.08

*, **Significant at 5% and 1% level of significance, respectively.

TABLE 2

Mean values of parents and F_1 hybrids

Parents and crosses	Days to flowering	No. of flowers per cluster	Plant height (cm)	Fruit length (cm)	Fruit girth (cm)	No. of fruits per plant	Average weight of fruit (g)	Total yield per plant (g)
1	47.00	4.33	62.33	30.33	11.00	29.00	34	990
2	53.33	2.33	49.00	19.00	16.00	16.33	52	890
3	55.33	3.00	56.33	19.33	21.00	11.33	91	1000
4	60.00	2.67	62.33	22.00	23.67	8.00	89	707
5	50.67	3 67	55.33	26.33	13.00	24.33	49	1190
6	53.00	3.00	53.33	15.33	14.00	10.67	66	717
1×2	46.00	3.67	50 00	21.33	11.67	23.33	37	884
1×3	48.00	3.00	53.67	16.67	14.33	24.00	58	1393
1×4	47.33	3.33	54.67	25.67	15.67	17.67	61	990
1×5	46 00	4.00	58 33	27.33	11.67	36 67	42	1550
1×6	48.33	3.67	55.33	30.67	11.67	23.00	50	1160
2×3	44.33	3.00	53.33	19.33	18.33	14.67	64	933
2×4	55.33	3.00	66.67	23.00	20.33	16.00	82	1327
2×5	51.67	3.00	56 00	24.00	14.00	20.00	50	993
2×6	52.00	3.00	58.33	29.00	16.00	18.33	62	1130
3×4	53.00	3.00	56.00	19.00	22 33	13.67	78	1088
3×5	52.00	3.33	52.33	17.33	15.67	9 33	52	480
3×6	54.00	3.00	71.33	25 33	20.00	16.33	76	1280
4×5	56.00	3 00	54.33	20.00	18.67	14 67	71	1043
4×6	57 00	3.33	60.00	28.67	18.33	7.67	79	633
5×6	53.33	3.00	71.00	27.00	13.67	14.00	44	747

whereas one for number of flowers, and girth of fruit, four for length of fruits, one for number of fruits and three for total yield exhibited significant positive sca effects. Highest sca effects for total yield were observed in $P_1 \times P_5$ followed by $P_2 \times P_4$ and $P_3 \times P_6$. The estimates of sca indicated that no cross combination was consistently good for all the characters. For every character, a number of crosses had negative significant sca effects indicating the presence of epistatic effects of undesirable types. The sca effects of certain crosses had some association with gca effects of their parents. In cross ($P_1 \times P_5$) showing high sca for yield and number of fruits per plant involved atleast one parent with high gca effects for respective characters. Crosses showing highest sca for total yield involved parents with good × average ($P_1 \times P_5$), poor × poor ($P_2 \times P_4$), and average × poor ($P_3 \times P_6$) gca parents. Therefore, gca of the parents might be one of the considerations in predictions of the yield potential of a cross. Similar results were obtained by Vijay *et al.* (1978) in brinjal.

TABLE 3

Heterosis over mid parent (MP), better parent (BP) and best check (BC) in respect of eight characters of brinjal

Crosses	Days to flowering			Number of flowers per cluster			Plant height (cm)			Fruit length (cm)		
	Heterosis over (%)			Heterosis over (%)			Heterosis over (%)			Heterosis over (%)		
	MP	BP	BC	MP	BP	BC	MP	BP	BC	MP	BP	BC
1×2	−6.32*	−2.10	−2.10	10.20	−15.20*	—	−11.90	−19.71	—	−13.50	29.67*	—
1×3	−8.15	2.10	—	−18.20*	−30.70*	—	−5.00	−13.80	—	−32.80*	−45.03*	—
1×4	−12.15*	−0.70	—	−4.80	−23.00*	—	−12.00	−12.20	—	−1.90	−15.36	—
1×5	−3.77	−2.10	−2.10	0.20	−7.60	—	−0.80	−6.40	—	−3.50	−9.59	—
1×6	−6.00	2.80	—	0.20	−15.20*	—	−4.30	−11.20	—	−31.40*	1.12	1.12
2×3	−1.84*	−16.80*	−5.68	12.30	0.30	—	1.20	−5.30	—	0.80	0.57	—
2×4	−2.36	3.70	—	20.00*	12.30	—	19.70	6.90	6.96	12.10	4.54	—
2×5	−0.63	1.90	—	0.30	−18.20*	—	7.30	1.20	—	5.80	−3.84	—
2×6	−9.04*	−1.80	—	12.30	0.30	—	13.90	9.30	—	68.80*	−52.63*	—
3×4	−8.10*	−4.20	—	5.60	0.30	—	−5.60	−10.10	—	−1.50	−13.63	—
3×5	−4.40	2.60	—	−0.20	−9.20	—	−6.20	−7.10	—	−24.00*	−34.18*	—
3×6	−0.16	1.80	—	0.30	0.30	—	30.00*	26.60	14.44	46.10*	31.63	—
4×5	1.10	10.50*	—	−5.30	−18.20*	—	−7.80	−12.80	—	−17.20*	−24.04*	—
4×6	0.80	7.50	—	17.20	11.00	—	3.70	−3.70	—	53.50*	30.31*	—
5×6	2.80	5.20	—	−9.90	−18.20*	—	30.60*	28.30	13.91	26.60*	2.54	—
C.D. at 5%	3.56	4.14		0.50	0.63		15.22	17.62		4.11	4.79	

Contd.

TABLE 3—*(Contd.)*

Crosses	Fruit girth (cm)			Number of fruits per plant			Average weight of fruit (g)			Total yield per plant (g)		
	Heterosis over (%)			Heterosis over (%)			Heterosis over (%)			Heterosis over (%)		
	MP	BP	BC	MP	BP	BC	MP	BP	BC	MP	BP	BC
1×2	—13 55	—27.06*	—	2.91	—19.50	—	—13.95	—28.84	—	— 5.95	—10.71	—
1×3	—10.43	—31.71*	—	22.07	—17.24	—	— 6 45	—36.26*	—	40.00	39.36	12.02
1×4	— 9 63	—33.79*	—	— 4.48	—40.10*	—	1.66	—31.46*	—	16.74	0 01	—
1×5	— 2 75	—10.23	—	37.49*	26.44	26 45	2.43	—14.28	—	42 20*	30 25	0.25
1×6	— 6.64	—16 64	—	15.92	—20 68	—	2.04	—24 24	—	35.99	17.17	—
2×3	— 0.91	—12.71*	—	6.07	—10.16	—	— 9 85	—29.67*	—	— 0.01	— 6.70	—
2×4	—18.15*	—14.11*	—	31.47	— 2.02	—	11.42	— 7.86	—	66.29*	49.10	11.51
2×5	— 3.44	—12 50	—	— 1.67	—17.79	—	2.04	— 3 84	—	— 4.51*	—16 55	—
2×6	6.66	0.06	—	35.77	12.24	—	5 08	— .06	—	40.56	26.96	—
3×4	— 0.04	— 5.66	—	41.36	20.65	—	—13.3	—14 28	—	27.54	8.80	—
3×5	— 7.82	—25.38*	—	—47.67*	—61.65*	—	—25 71*	—31.86*	—	—56.16*	—59.66	—
3×6	—14.28*	— 4.76	—	52.09*	47.66	—	— 2.56	—16.48	—	49 18	28.00	7.57
4×5	1.79	—21.12*	—	— 9 27	— 9.70*	—	2.89	—20.22*	—	10.02	—12.35	—
4×6	— 2.70	—22.56*	—	—17 80	—28 11	—	2 59	—11.23	—	—11.09	—11.7	—
5×6	1.25	— 2.3	—	—20.00	—42.45*	—	—12.28	—33.33*	—	—21.61	—37.22	—
C D. at 5%	2.25	2.65		6.54	7.59		14 58	16.86		427.6	493.79	

*Significant at 5% level.

TABLE 4

Anova for combining ability mean sum of squares

Source of variation	d. f.	Days of flowering	Number of flowers/ cluster	Height of plant (cm)	Length of fruit (cm)	Girth of fruit (cm)	Number of fruits per plant	Av. weight of fruit (g)	Total yield per plant (g)
GCA	5	46.67**	0.60**	N. S.	35.94**	53.64**	94.51**	1707.45**	40241.18
SCA	15	7.26**	0.54	N. S.	19.00**	0.91	38.21**	195.26**	79590.03*
Error (6^2e)	40	2.21	0.04	—	2.97	0.89	7.47	36.94	31734.03
6^2g		4.93	0.01	N. S.	2.12	6.59	7.04	189.02	—4918.61
6^2s		5.05	0 50	N. S.	16.03	0.02	30.74	158.32	47856.03

*,** significant at 5% and 10% level of significance, respectively.

TABLE 5

Values of general combining ability of the parents and specific combining ability of the crosses

Parents and crosses	Days to flowering	Number of flowers per cluster	Fruit length (cm)	Fruit girth (cm)	Number of fruits per plant	Average wt. of fruits (g)	Total yield per plant (g)
1	−3.94*	0.48*	2.51*	−3.33*	7.45*	− 4 12*	114.41*
2	−0.65	−0.26*	−0.94	−0.16	0 24	0.50	0.66
3	0.10	−0.13*	−3.23*	2.37*	−2.79*	10.12*	16.54
4	3 43*	−0.18*	−0.23	3.62*	−4.66*	15 00*	−68.33
5	−0.11	0.15*	0. 6	−1.74*	−1.37	− 9.00*	18.91
6	1.18*	−0.05	1.14*	−0.75*	−2.79*	1.75	−82 20
1×2	−1.01	0 24	−3.41	−1.07	−1 95	−10.66	−237.04
1×3	0.29	−0.55*	−5.78*	−0.45	1.76	0.71	256.09
1×4	−3.76*	−0.18	0.22	−0.87	−2.70	− 1.16	− 62.04
1×5	−1.55	0.15	0.88	0.51	−10.26*	3 84	410 71*
1×6	−0.51	0.03	3 85*	0 49	0.75	1.09	121.80
2×3	−6.72*	0.20	0.34	−0.12	−0.36	− 7.91	−90.16*
2×4	0.95	0.24	1.01	0.63	2 84	5.21	388.70
2×5	0.83	−0.10	1.01	−0.33	0.80	−2.79	−30.54
2×6	−0.13	0.11	5.57*	0.67	3.80	−1.54	205.59
3×4	−2.13	0.11	−0.70	0.09	3.55	−8.41	133.84
3×5	0.41	0.11	−3.37*	−1.20	−6.33*	−10.41	561.41
3×6	1.12	−0.01	4.26*	2.13*	4.34	2.84	339.71*
4×5	1.08	−0.18	−3 70*	0.55	0.38	3.71	86.46
4×6	−3.21*	0.36*	4.60*	−0.79	−2.45	0.96	−222.41
5×6	0.66	−0.30	1.93	−0.07	−1.86	−10.04	147.00
C.D. at 5%							
(gi)	0.96	0.12	1.08	0.60	1.74	3.90	108.98
(sij)	2.64	0.34	3.04	1.66	4.84	10.76	315.80

*Significant at 5% level.

While comparing the *per se* performance and sca of crosses, some degree of association were observed. Some crosses which showed high *per se* performance also showed high sca value, for example crosses $P_1 \times P_5$, $P_2 \times P_4$ and $P_3 \times P_6$ for yield, crosses $P_2 \times P_3$ for earliness and cross $P_1 \times P_5$ for number of fruits. On the basis of these results even *per se* performance of a hybrid could give some indication for the sca.

The crosses $P_1 \times P_5$, $P_2 \times P_4$ and $P_3 \times P_6$ exhibited high heterosis alongwith high sca and one of the parents involved was of high gca.

REFERENCES

Gill, H. S., Arora, R. S., Tiwari, R. N. and Sharma, R. K. 1976. Exploitation of heterosis in tomato. *Indian J. Hortic.* 33(2): 176.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.* 9 : 463-93.

Pal, B. P. and Singh, H. B. 1946. Studies on hybrid vigour in brinjal and bitter gourd. *Indian J. Genet.* 6 : 19-33.

Singh, H. N., Singh, S. N. and Mittal, R. K. 1974. Heterosis in brinjal. *Indian J. Genet. 34 A*: 125-47.

Singh, B., Joshi, S, and Kumar N. 1978. Hybrid Vigour in brinjal *(Solanum melongena* L.*). Haryana J. Hort. Sci. 7:* 95-99.

Swarup, Vishnu and Pal, A. B. 1966. Gene effects and heterosis in cauliflower. I, *Indian J. Genet. Plant Breed* 26 (1-3) : 269.

Thakur, M. R., Singh. K. and Singh, J. 1968. Hybrid vigour studies in brinjal *(Solanum melongena* L.). *Punjab Agric. Univ. J. Res.* 5 : 490-95.

Tiwari, R. D. 1966. Studies on hybrid vigour in *Solanum melongena* L. *J. Indian Bot. Sci.* 45 : 138-49.

Vijay, O. P., Nath, Prem and Jalikap, S. N. 1978. Combining ability in a diallel cross of brinjal *(Solanum melongena* L.*). Indian J. Hort. 35 :* 35-38.

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CORRELATION AND PATH COEFFICIENT ANALYSIS IN INDIAN BEAN (*DOLICHOS LABLAB* VAR. LIGNOSUS L.)

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ABSTRACT

Experiment with thirty nine genetically diverse lines was conducted to assess the association between pairs of characters and their contribution towards yield. All the characters except length of pod and seeds per pod exhibited high correlation values with yield at both the levels. Plant height, length of pod and seeds per pod indicated positive relationship with weight of pod. however, the latter was negatively associated with pods per plant. High genotypic and phenotypic correlation coefficients were also observed between length of pod and seeds per pod. Path analysis suggested that selection based on pods per plant, weight of pod and height of plant would be more effective for the improvement of yield in Indian bean.

Yield, a dependent character, is the resultant effect of a number of quantitative characters. The study of the association between pairs of these characters and yield provides basis for further breeding plans. The correlation study does not reveal the direct and indirect contribution of individual character towards yield. In order to have more clear picture of yield components for effective selection programme, it would be desirable to consider the relative magnitude of various characters through direct and indirect effect, contributing to the observed correlation. Wright (1921) developed path coefficient technique which helps in estimating direct and indirect contribution of various components in building up the total correlation towards yield. On the basis of these studies the importance of component characters are marked to facilitate the selection programme for better gains. Therefore, the present investigations were carried out to study correlation and path analysis in Indian bean.

MATERIAL AND METHODS

The experimental material consisting of thirty nine genetically diverse lines of Indian bean was grown in 1978 in a randomized block design with three replications having a plot size of 3.0×1.5 meters with 150 cm and 60 cm spacing between rows and plants, respectively. All the five plants were taken for recording the data on six characters, viz., height of plant at 60 days (cm) , pods per plant, weight of pod (g), length of pod (cm), seeds per pod and yield per plant (kg). Statistical analysis for computation of variance and correlation coefficients were

carried cut according to the method suggested by Panse and Sukhatme (1961) and path coefficient analysis was followed as explained by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Variance analysis of the design of experiment showed significant genotypic differences for all the characters suggesting the presence of sufficient genetic variability among strains assessed (Table 1). From mean performance of varieties (Table 2) it was obvious that varieties HD 18, HD 59, HD 60, HD 91 and HD 86 were outstanding almost for all the characters. HD 59 over yielded the varieties HD 1 and HD 18, the already released ones which are in cultivation. Variety HD 83 was poorest for green pod yield. Genotypic and phenotypic correlation coefficients given in Table 3 indicated a desirable association between pairs of characters. Positive and significant association of height of plant at 60 days, pods per plant and weight per pod with yield suggested that effective improvement in pod yield through these components could be achieved, while negative association of pods per plant with weight per pod showed loss in pod weight with the increase in pod number per plant. Aggarwal and Kang (1976) stated similar results in Horse bean. Significant and positive relationship of weight per pod and seeds per pod with length of pod indicated that selection for long pods would also improve weight and seeds per pod simultaneously. Joshi (1971) in Indian bean and Singh and Mehandiratta (1969) in cowpea recorded similar trends.

Simple correlation may not be much reliable and can misguide, therefore, to find out the actual dependence of yield on its components path coefficient analysis was done and results are presented in Table 4. The strong positive association (0.4931) of pods per plant with yield was only due to its direct contribution (0.8182) which was also highest in magnitude, thereby indicating a true correlation and could be taken as a major component for the improvement of yield. These results also supported the findings of Aggarwal and Kang (1976) in Horse bean. Height of plant at 60 days made a direct positive contribution (0.3678). However, its indirect contribution (0.3225) via weight per pod was also equally important in

TABLE 1

Variance analysis for certain characters in Indian bean

Characters	Mean square		
	Replications	Genotypes	Error
d. f.	2	38	76
Height of plant	11697.00**	3303.34**	1070.70
Pods per plant	216.50	72101.29**	675 42
Weight of pod	0.53	15.94**	0.45
Length of pod	0.72	15 93**	1 21
Seeds per pod	0.08	0.60**	0.13
Yield per plant	0 01	1 87**	0.04

**Significant at 1%

TABLE 2

Mean performance of Indian bean varieties for certain characters

Varieties	Height of plant (cm)	Pods per plant	Weight of pod (g)	Length of pod (cm)	Seeds per pod	Yield per plant (kg)
1 2	3	4	5	6	7	8
1. HD 1	319.66	654.06	3.85	8.46	4.62	2.63
2. HD 5	351 66	334.82	5 85	9.04	4.63	1.72
3. HD 7	274.78	390.06	3.75	14.07	5.24	1.67
4. HD 8	275.80	271.13	5.25	12.44	4.19	1.30
5. HD 11	292.33	438.33	3.05	9.71	4.23	1.62
6. HD 12	297.33	243.95	7.92	10.28	4.42	1.29
7. HD 17	297.13	353 73	9.06	10.98	5.44	2.18
8. HD 18	344 26	366.10	8.33	8 72	4.29	3.19
9. HD 22	324.00	525.33	4.74	10.79	4 66	2.75
10. HD 23	196.93	644.55	1.35	4.66	3.36	1.17
11. HD 26	337.53	263.98	10.91	16.81	4.85	2.77
12. HD 27	356.86	89 40	9.14	10.42	4.33	0.84
13. HD 29	268 46	334 66	4.40	8.79	4.36	1.70
14. HD 30	227.00	643.00	1 57	4.78	3 56	1.30
15. HD 32	329.05	408.13	3.92	8 41	5.00	1.90
16. HD 42	328.13	336.37	3.50	9.53	4.96	1 58
17. HD 46	294.00	152.06	6.46	12.79	5.53	1.15
18. HD 57	300.13	237.20	6.11	10.17	4.90	1.19
19. HD 59	368.66	438.06	8.33	9.13	4.76	3.89
20. HD 60	318.40	415.80	8.92	8 94	4.76	3.15
21. HD 61	304.86	361.13	4 57	11.76	4.43	1.36
22. HD 65	278.75	483.06	3 92	13.57	5.44	2.00
23. HD 83	314.06	137.80	3.41	7.87	4.95	0.45
24. HD 86	343.06	772 80	4.72	10 36	4 54	2 87
25. HD 90	326.46	259 06	5 82	9.45	4.24	1 76
26. HD 91	317.73	475.40	5 59	8.70	4.51	2.94
27. HD 96	314.46	347.93	3.21	7.59	4.49	1.33
28. HD 98	303.46	369.39	7.08	8 35	4.35	2.46
29. HD 99	328.40	348.36	3.20	7.17	4.36	1 27
30. HD 100	268.33	404.33	2 36	6.68	41.15	1.11
31. HD 101	327.53	741.90	4.46	7.83	4.50	2.38
32. HD 102	311.26	166 33	5.68	8.67	4.39	0.70
33. HD 103	318.00	341 00	4 17	8 75	4 70	1.54
34. HD 106	347.73	471.36	5.20	10.66	4.91	2.72
35. HD 107	299 21	387.26	3.09	6 99	4.36	1.42
36. HD 110	320.00	360.73	2 73	6.91	4.38	1.26
37. HD 116	308 00	242.77	3.82	10 27	4 63	1.01
38. HD 120	318.03	434.51	5.38	9.77	4.76	1.95
39. Sem No. 2	300.46	326.13	8.88	11.17	5.17	2.48
C. D. at 5%	52.36	41.58	1.07	1.76	0.58	0.33

TABLE 3

Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients between pairs of characters in Indian bean

Characters	Yield per plant (kg)	Height of plant at 60 days (cm)	Pods per plant	Weight of pod (g)	Length of pod (cm)	Seeds per pod
Yield per plant (kg)	1.0000	0.5236	0.4930	0 4840	0.2045	0.2385
Height of plant at 60 days (cm)	0.3339*	1.0000	—0.2412	0.5731	0.2740	0.5121
Pods per plant	0 4739**	—0.1129	1.0000	—0 3866	—0.3192	—0 3036
Weight of pod (g)	0.4424**	0.3985*	—0.3567	1.0000	0.5655	0.4229
Length of pod (cm)	0.1765	0.1986	—0.2937	0.4577	1.0000	0.7381
Seeds per pod	0.1638	0.2378	—0.2241	0.3214*	0.5565**	1 0000

*,**Significant at 5% and 1%, respectively.

TABLE 4

Direct (diagonal) and indirect (off diagonal) effects of yield components in Indian bean

Characters	Height of plant at 60 days (cm)	Pods per plant	Weight of pod (g)	Length of pod (cm)	Seeds per pod	Genotypic correlation coefficient (rg) with yield per plant
Height of plant at 60 days (cm)	0.3678	—0.1973	0 3225	0.0012	0.0294	0 5236
Pods per plant	—0.0887	0.8182	—0 2176	—0 0013	—0 0174	0.4931
Weight of pod (g)	0.2108	—0.3163	0.5628	0.0024	0 0243	0 4840
Length of pod (cm)	0.1008	—0.2612	0.3183	0.0042	0.0424	0.2045
Seeds per pod	0.1884	—0.2484	0.2380	0.0031	0.0574	0.2385

Residual effect=0.117.

building up the total correlation with yield. Interestingly, weight per pod was positively correlated with yield which was mainly due to its high (0.5628) direct contribution. Its indirect contribution towards total correlation (0.4840) was through height of plant at 60 days (0.2108). The correlations of length of pod and seed per pod with yield were low, but attributed mainly through indirect contribution of these traits via weight per pod. Therefore, it can be concluded that making selection on the basis of pods per plant, weight per pod, and plant height would lead towards the desired end. Computation of partial regression is helpful in formulating selection index. On the basis of this analysis an expression of selection index for yield per plant has been derived as : $Y=-2.314+0.00398\ X_1+0.32737\ X_2-0.023209\ X_3+0.256905\ X_4$; where, X_1,

X_2, X_3, and X_4 are number of pods per plant, number of seeds per pod, length of pod and weight of pod, respectively. This expression shows the relative weightage to be given to a character when selection is executed. The results of this analysis also support the conclusion obtained in path coefficient analysis.

The residual effect was quite low (0.117) indicating that characters other than studied here had very little role towards improvement of yield potential of Indian bean.

REFERENCES

Aggarwal, V. D. and Kang, M. S. 1976. Genetic variability, correlation and path analysis studies (*Dolichos biflorus* L.). *Trop. Agric.* 53 (4) : 335-40.

Dewey, D. A and Lu, K. H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.* 51 : 515-18.

Joshi, S. N. 1971. Studies on genetic variability for yield and its components in Indian bean (*Dolichos lablab* var. lignosus L.). *Madras Agric. J.* 58 (5): 367-71.

Panse, V. G. and Sukhatme, P. V. 1961. *Statistical methods for Agricultural Workers*, Indian Council of Agricultural Research, New Delhi.

Singh, K. B. and Mehandiratta, P. D. 1969. Genetic variability and correlation studies in cowpea. *Indian J. Genet.* 29(1) : 104-09.

Wright, S. 1921. Correlation and causation. *J. Agric. Res.* 20 : 557-85.

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COBALT-PHOSPHORUS INTERACTION IN ENTISOLS OF HARYANA—INCUBATION STUDY

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ABSTRACT

In order to study the inter-relationship of cobalt and phosphorus in soil system, incubation study was carried out in entisols of Ambala (Haryana) at its 60% of water holding capacity for 0, 7, 14 and 28 days at 30±1°C. Cobalt and phosphorus at the rate of 0, 2.5, 5 and 10 ppm and 0, 100, 200 and 400 ppm, respectively, in all combinations were added in the soil. A decreased availability of cobalt was observed with the addition of phosphorus and vice-versa. The availability of cobalt increased with the days of incubation except at 7 days. However, availability of phosphorus decreased consistently with the period of incubation.

The amount of cobalt and phosphorus in plants is of considerable importance for animal health particularly in Haryana State where animal husbandry plays an important role in its economy. Generally, available phosphorus ranges from low to medium and available cobalt recently has been found to be deficient (Yadav *et al.*, 1975) in 25% of soils of Haryana.

The concentration of a nutrient in plant mainly depends upon its available status in the growing medium. Furthermore, interaction between cobalt and phosphorus in soil affecting their uptake by plants has been shown to occur. However, like other nutrient interactions, its exact mechanism is not well understood. Therefore, under the increased supply of fertilizer phosphorus to soils, it was thought upon to carry out laboratory studies to determine the effect of phosphorus on cobalt availability and vice-versa in entisols.

MATERIAL AND METHODS

To know the phosphorus-cobalt inter-relationship, an incubation study was carried out with surface sample (0-15 cm) of entisols from Ambala district (Haryana). The soil under study had pH and E C. (1:2 soil : water) as 7.4 and 0.14 mmhos/cm, respectively. It was low in organic carbon (0.21%) with loamy sand texture having C.E.C. 2.80 m.e/100g. The Olsen's phosphorus and available cobalt were 10.73 and 0.10 ppm, respectively. Phosphorus at the rate of 0, 100, 200 and 400 ppm in the form of KH_2PO_4 solution in combinations with 0, 2.5, 5.0 and 10.0 ppm cobalt as cobaltous nitrate solution were

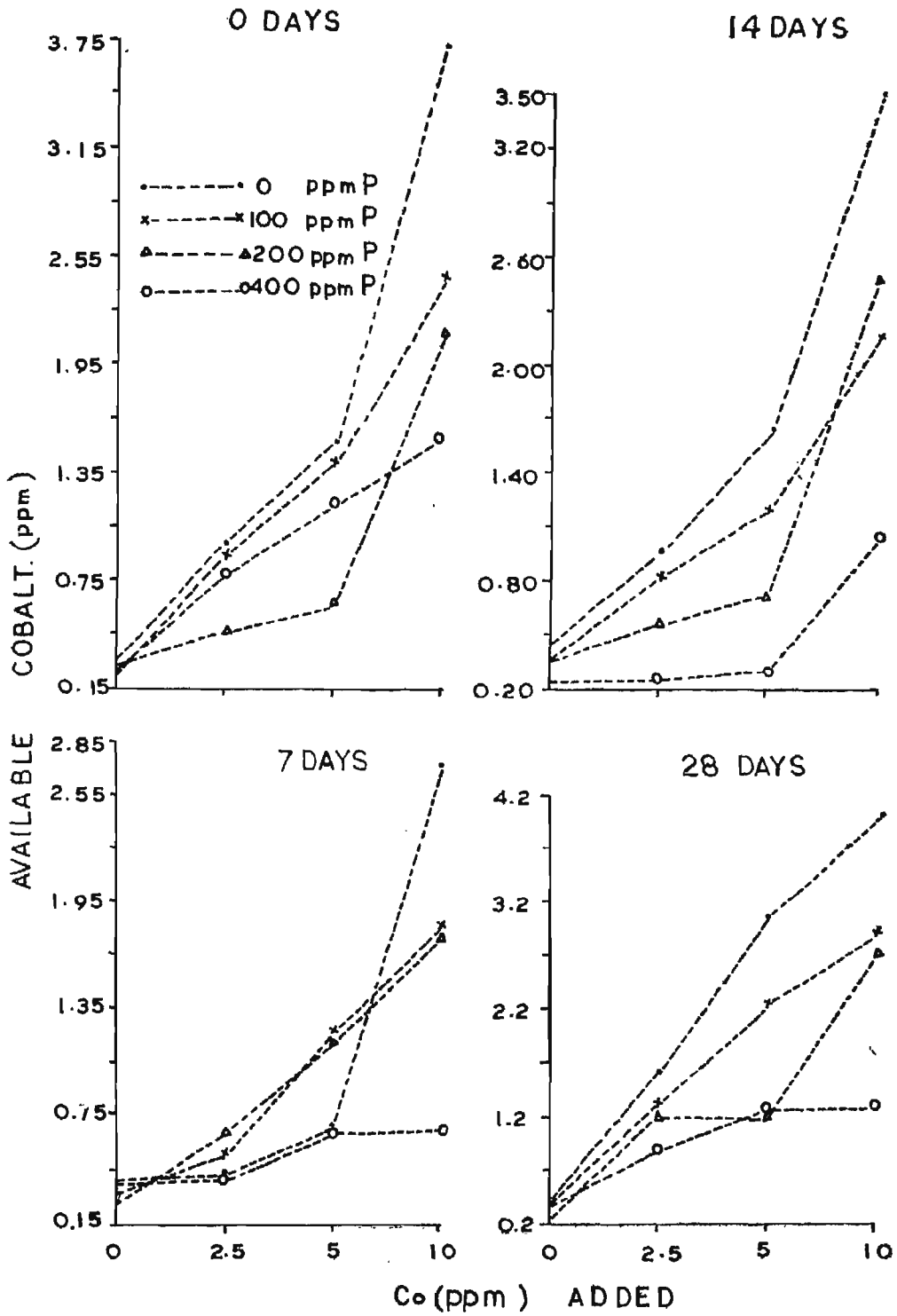


Fig. 1. Effect of various levels of Co and P on available Co in Ambala soil with time.

homogeneously mixed into the soil. The treated soil was taken into pH bottles and incubated at 60% of its water holding capacity (28.5%) for 0, 7, 14 and 28 days at 30 ± 1°C for the determination of available cobalt and phosphorus. A few drops of chloroform were added to check the growth of microbes.

After extracting available cobalt according to Alban and Kubota (1960), its amount was estimated with the help of atomic absorption spectrophotometer. Available phosphorus was determined by the method of Olsen *et al.* (1954) using 0.5N $NaHCO_3$ buffered to pH 8.5 and CEC in normal neutral ammonium acetate (Jackson, 1958).

RESULTS AND DISCUSSION

Effect of cobalt and phosphorus on the availability of cobalt

A perusal of Fig. 1 reveals that at zero day of incubation, available cobalt content increased at all levels of cobalt along with the addition of phosphorus except at 200 ppm P which significantly decreased the same. However, a significant decreasing trend in available cobalt was observed with phosphorus levels upto 200 ppm, but at 400 ppm

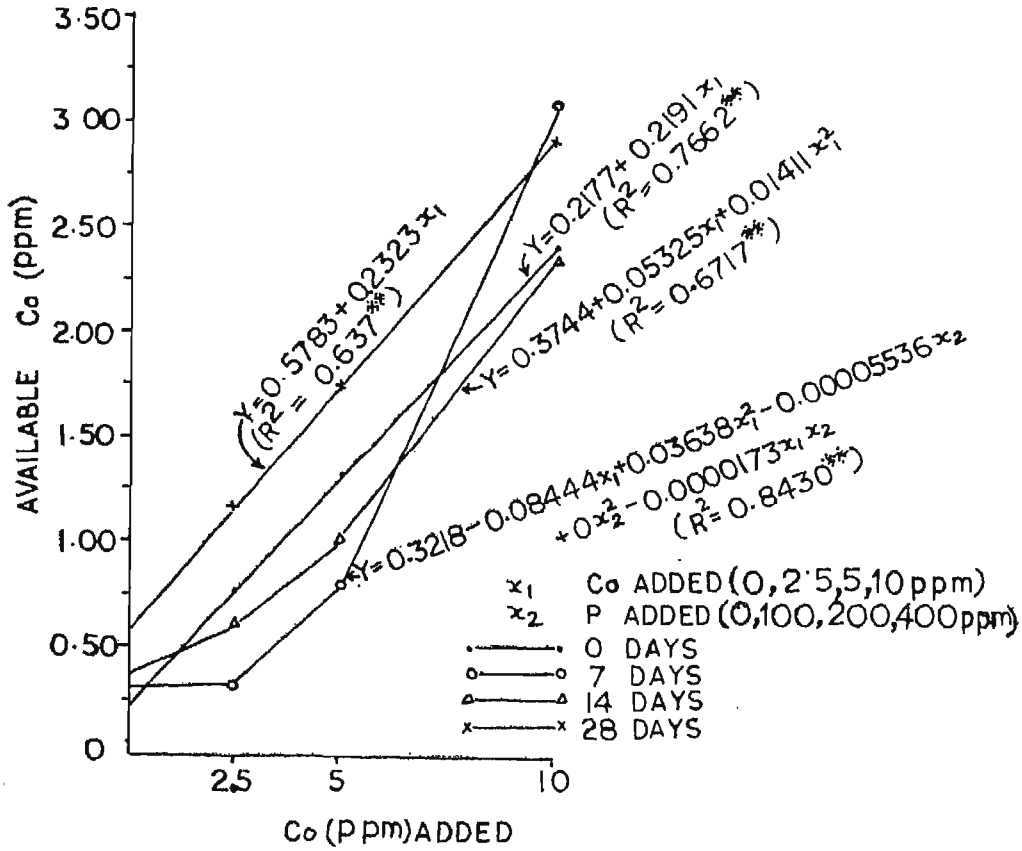


Fig. 2. Expected effect of various levels of Co and P on available Co with time in Ambala soil.

phosphorus, an increasing trend was observed with all cobalt levels excluding that of 10 ppm.

At seven days of incubation, 100 and 200 ppm P each with 2.5 and 5.0 ppm Co combinations had more available cobalt than that of control but the highest level of phosphorus (400 ppm) showed a reverse trend. Generally, available cobalt status decreased at 7 days over that of zero day of incubation except at 200 ppm P with 2.5 and 5.0 ppm Co treatments.

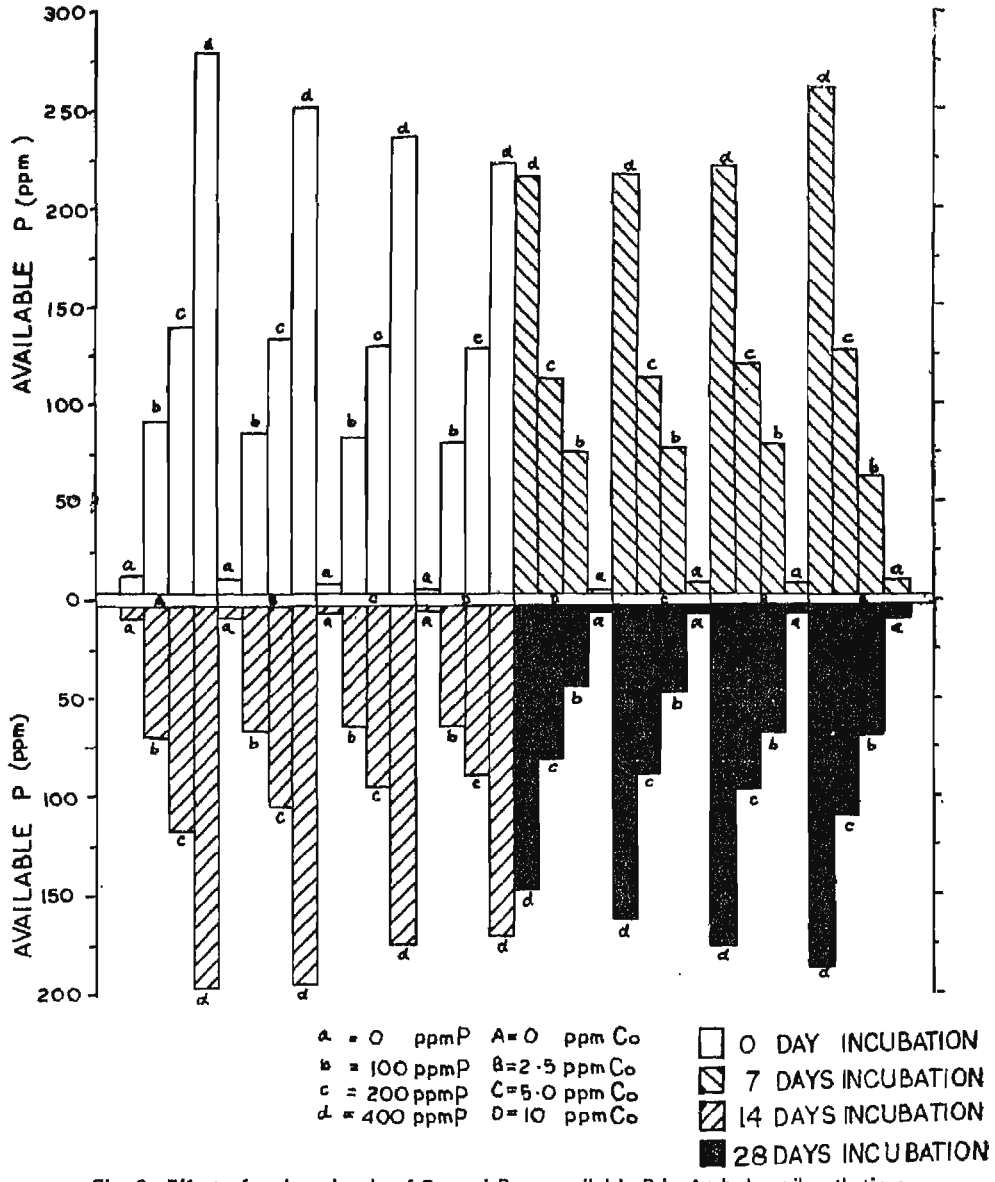


Fig. 3. Effect of various levels of Co and P on available P in Ambala soil with time

After 14 days of incubation, a significant decrease in available cobalt was observed with increasing amount of added phosphorus in combination with all levels of cobalt except 200 ppm P which showed an increase over 100 ppm P each with 10 ppm Co. It is also clear from the figure that at 28 days of incubation, availability of cobalt followed the same trend as that of 14 days with respect to phosphorus levels, with the exception that 5 ppm Co with 200 ppm P had less available cobalt as compared to that at 400 ppm P. It may also be visualised that available cobalt content increased with number of days of incubation over that of 7 days in all cobalt-phosphorus treatments. Exceptionally, it was significantly higher at 200 and 400 ppm phosphorus each with 2.5 and 5.0 ppm cobalt at 7 days of incubation.

On the basis of mean effects of cobalt and phosphorus, the data were subjected to computerization and found out the suitable functions (Fig 2) to predict the availability of cobalt affected by simultaneous addition of cobalt and phosphorus over days of incubation.

Effect of cobalt and phosphorus on the availability of phosphorus

It is very much evident from Fig. 3 that at 0, 7, 14 and 28 days of incubation, availability of phosphorus decreased more or less significantly at its all levels with an addition of cobalt. Olsen's phosphorus increased significantly with addition of P at each levels of cobalt. It may also be noticed that with increasing days of incubation, available phosphorus content decreased at each cobalt-phosphorus combination.

It may be concluded from the foregoing discussion that the addition of cobalt or phosphorus decreased the availability of phosphorus or cobalt. The reduced availability of phosphorus with time and cobalt addition and the decreased availability of cobalt with phosphorus addition might be attributed to the fixation mechanisms and formation of $Co_3(PO_4)_2$ and $Co(HPO_4)$ which had low solubility (Young, 1949). pH of the soil being 7.4 might be another factor which contributed to the reduced availability of cobalt and phosphorus, because Askew *et al.* (1938) had observed a rapid drop in the solubility of cobalt between pH 6.0 and 8.0 when it was added in soil mixed with superphosphate at the rate of 0.2 per cent.

REFERENCES

Alban, L. A. and Kubota, J. 1960. A study of extractable soil cobalt in soils of southeastern United States. *Proc. Soil Sci. Soc. Am.* 24 : 183-85.

Askew, H O., Rigg, J. and Stanton, D. J. 1938. Cobaltized superphosphate. *N. Z. J Sci. Technol.* 20A : 82-89.

Jackson, M. L. 1958. *Soil chemical analysis.* Prentice Hall Inc., Englewood, Cliffs, N.J.

Olsen, S R., Cole, C. V., Watanabe, F. S. and Dean, L. S. 1954. *Estimation of available phosphorus in soil using* $NaHCO_3$. U.S.D.A. Cir. No. 939.

Yadav, D. V., Chaudhary, M L. and Khanna, S. S. 1975. Cobalt status of Haryana soils and its relationship with some soil characteristics. *Haryana agric. Univ. J. Res.* 5 : 103-09.

Young, R. A. 1949. Some factors affecting the solubility of cobalt. *Proc. Soil Sci. Soc. Am.* 13 : 122-26.

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USE CF FUNGICIDES IN OIL AND WAX EMULSIONS TO INCREASE THE STORAGE LIFE OF KINNOW FRUITS

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ABSTRACT

Storage studies were conducted on Kinnow fruits by using waxol and mustard oil emulsions alone and in combination with Roveral and Bavistin fungicides as coating material at room temperature and the treated fruits were subjected to physico-chemical assessment at 7 days interval. The least loss in fruit weight was observed in waxol coated fruits. The microbial decay was least in waxol plus fungicide coated fruits as compared to coated with the mustard oil or waxol alone. T. S S. and total titratable acidity showed an increasing trend upto 28 days of storage in all the coatings.

Kinnow—a mandarin hybrid, is a prolific bearer, well flavoured and less prone to citrus decline. But the fruits develop granulation if kept on the tree for long after maturity, loose their firmness and appearance durinc storage at room temperature (Chundawat *et al.*, 1978) and spoiled by decaying organisms (Singh and Gupta, 1979). Various chemical coatings as post-harvest application have been reported to increase the shelf life of various fruits by keeping the fruits firm and controlling the decay organisms. The present paper reports the work, conducted to find out the suitable chemical coatings for prolongirg the storage life of Kinnow fruits at room temperature.

MATERIAL AND METHODS

Studies were conducted at the post-harvest Technology Laboratory during the year 1977-78. The fruits were harvested from nine years old trees in December when these were in mature yellow green stage. The coatings with chemical or washing with water were administered by the dip method for 2 min. The fruits were coated with waxol-0-12 and 12% mustard oil emulsion alone and in combination with 500 ppm Roveral (50% wp glycophene (1-isopropyl acarbamoyl-3-(3, 5-dichlorophenyl) hydantion); and 500 ppm Bavistin (50% wp carbendazin 2-(methoxycarbamoyl) benzimidazole). The treated fruits were packed in vented wooden boxes using paper cuttings as packing material and placed in a storage room along with untreated fruits at 24±5°C and 80±10% relative humidity.

Extent of losses due to decay and transpiration were determined at one-week ir terval upto 42 days. The microbial decay was calculated by the number of fruits showing the symptoms of decay (Srivastava *et al.*, 1964). Organoleptic rating was done at the end of the experi-

ment. Estimations of chemical characteristics were made at weekly intervals upto 35 days. The total soluble solids (T. S. S.) were determined with the help of hand refractometer. Total titratable acidity and ascorbic acid contents were determined by the methods of A. O. A. C. (1965).

RESULTS AND DISCUSSION

The differences observed in physico-chemical constituents in fruits during storage due to waxol-0-12 and oil emulsions alone and in combination with fungicidal coatings on Kinnow fruits were at pooled level. The lowest weight loss was recorded in waxol-0-12 coated fruits and highest in control (Table 1). The least decay was observed in fruits coated with waxol-0-12 in combination with Roveral or Bavistin, and highest in mustard oil and waxol-0-12 coatings even to control after 42 days of storage. The weight loss in fruits was observed in all the treatments including control from the very first observation (Fig. 1), whereas the starting of decay due to microbes was variable (Fig. 2). The decaying of fruits started after 14 days of storage in control and also in mustard oil and waxol-0-12 coated fruits, and after 21, 28 and 35 days of storage in mustard oil with Bavistin or Roveral, waxol-0-12 with Bavistin, and waxol-0-12 with Roveral, respectively. Though the rate of weight and decay loss of fruits vary in different treatments the periodical increase in loss in weight and decay was observed in all the coatings and control.

The highest T. S. S., and acidity were observed in fruits coated with waxol-0-12 alone or in combination with fungicides and also control where the differences were not significant. But highest ascorbic acid content was recorded only

TABLE 1

Effect of various coatings on the shelf life of Kinnow fruits at room temperature

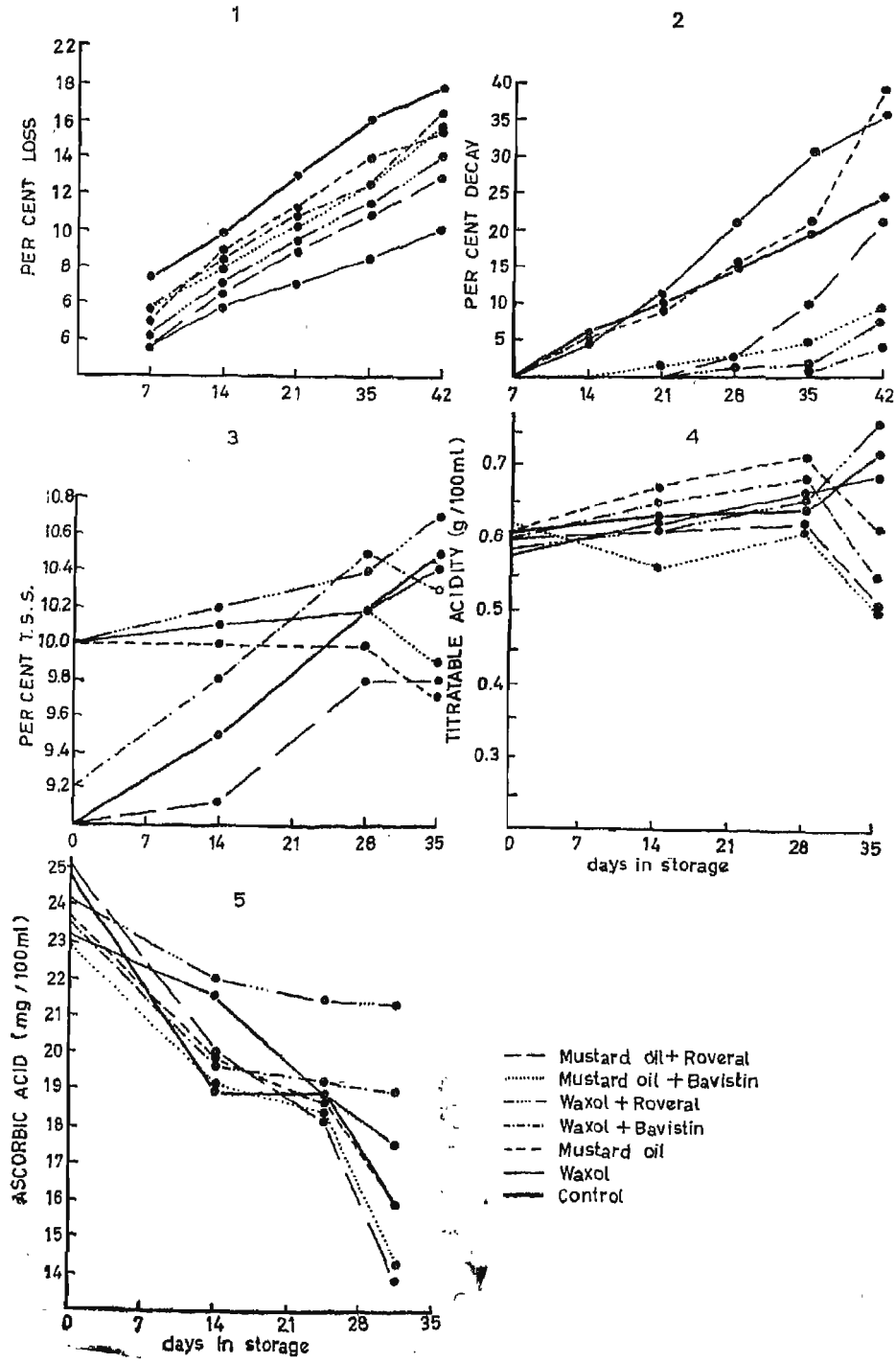
Coatings	T. S. S.* (%)	Acidity* (g/100ml)	Ascorbic acid* (mg/100ml)	Weight loss** (%)	Decay loss** (%)	Organo-leptic test*** rating
Control	10.5	0.75	15 8	20.1	27 1	16 1
Waxol	10.4	0 68	17.5	11.9	36.4	22.7
Mustard oil	9.6	0.61	15.8	18.4	37.8	13 5
Waxol+Bavistin	10.6	0.76	22.1	16.2	7.4	17.7
Waxol+Roveral	10.3	0.55	20.8	17.1	4.1	16.6
Mustard oil+Bavistin	9.8	0.51	13.7	16.5	9.6	12.2
Mustard oil+Roveral	9.9	0.50	14.2	17.6	20.9	13.3
CD at 5%	0.4	0.50	2.4	2.4	11.4	—

Quality of fruits prior to storage : T. S. S. (%)=9.5, Acidity (g/100ml)=0.6, Ascorbic acid (mg/100ml)=23.9.

*After 35 days of storage

**After 42 days of storage

***Organoleptic test rating=25 excellent; 20-25 highly acceptable;
15-20 acceptable;
Below 15 not acceptable.



Figs. 1–5. Per cent loss in weight (1), per cent decay (2), changes in T. S. S. (3), change in titratable acidity (4), change in ascorbic acid (5), during storage.

in waxol-0-12 with Bavistin or Roveral. The fruits coated with mustard oil alone and in combination with fungicides were low in the content of these chemical parameters. There was an increase in T. S S. and acidity content upto 28 days of storage in all the treatments and retained this trend in control, waxol-0-12 alone and in combination with Roveral upto 35 days of storage, whereas in other treatments there was a decline (Figs. 3, 4, 5). But, the rate of increase or decrease was variable in all the treatments. However, there was a continuous decrease in ascorbic acid content with the increase in days of storage. The organoleptic ratting also showed similar trend to that of chemical constituents of fruits in different treatments.

This shows that the mustard oil alone or in combination with fungicides is detrimental when used as coating material for Kinnow fruits during storage. These observations confirm the early view of Singh *et al.* (1978), that waxol-0-12 retained the quality than oil emulsions. The retention of quality of fruit appears mainly due to the fact that the coating of these chemicals had the effect on the physiolcgy of the fruit and these chemicals did not have any fungicidal effect (Pelser, 1975; Salih and Cengiz, 1976; Singh and Gupta, 1979). The overall storage life and quality of fruits was retained as a result of the addition of 500 ppm Roveral or Bavistin in waxol-0-12. Therefore, the low decay and retention of quality during storage resulted mainly due to the additive effect of the activity of fungicides and waxol-0-12 (Aulakh and Grover, 1968; Harding and Schade, 1967). The decrease in ascorbic acid content was, however, observed in all coatings and control during storage. This decrease was mainly due to the oxidation of ascorbic acid. The interested part in this study is that the rate of decrease in ascorbic acid content was low when fungicides were added to waxol-0-12 or compared to the oil emulsions alone or with fungicides and control. On one hand, the use of fungicides with waxol-0-12 further reduced the oxidation, while these fungicides with mustard oil enhanced the oxidation of ascorbic acid.

REFERENCES

A. O. A. C. 1965. Official and tentative methods of analysis. 10 ed Washington D. C., U. S. A.

Aulakh, K S. and Grover, R. K. 1968. Ripe fruit rots in tomato and their control by oils. *Plant Dis. Rep.* 52 : 535-59.

Chundawat, B. S., Gupta, A K. and Singh, B P. 1978. Storage behaviour of different grades of Kinnow fruits. *Punjab Hortic. J.* 18 : 156-60.

Harding P. R. Jr. and Schade, J E. 1967. Testing thiobendazole in resin solvent and wax emulsion coating for control of *Penicilium digitatum* in Navel oranges. *Plant Dis. Rep.* 51 : 51-53.

Pelser, P Du. T. 1975. Decay control in mandarin-type fruits. *Citrus Sub-trop. Fruit J.* 495 : 10-15.

Salih, H. and Cengiz, A. 1976. Recent experiments on possibilities of controlling post-harvest rot of Citrus fruits. *Bitki Koruma Bul.* 16 : 47-60.

Singh, J. P. and Gupta, O. P. 1979. Control of post-harvest decay in mandarin hybrids and sweet orange during storage. *Indian J. agric. Sci.* 49 : 862-66.

Singh, B. P. Gupta, A. K. and Chundawat, B. S 1978. Effect of various treatments on storage behaviour of Kinnow fruits. *Punjab Hortic. J* 18 : 161-65.

Srivastava, M. P, Tondon, R. N., Bilgtami, K. S. and Ghose, A. K. 1964. Studies on fungal disease of some tropical fruit trees. I. A list of the fungi isolated from fruits and fruit trees. *Phytopathol Z.* 5 : 250-61.

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SCREENING OF SOME PROMISING BARLEY STRAINS AND RECOMMENDED VARIETIES FOR RESISTANCE TO THE BARLEY APHID, *RHOPALOSIPHUM MAIDIS* (FITCH.)

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ABSTRACT

Eighteen barley strains/varieties were examined for their relative resistance to the barley aphid, *Rhopalosiphum maidis* (Fitch.) under natural infestation in the field and controlled infestetion in the screen house. In the field, the strains/varieties which registered the least aphid populations were BP 462, BP 465, BP 464, BP 454, BP 380 and BP 456. Maximum aphid counts were obtained on the varieties Jyoti, BG 25, RD 103 and C 164. Under artificial infestation conditions the least multiplication of the aphid was observed on BP 462, BP 454, BP 464, BP 380 and BP 456 and the maximum on RD 103, BG 25, C 164 and BG 105.

Barley *(Hordeum vulgare)* occupies an important place among *rabi* cereals. This crop can be successfully grown in areas with limited or no irrigation facilities and in marginally fertile soils. Of the various insect pests which attack this crop, the barley aphid, *Rhopalosiphum maidis* (Fitch) (Aphididae : Hemiptera) is by far the most destructive and often a limiting factor in the successful cultivation of this crop. The yield losses in barley due to this aphid in the northern India have been estimated to be between 30 and 100 per cent (Murthy *et al.*, 1968).

A large number of insecticides have been reported to control this insect effectively (Bhatia *et al.*, 1973; Sarup *et al.*, 1961; Stern, 1967). Since this crop is grown mostly under low input conditions, the use of expensive insecticides does not find favour with the cultivators. It is, therefore, imperative to develop aphid-resistant barley varieties and to use them in reducing the populations of insects and the damage done by them (Painter, 1958). With this aim in view, the barley strains developed for aphid resistance in the department of Plant Breeding as well as the recommended barley varieties were screened against this pest both under natural and controlled infestation conditions. Work on the transfer of aphid resistance to the agronomically suitable barley varieties is underway.

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MATERIAL AND METHODS

The studies were conducted under field conditions at Hissar and Karnal and under artificial infestation conditions in the screen house at Hissar during the year 1975-76. In all, 18 barley strains/varieties (Table 1) were examined. Variety 'Jyoti' was tested only under natural infestation conditions in the field and the varieties BG 105 and BG 108 only under controlled infestation condition in the screen house.

TABLE 1

Barley strains/varieties screened for resistance to *R. maidis*

Strain/variety	Pedegree
BG 26	C 138×CN 170 C
BG 105	C 141 × Montlesso
BG 108	C 164 × Kindred
BG 380	C 164 × EB 921
BP 449	C 138 × EB 921
BP 454	-do-
BP 455	-do-
BP 456	-do-
BP 457	-do-
BP 461	-do-
BP 462	-do-
BP 463	-do-
BP 464	-do-
BP 465	-do-
C 164	C 155 × C 141
EB 921*	Introduction from Taiwan
Jyoti	C 251 × K 12
RD 103	RDB × K 18

*Two rowed Exotic Barley

Under field conditions (at both the locations), 14 barley strains/varieties were sown during the first week of November, 1975. The lay-out was on randomised block design with three replications and plot size of 8×2 m. There were 6 barley rows in each plot, of which the first and the sixth row were used for recording aphid counts. From these two rows in each plot, 100 random tillers were gently removed (with the help of a razor blade) from their bases and the total number of aphids found thereon were counted. At each location, these counts were taken when the crop was 65-70 (growth stage) and 95-100 (earing stage) days old. The strain BP 456 was tested only at Hissar while BP 449 only at Karnal (Tables 2 and 3).

In the screen house, 15 strains/varieties were sown on 27th November, 1975. The three enteries EB 921, BG 105 and BG 108, which could not be tested under field conditions, were also evaluated. Three earthen pots (22 cm diameter), each sown with 3-4 seeds, were used for each strain/variety. When these plants were 60 days old, they were thinned so as to retain only 5 same sized tillers per pot. On each tiller, two 4th-instar aphid nymphs, of uniform size and vigour, were released. Each pot was then covered with a bottomless, cylindrical metallic framed muslin cloth cage (70×18 cm). The cage fitted nicely along the inner wall of the earthen pot. To ensure that this fitting was insect proof, a lining of absorbent cotton was provided along the outer base of the cage. Total number of aphids on 5 tillers in each pot were counted 24 days after their release. The population data, after necessary transformation, were subjected to analysis of variance.

RESULTS AND DISCUSSION

The data on the incidence of *R. maidis* on different barley enteries grown under field conditions at Hissar and Karnal are given in Tables 2 and 3 and those on the increase in the insect populations on different strains/varieties subsequent to controlled infestations in

TABLE 2

Incidence of *R. maidis* on different barley strains/varieties grown under field conditions at Hissar

Strain/variety	Mean No. of aphid nymphs and adults per 100 tillers		
	Growth stage*	Earing stage**	Data pooled for the two stages
BP 454	10.7(3.08)***	0.7(1.24)***	5.7(2.16)***
BP 465	23.0(4.66)	22.7(4.36)	22.8(4.51)
BP 462	42 0(6.05)	42 0(4.42)	42.0(4.73)
BP 464	69.3(7.70)	2.7(1.90)	36.0(4.80)
BP 466	94,7(8 74)	8.7(3.09)	51.7(5.91)
BP 380	76.7(8 30)	18.0(3.98)	47.3(6.14)
BP 457	125.0(10.45)	10.7(3.38)	67.8(6.91)
BP 455	117.3(10.69)	20.0(4.34)	68.7(7.51)
BP 463	78.3(8 67)	61.3(6.45)	69 7(7.56)
BP 461	322.7(17.70)	96.7(9.32)	209.7(13.51)
BG 25	479.3(20.35)	100.0,9.47)	289.7(14.91)
Jyoti	419 0(20.46)	142.3(11.80)	280.7(16.13)
C 164	254.7(15.55)	526 0(18 96)	390.3(17.26)
RD 103	629.3(24.70)	138.0(10.29)	383.7(17.50)
Statistical constants : C. D. at 5%	(7.92)	(7.75)	(7.92)

*65-70 days after sowing

**95-100 days after sowing

***$\sqrt{n+1}$ transformation

TABLE 3

Incidence of *R. maidis* on different barley strains/varieties grown under field conditions at Karnal

Strain/variety	Mean No of aphid nymphs and adults per 100 tillers		
	Growth stage*	Earing stage**	Data pooled for the two stages
BP 462	0.0(1.00)***	0.0(1.00)***	0.0(1.00)***
BP 465	0.0(1 00)	1.0(1.33)	0 5(1.16)
BP 464	2.3(1.61)	2.0(1.67)	2.2(1.64)
BP 454	1.7(1.58)	6 0(2.44)	3.8(2.01)
BP 380	6.7(2 74)	7.0(2 23)	6.8(2.48)
BP 449	12.0(3.58)	2 0(1.55)	7.0(2 56)
BP 461	19.3(3.77)	4 0(2 05)	11.7(2.91)
BP 466	11.3(3 28)	13.0(3.24)	12 2(3.26)
BP 457	21 7(4.25)	10.0(2.88)	15.8(3 57)
BP 463	17.0(3.57)	17.0(3.94)	17.0(3.76)
RD 103	11.3(3.32)	21.0(4.27)	16.2(3.80)
C 164	47.7(6.67)	16.0(3.56)	31.8(5.12)
BG 25	40 0(6.09)	24.0(4.32)	32.0(5.21)
Jyoti	102 3(8.63)	22.0(4 45)	62.2(6.54)
Statistical constants : C D. at 5%	(3.39)	(2.12)	(3.14)

*65-70 days after sowing

**95-100 days after sowing

***$\sqrt{n+1}$ transformation

the screen house, are given in Table 4. On the basis of the data presented in these tables, the following observations were made :

None of the barley enteries was completely resistant to the aphid (Tables 2-4). There was, however, a great variation in the level of insect infestation among all the enteries, suggesting thereby the preferential feeding habit of the insect.

The enteries BP 454, BP 462, BP 464, BP 380 and possibly BP 456 (tested in the screen house and under only one field condition, at Hissar) exhibited good level of resistance when evaluated at both the field locations as well as in the screen house under artificial infestation condition. EB 921 was tested only under controlled infestation condition and it shcwed quite a good level of resistance to the aphid. The entry BP 465 did well under field conditions both at Hissar and Karnal, but did not show a good promise in the screen house. The differential behaviour of this entry, in all probability, could be a case of escape when grown in the field.

The enteries RD 103, BG 25 and C 164 not only supported the highest aphid populations at both the field locations but also revealed the highest multiplication rate (57 to 116 times in 24 days) of the pest under controlled condition in the screen house. All these three varieties revealed a considerable susceptibility to the aphid.

It is quite interesting that all the barley varieties (BG 25, BG 105 and C 164) which are recommended for limited irrigated areas in Haryana are very much susceptible to the barley aphid. The variety C 138, recommended for the rainfed areas in the State, could not be tested as the present studies were conducted under irrigated conditions.

TABLE 4

Mean population of R. maidis 24 days after releasing two aphids per tiller

Strain/variety	Mean No. of aphid nymphs and adults per 5 tillers	Insect multiplication factor in 24 days
BP 462	14.0	1.40
BP 454	15.7	1.57
BP 464	16.7	1.67
BP 380	22.3	2.23
BP 456	27.3	2.73
EB 921	47.0	4.70
BP 461	52.3	5.23
BP 455	60.7	6.07
BP 465	63.3	6.33
BP 457	85.3	8.53
BG 108	195.7	19.57
BG 105	430.7	43 07
C 164	565.3	56.53
BG 25	786.0	78.60
RD 103	1159.7	116.97

Studies on evaluation of genetic stocks of barley for resistance to *R. maidis* have also been conducted by several workers. Maxwell *et al.* (1972) published a comprehensive review on this topic. As regards the mechanism of resistance, Hormchang and Wood (1963) considered that antibiosis was not a factor in barley resistance to *R. maidis* although the studies by Dishner and Everly (1962) which were based on progeny survival, reflected antibiosis as the possible mechanism. Working with this aphid species on sorghum, Pathak and Painter (1958) observed a reduced fecundity of the insect on resistant than on susceptible plants. Reduced multiplication rate of aphids on resistant than on susceptible barley varieties in the present studies could well be a case of antibiosis.

Murthy *et al.* (1968) screened a world collection of barley against *R. maidis*. They also observed that none of the enteries was immune and the resistant varieties were mostly from Mediterranean areas and Taiwan. Trehan *et al.* (1970) observed that the early maturing barley varieties escaped aphid infestation. These varieties matured by mid-January (in 85-95 days), the time when aphid infestation starts in the field. The enteries REB 264 (Omugi Shin) from Japan and REB 501 (Guided Real) from Spain were highly resistant. In the studies conducted at Hissar during 1977-79 (Chhillar, B. S. : personal communication), REB 501 was, however, found to be highly susceptible to *R maidis*.

The two rowed barley variety EB 921 (C.A No. 1) from Taiwan showed little or no infestation by *R. maidis* (Murthy *et al.*, 1968; Trehan *et al.*; 1970). The present studies also revealed almost a similar type of reaction in this variety. It would be of interest to note that all the promising strains in the current studies were the crosses of EB 921 with the recommended barley varieties C 164 and C 138 (Table 1).

A good possibility exists for using these promising aphid resistant barley genotypes by way of transfering the aphid-resistance to the agronomically superior barley varieties. Moreover, as all the promising lines are 6 rowed barleys, their yield potential is certainly better than the 2 rowed donor parent, EB 921 (Table 1). Studies on characterisation for aphid resistance in barley and also on the mode of inheritence of this resistance are infact, underway.

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REFERENCES

Bhatia, S. K., Young, W. R., Phadke, K. G. and Srivastava, A. N. 1973. Control of corn leaf aphid on barley in India. *J. econ. Entomol.* 66 (2) : 463-67.

Dishner, G. A. and Everly, R. T. 1962. Green house studies on the resistance of corn and barley varieties to survival of the corn leaf aphid [*Aphis (Rhopalosiphum) maidis* (Fitch.)]. *Proc. Indian Acad. Sci.* 71 : 138-41.

Hormchang, T. and Wood Jr., E. A. 1963. Evaluation of barley varieties for resistance to the corn leaf aphid. *J. econ. Entomol.* 56 : 113-14.

Maxwell, F. G., Jenkins, J. N. and Parrott, W. L. 1972. Resistance of plants to insects. *Adv. Agron.* 24 : 187-265.

Murthy, B. N., Jain, K. B. L., Mathur, V. S., Gulati, S. C. and Satyawati, D. 1968. Aphid resistance in barley. *Indian J. Genet. Plant Breed.* 28 : 91-93.

Painter, R. H. 1958. Resistance of plants to insects. *Ann. Rev. Entomol.* 3 ; 267-90.

Pathak, M. D. and Painter, R. H. 1958. Differential amounts of material taken up by four biotypes of corn leaf aphids from resistant and susceptible sorghum. *Ann. Entomol. Soc. Am.* 51 : 250-54.

Sarup, P., Jotwani, M. G. and Pradhan, S. 1961. Relative toxicity of some important insecticides, as contact poisons, to the maize aphid, *R. maidis* (Fitch.). *Indian J. Entomol.* 23 : 257-61.

Stern, V. M. 1967. Control of aphids attacking barley and analysis of yield increases in the Imperial Valley, California. *J. econ. Entomol.* 60 (2) : 485-96.

Trehan, K. B., Bhatnagar, V. K., Sharma, R. C. and Chandola, P. 1970. Note on genetic stocks of barley (*Hordeum vulgare* L.) resistant to the aphid, *Rhopalosiphum maidis* (Fitch.). *Indian J. agric. Sci.* 40 (8) : 756-58.

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CONCEPT OF SEGREGATING ABILITY IN RELATION TO COMBINING ABILITY AND *PER SE* PERFORMANCE IN WHEAT

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ABSTRACT

An attempt was made to assess the segregating ability of some wheat hybrids in relation to the performance and combining ability. Thirtysix intervarietal wheat hybrids resulting from crossing of 12 lines with three testers, namely, K227, S308 and HD1941, were studied for their segregation pattern in F_2 generation. The segregating ability was measured in terms of the number of segregates surpassing the best parental variety under study and was expressed in percentage. As a male parent, the crossed K227 gave a higher frequency of desirable segregates than other testers. Among the lines, crosses of HD2009, HD2021, R857 and J6 were superior in producing a higher percentage of desirable segregates. These results were discussed in the light of the general combining ability of the parents and specific combining ability of their hybrids.

Combining ability analysis has been used by many workers in characterizing the type of gene action involved in the expression of various metric traits. Consequently, the appropriate breeding procedures that are likely to be effective in improving the crop species have also been suggested. It is axiomatic to understand that such an analysis is not only useful but necessary in cross pollinated crops where a large number of inbred lines are tested for subsequent use in the breeding plans aimed at evolving hybrids, synthetics or composits for commercial crop production.

Combining ability analysis has been equally frequently performed in a number of self pollinated crops including wheat (Kronstad and Foote, 1964; Widner and Lebsock, 1973; Gill *et al.*, 1974; Tiwari and Ramanujam, 1974). Though, the kind of gene action involved in the important metric traits have been characterized and effective breeding procedures have been suggested, yet such an analysis appears to be of limited use in self pollinated crops. For, in these crops, almost always pedigree system of breeding is employed. Obviously, under these circumstances, the breeder is interested in the frequency of desirable segregates rather than the combining ability as such. Whether the combining ability of the parents is reflected in the pattern of segregation is not known.

The present study elucidates the results on combining ability in relation to the segregation behaviour of the hybrids in bread wheat.

MATERIAL AND METHODS

F_2 population of 36 intervarietal wheat hybrids resulting from crossing 12 diverse lines to 3 testers formed the material for the present study. Fifteen parental varieties and 36 F_2 populations of their hybrids were tested in the field following a randomized block design with three replications. Parental lines and F_2 population were accommodated in single and three row plots, respectively. Three meter long rows were spaced 30 cm apart, distance among plants within rows being about 15 cm. Observations on 10 plants from the pure lines and 35 plants from F_2 per replication were recorded for grain yield and its components.

In the parent varieties, average and confidence limits were computed for all the characters based on the observations of 30 plants. These were used in the calculation of the transgressive segregates.

RESULTS AND DISCUSSION

Results on the combining ability of the lines used in crosses have been reported by Nehra (1979). Segregation pattern of the hybrids and its possible relationship with the combining ability of the parents are being discussed here.

Average grain yield of the varieties is presented in Table 1. The limit for calculating transgressive segregates was determined by adding the confidence limit to the average of the better parent in a cross. The plants falling outside the confidence limit in the desired direction were recorded as transgressive segregates. Frequency of such segregates expressed in per cent is given in Table 2. Frequency of segregates ranged from 5.6% for the cross S226 × S308 to 30 5% for the cross J3 × HD 1941. In general, the hybrids

TABLE 1

Grain yield of parental varieties and their confidence limits

Varieties	Grain yield (g)
Males	
(i) HD 1941	16.29 ± 5.58
(ii) K 227	17.17 ± 9.32
(iii) S 308	19.47 ± 12.51
Females	
(i) C 285	19.39 ± 8.67
(ii) C 591	17.44 ± 10.20
(iii) HD 2009	17.78 ± 8.44
(iv) HD 2021	20.96 ± 8.71
(v) J 3	14.46 ± 11.47
(vi) J 5	19.06 ± 10.56
(vii) PV 18	17.24 ± 11.85
(viii) P 62	15.71 ± 8.13
(ix) R 857	18.10 ± 8.49
(x) S 226	16.34 ± 10.31
(xi) S 316-66-II	13.29 ± 6.66
(xii) WG 377	19 54 ± 8.52

TABLE 2

Transgressive segregates (per cent) in the desired direction for grain yield in some wheat crosses

Females \ Males →	HD1941	K 227	S 308
C 285	18.2	11.4	15.2
C 591	16.4	14.8	20.6
HD 2009	27.4	29.3	13.5
HD 2021	22.4	24.8	10.5
J 3	30.5	30.1	17.1
J 5	21.2	19.0	5.7
PV 18	15.2	12.4	10.5
P 62	21 3	25.7	14.3
R 857	14.3	29.5	27.2
S 226	11.2	17.1	5.6
S 316-66-II	20.4	19.8	7.5
WG 377	17.3	20.0	12.0

of K227 produced more transgressive segregates while those of S308 showed a lower frequency of such segregates. This appeared to be due to the fact that the confidence limit of the later was higher and hence, its transgressive segregation frequency was low. On the other hand, the confidence limit for K227 crosses were lower than those of S308. Therefore, the frequency of transgressive segregates was high in its crosses.

Frequency of transgressive segregates is not the only criterion of breeder's interest. In evaluating the potentiality of a cross for desirable segregates, the breeder is interested in the best segregates in desired direction. A limit is set, beyond which the individual plants are selected. Obviously, such a limit is generally higher than the one for transgressive segregates. With this view, the segregates for grain yield were scored which surpassed the best yielding variety under study. Percentage of such segregates has been shown in Table 3. Here the picture was different than the one observed in case of transgressive segregates. Crosses of S308 particularly with R857 and C591 were comparatively better in yielding the desirable segregates. HD2021 × HD1941 and HD2021 × K227 were also equally good crosses in this respect. Further, the crosses showing a high frequency of transgressive segregates in general, also showed a high frequency of desirable segregates.

Finally, an attempt was made to see whether any kind of relationship existed between combining ability of the lines on one hand and the desired segregation potential of their hybrids on the other. General combining ability of the lines and testers in terms of good, average and poor combiners while *sca* rank of the hybrids (in parenthesis) have been shown in Table 3 itself. There does not appear any consistent relationship between *sca* of the hybrids and their segregation potential. The best (PV18 × HD1941) and the poorest (PV18 × K227) specific cross combination yielded nearly equal frequency of desirable

TABLE 3

Percentage of desirable segregates for grain yield based on the best parent

Females	Males→ GCA	HD 1941 average	K 227 good	S 308 poor
C 285	average	9.8 (9)	6.7(23)	15.2(24)
C 591	average	6.7(18)	9.3(26)	20.6(10)
HD 2009	good	15.1(32)	14.1(4)	13.5(17)
HD 2021	average	20.1(25)	20.9(5)	10.5(28)
J 3	good	11.4(30)	16.8(8)	17.1(15)
J 5	poor	16.3(2)	14.3(33)	5.7(19)
PV 18	good	10.5(1)	8.6(35)	10.5(27)
P 62	average	11.0(21)	10.5(14)	14.3(16)
R 857	poor	6.6(34)	18.1(12)	27.2(6)
S 226	poor	5 0(22)	6.7(33)	5.6(3)
S 316-66-II	poor	7.0(13)	11.3(11)	7 5(29)
WG 377	good	11.5(20)	12.6(7)	12.0(27)

Values in parentheses are the *sca* rank of the hybrids

segregates i.e., 10.5% and 8.6%, respectively. Similarly, the hybrids R857 × S308, HD2021 × HD1941, HD2021 × K227 and C591 × S308, though produced a larger number of desired segregates, their *sca* ranks varied from 5 to 25.

To some extent, there appeared to be a positive association between *gca* of parent varieties and the frequency of desirable segregates in their crosses. The lines, HD2021, J3, HD2009, WG 377 and P62 were average to good general combiners and their all the crosses invariably produced a fairly good number of desirable segregates (more than 10%). Similarly, S226 and S316-66-II were poor combiners and produced few desirable segregates in their crosses. This, however, is not supported by the general combining ability of the male parents, since the crosses of good (K227) and poor (S308) male combiners were generally at par in respect of producing desirable segregates. Combining ability of the lines in a study is a comparative evaluation. Therefore, in a group of just three male parents, as in the present study all the three could never be estimated as a good general combiner. If the same three could have been tested in a larger group, perhaps all the three could turn out to be fairly good combiners. Moreover, combining ability estimates may vary with changing environments (Rojas and Sprague, 1952; Paroda and Joshi, 1970; Tiwari and Ramanujam, 1974). Therefore, combining ability estimates and the segregation potential of the hybrids should be studied under varying environments in order to establish a reliable relationship between these two parameters. However, the present study, has shown that the hybrids of good general combiners generally produce more desirable segregates. In the light of the fact that *gca* is the function of additive genes which are fixable, this is expected. Specific combining ability, on the other hand, is due to non-additive genes and since these are not fixable, hybrids with high *sca* effects do not necessarily produce a large number of desirable segregates.

REFERENCES

Gill, K. S., Dhillon, S. S. and Arora, B. S. 1974. Line X tester analysis of combining ability and heterosis in wheat. *Indian J. Genet.* 34A : 601-09.

Kronstad, W. E. and Foote, W. E. 1964. General and specific combining ability estimates in winter wheat (*Triticum aestivum*). *Crop Sci.* 4 : 616-19.

Nehra, S. S. 1979. Search for biochemical basis of combining ability in wheat. Ph. D. thesis, Haryana Agricultural University, Hissar.

Paroda, R. S. and Joshi, A. B. 1970. Genetic architecture of yield and components of yield in wheat. *Indian J. Genet.* 30 : 298-314.

Rojas, B. A. and Sprague, G. F. 1952. A comparison of variance components in corn yield trait. III. General and specific combining ability and their interactions with locations and years. *Agron. J.* 44 : 462-66.

Tiwari, A. S. and Ramanujam, S. 1974. Partial diallel analysis of combining ability in mungbean. *Z. Pflanzenzuecht.* 73 (14): 103-11.

Widner, J. N. and Lebsock, K. L. 1973. Combining ability in durum wheats. I. Agronomic characteristics. *Crop Sci.* 13 : 164-67.

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STUDIES ON PHYTOTOXIC EFFECTS OF SOME MODERN INSECTICIDES TO CUCURBITS*

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ABSTRACT

Phytotoxicity of 8 insecticides to 10 different cucurbits was studied. BHC and DDT proved more phytotoxic than the other six to more or less all the cucurbits tested. Carbaryl and sevimol were found to be safe to all the cucurbits while malathion, endosulfan, phosphamidon and DDVP were found to be intermediate in their phytotoxic effects on the test cucurbits.

The bottle gourd, cucumber and snake gourd were recorded to be the most susceptible to insecticidal injury, while ridge gourd, smooth gourd and pumpkin were tolerant. Rest of the cucurbits fell between these two categories.

Cucurbits form an important group of summer and rainy season vegetables. Their yield and quality are, however, affected by the attack of a number of insect pests. To minimise the damage done to them by the insect pests and to produce quality vegetables, the use of insecticides becomes an integral part of the production technology of these vegetables. But the cucurbit vines are very delicate and sensitive to phytotoxic effect of insecticide application.

The presently available synthetic organic insecticides are reported to be phytotoxic to cucurbits. Some of the insecticides produce phytotoxic effects after their application resulting into reduced yield, stunted growth, production of necrotic spots, yellowing, chlorosis, burning of leaves and at times even in complete death of creepers. Various workers have reported the phytotoxic effects of these chemicals on cucurbitaceous crops. Chapman and Allen (1948) observed chlorosis, necrosis, stunting and decreased yield of cucurbits treated with DDT and other chlorinated hydrocarbons. Mukherjee and Wadhi (1956) studied the phytotoxicity of toxaphene, DDT, dieldrin, lindane and aldrin to some of the cucurbits. Shinde (1959) reported that except folidol and chlordane other insecticides viz., toxaphene, aldrin, dieldrin and parathion were quite safe to use on all cucurbits

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except bottle gourd whereas Sood *et al.* (1972) observed that dimethoate was slightly phytotoxic to bottle gourd, cucumber and round gourd.

Looking to the economic importance of the pest species that attack cucurbits, it was felt necessary to test a few modern insecticides safer for use on cucurbits in order to successfully control the insect pests of cucurbitaceous vegetables.

MATERIAL AND METHODS

Phytotoxicity studies on the different cultivars of the cucurbits were carried out on potted plants at 6 leaf stage. The seeds before sowing were soaked in water for 24 h and only 5 plants were allowed to continue to grow in 18 inches diameter pots for further studies. Three concentrations (below recommended, usually recommended and above recommended) of 8 insecticides, namely DDT 50 WP, carbaryl (Sevin 50 WP), sevimol 40, endosulfan (Thiodon 35 EC), BHC 50 WP, malathion 50 EC, DDVP and phosphamidon 100 replicated three times were tested for phytotoxicity to ten different cucurbits, viz., cucumber, pumpkin, snake gourd, ridge gourd, water melon, round gourd, bitter gourd, smooth gourd, ash gourd and bottle gourd with a total number of 25 treatments including control.

Observations were taken for necrotic spots produced on the total leaf area of the test plants and percentage affected leaves at different intervals, viz., 24, 48, 72 h and one week after treatment. Besides this, the morphological changes in leaves were recorded, i. e., chlorosis, stunting and leaf burning. The foliage injury due to insecticides was categorized in four groups, viz., safe, slightly phytotoxic, moderately phytotoxic and severely phytotoxic (0 to 5, 6 to 10, 11 to 15 and 16 and above per cent affected leaves, respectively). During the experimental period, the minimum and maximum temperatures and per cent relative humidity varied from 23.70 to 29.50°C and 28.60 to 42 40°C and 25 to 87% RH, respectively.

RESULTS

The results on average of necrotic spots percentage affected leaves and phytotoxic level of various insecticides on ten cucurbits were presented in Tables 1 to 4.

24 h after treatment. The average number of necrotic spots in different concentrations of different insecticides ranged from 0.70 to 1.48 spots. The number of spots produced in higher concentration of BHC, phosphamidon and DDT was the highest. Least number of spots appeared in case of lower concentrations of malathion, phosphamidon, sevimol and all three concentrations of carbaryl. Rest of the concentrations produced moderate number of necrotic spots not differing significantly among themselves but DDVP, phosphamidon and malathion differed significantly from control (Table 1).

The percentage of affected leaves was significantly more in higher concentration of DDT and BHC as compared to all the concentrations of other insecticides while minimum percentage of leaves were affected in case of lower concentration of phosphamidon, DDVP, endosulfan and all the three concentrations of carbaryl. Rest of the concentrations produced moderate phytotoxic effect and did not differ significantly

TABLE 1

Average number of necrotic spots (24, 48, 72 h and one week after treatment)

Sr. No.	Name of insecticide	Concentration	Number of necrotic spots after treatment			
			24 h	48 h	72 h	7 days (one week)
1.	DDT	0.05	0.16(0 76)	0.16(0.78)	0.5 (0 92)	0.60(0.97)
		0.10	0 66(1.03)	0.76(1.06)	0.10(1.25)	1.23(1.30)
		0.20	1.70(1 43)	1.76(1.46)	2.13(1.57)	2.26(1.63)
2.	Carbaryl (Sevin)	0.05	0.00(0.70)	0.00(0.70)	0.00(0.70)	0.00(0.70)
		0.10	0.00(0.70)	0.00(0 70)	0 00(0.70)	0.00(0.70)
		0.20	0.10(0.75)	0.10(0.75)	0.02(0.78)	0.23(0.81)
3.	Sevimol	0.05	0.10(0.76)	0.01(0.73)	0.02(0 78)	0.20(0.77)
		0.10	0.10(0.77)	0.30(0.77)	0.23(0.80)	0 26(0.79)
		0.20	0.53(0.92)	0.56(0.90)	0.52(0.97)	0.56(0.94)
4.	Endosulfan (Thiodan)	0.035	0.00(0.70)	0.00(0.70)	0.00(0.70)	0.00(0.73)
		0.07	0.20(0.80)	0.02(0.79)	0.23(0.78)	0.30(0.83)
		0.14	0.63(0.99)	0.73(0.02)	1.03(1.15)	1.00(1.12)
5.	BHC	0.05	0.16(0.76)	0.66(0.98)	0.63(0.98)	0.63(1.01)
		0.10	0.50(0.93)	1.33(1.23)	1.96(1.43)	1.60(1.41)
		0.20	1 83(1.48)	2.36(1.65)	3.53(1.92)	2.50(1.67)
6.	Malathion	0.025	0.10(0.73)	0.13(0.76)	0.16(0.77)	0.66(1 02)
		0.05	0.26(0.81)	0.40(0.87)	0.40(0.89)	1.23(1.28)
		0.10	0.76(1.03)	0.73(1.02)	0.80(1.05)	2.33(1.65)
7.	DDVP (Nuvan)	0.02	0.00(0.70)	0.13(0.74)	0.26(0.80)	0.60(0.94)
		0.04	0.46(0.81)	0.33(0.89)	0.93(1.03)	1.00(1.06)
		0.08	0.53(1.00)	0.66(0.97)	1.43(1 23)	1.20(1.13)
8.	Phosphamidon (Dimecron)	0.02	0.00(0.70)	0.23(0.82)	0.33(0.82)	0.50(0.94)
		0.04	0.23(0.81)	0.63(1.00)	0.43(0.97)	1.16(1.21)
		0.08	0.76(1.05)	0.86(1.08)	0.70(1.12)	1.56(1.30)
9.	Control	—	0.00(0.70)	0.00(0 70)	0.00(0 70)	0.00(0.70)
	S. Em.	—	0.019	0.02	0.03	0.02
	C. D. 5%	—	0.052	.054	.082	0.054
	C. D. 1%	—	0.069	0.071	.1 .7	0.071

Angular transformed values are given in parentheses.

among themselves but malathion and BHC differed from control significantly (Table 2).

48 h after treatment. The necrotic spots produced were significantly more in the two higher concentrations of BHC and at higher concentration of DDT while significantly less number of spots were produced in lower concentrations of sevimol, DDVP and at higher concentration of carbaryl. However, no spots were produced in lower concentrations of endosulfan and two lower concentrations of carbaryl. Remaining concentrations produced moderate number of spots which did not differ significantly among themselves but significantly differed from control (Table 1).

TABLE 2

Average percentage affected leaves (24, 48, 72 h and one week after treatment)

Sr. No.	Name of insecticide	Concentration	Percentage affected leaves after treatment			
			24 h	48 h	72 h	7 days (one week)
1.	DDT	0.05	18.77(21.81)	18.21(19.27)	41.10(39.23)	14 37(18.99)
		0.10	27.98(26.00)	29.91(29.27)	52.60(46.55)	35.47(33.71)
		0 2	52 92(48.38)	62.56(55.87)	60.66(52 51)	51.87(45.18)
2.	Carbaryl	0.05	0.00(0.57)	0.00(0.57)	0.00(0.57)	0.00(0.57)
	(Sevin)	0 10	0.00(0.57)	0.00(0.57)	0.00(0.57)	0.00(0.57)
		0.20	2.01(4.08)	2 01(3.51)	2.08(4.00)	2.32(4.41)
3.	Sevimol	0.05	0 00(0.57)	4.44(4.18)	0.00(0.57)	0.00(0.57)
		0.10	0.00(0.57)	5.58(4.95)	0.00(0.57)	0.00(0.57)
		0.20	1.72(2.76)	8.22(8.17)	1.78(3.08)	1.75(2.98)
4.	Endosulfan	0.035	0.00(0.57)	0.00(0.57)	0.00(0.57)	3.57(6.12)
	(Thiodan)	0 07	6.84(7.48)	7.44(7.32)	2.80(3.70)	6.86(9.10)
		0.14	20.18(19.81)	10.65(20.05)	41.36(37.48)	24.64(25.85)
5.	BHC	0 05	11 54(11.47)	11.32(11.61)	16.47(16.55)	13.34(19.57)
		0.10	20.17(21.02)	26.33(30.16)	41.59(36.10)	30.52(31.76)
		0.20	44.63(42.07)	43.58(44.56)	74.74(65.03)	49.07(45.55
6.	Malathion	0.025	2.34(4 27)	3.06(3.86)	3.60(4.19)	24.62(27.03)
		0.05	6.91(10.22)	8.19(9.67)	13.16(14.05)	36.45(36.17)
		0.10	18.40(19.37)	20.25(19.67)	25.04(24.58)	53.54(48.10)
7.	DDVP (Nuvan)	0 02	0.00(0.57)	0.50(1.80)	0.00(0.57)	32.96(34.12)
		0.04	6.36(7.17)	7.68(9.19)	13.32(9.73)	41.00(37.37)
		0.08	20.25(13.28)	23.52(17.08)	28.86(24.01)	50.90(44.35)
8.	Phosphamidon	0.02	0.00(0.57)	4.80(4.89)	8.01(7 70)	20.49(22.57)
	(Dimecron)	0.04	6.73(7.44)	6.62(7.35)	15.57(11.78)	28.17(27.87)
		0.08	15.88(18.99)	15.48(16.80)	23.38(16.23)	39.24(34.10)
9.	Control	–	0.00(0.57)	0.00(0.57)	0.00(0.57)	0.00(0.57)
	S. Em.	–	2.62	2.80	2.60	4.52
	C. D. 5%	—	7.25	7.74	7.19	12 52
	C. D. 1%	—	9.50	10.15	9.43	16.42

Angular transformed values are given in parentheses.

Significantly higher percentage of leaves were affected in the two higher concentrations of DDT and BHC, respectively, which differed significantly from each other, while the affected leaves were nil in lowest concentration of endosulfan and two lower concentrations of carbaryl. The least percentage affected leaves were observed in lower concentration of endosulfan, malathion and DDVP, highest concentration of carbaryl and all three concentrations of sevimol. Rest of the concentrations did not show significant differences among themselves but significantly differed from control (Table 2).

72 h after treatment. The average number of necrotic spots produced was significantly more in two higher concentrations of BHC and DDT which significantly differed from each other and also

from all other concentrations. While no spots were produced in lowest concentration of endosulfan and two lower concentrations of malathion and highest concentration of carbaryl. Rest of the concentrations produced moderate number of spots that significantly differed from control (Table 1).

The higher percentage of leaves was affected by higher concentration of BHC followed by two higher concentrations of DDT significantly differing from all the concentrations while no leaves were affected in the lowest concentration of endosulfan and sevimol and two lower concentrations of sevimol and carbaryl. The lowest percentage of leaves was affected by lowest concentration of phosphamidon and highest concentration of carbaryl and sevimol. Rest of the concentrations did not differ significantly but higher concentration of carbaryl and endosulfan differed significantly from control (Table 2).

One week after treatment. Significantly more number of spots were produced in two higher concentrations of BHC, DDT and phosphamidon, while necrotic spots were produced in two lower concentrations of carbaryl and lowest concentration of endosulfan. Minimum spots were observed on lower concentration of endosulfan and two lower concentrations of sevimol. Rest of the concentrations did not differ significantly but higher concentration of carbaryl and endosulfan differed significantly from control (Table 1).

Higher percentage of leaves were affected in two higher concentrations of malathion and DDVP and higher concentration of DDT and BHC. These significantly differed from all other concentrations, but did not differ among themselves. The lowest percentage affected leaves were in the highest concentration of sevimol, carbaryl and lowest concentration of endosulfan, while no leaves were affected in two lower concentrations of carbaryl and sevimol. Rest of the concentrations did not differ significantly.

The performance of each insecticide and concentration within the insecticides varied significantly from cucurbit to cucurbit in producing necrotic spots at all intervals (24, 48, 72 h and one week after treatment). There was no significant difference in the number of necrotic spots and percentage leaves affected within the insecticides 72 h and one week after treatment (Table 3).

DISCUSSION

The average number of necrotic spots due to DDT application varied from 0.0 to 3.38 spots per 5 leaves. More number of spots were observed on bottle gourd (3.58), bitter gourd (2.50), water melon (2.08) and snake gourd (1.91) at the highest concentration used (0.20%) and minimum number of spots were observed on snake gourd, smooth gourd, ridge gourd, round gourd, ash gourd and pumpkin at the lowest concentration (0.05%).

The percentage of affected leaves was highest in cucumber (87.79) followed by water melon (81.40), bitter gourd (67.71) and bottle gourd (66.87) at 0.20% concentration of DDT. The minimum percentage of leaves affected was recorded on smooth gourd (9.27), ash gourd (15.20), bitter gourd (19.63) and water melon (20.74) at 0.05% concentration. Rest of the cucurbits had moderate percentage of leaves affected (Table 3).

TABLE 4

Phytotoxicity level in each cucurbit at different concentrations of insecticides

Sr. No.	Name of insecticide	Concentration (%)	Bottle gourd	Snake gourd	Bitter gourd	Smooth gourd	Water melon	Ridge gourd	Round gourd	Ash gourd	Cucumber	Pumpkin
1.	DDT	0.05	Sep	Sep	Sep	Sp	Sep	Sep	Sep	MP	Sep	Sep
		0.10	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep
		0 20	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep
2.	Carbaryl (Sevin)	0.05	S	S	S	S	S	S	S	S	S	S
		0.10	S	S	S	S	S	S	S	S	S	S
		0.20	Sep	S	S	S	S	S	S	S	S	S
3.	Sevimol	0.05	S	S	S	S	S	S	S	S	MP	S
		0.10	S	S	S	S	S	S	S	S	MP	S
		0.20	Sep	S	S	S	S	S	S	S	MP	S
4.	Endosulfan (Thiodan)	0.035	S	S	S	S	S	S	S	S	S	S
		0.07	Sep	S	S	Sp	S	S	S	S	MP	S
		0.14	Sep	Sep	Sep	Sep	Sep	Sep	Sp	MP	Sep	Sep
5.	BHC	0.05	Sep	MP	Sep	S	S	S	S	Sep	MP	S
		0.10	Sep	MP	Sep	S	Sep	MP	Sep	Sep	Sep	MP
		0.20	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Sep
6.	Malathion	0.025	Sep	MP	S	Sp	Sp	MP	S	S	Sp	S
		0.05	Sep	MP	S	Sp	Sep	MP	Sp	MP	Sep	S
		0.10	Sep	Sep	Sp	Sep	Sep	Sep	Sep	MP	Sep	Sp
7.	DDVP (Nuvan)	0.02	Sp	Sep	Sp	S	MP	S	MP	Sp	Sp	Sp
		0.04	Sep	Sep	Sep	S	MP	S	Sep	Sp	Sp	MP
		0.08	Sep	Sep	Sep	Sp	MP	Sp	Sep	Sep	Sep	MP
8.	Phosphamidon (Dimecron)	0.02	Sep	S	S	S	MP	S	Sp	Sp	Sp	Sep
		0.04	Sep	MP	S	S	Sep	S	Sep	MP	Sp	Sep
		0.08	Sep	MP	S	S	Sep	Sp	Sep	Sep	Sep	Sep

Index : S=Safe
Sp=Slightly phytotoxic
Sep=Severely phytotoxic
MP=Moderately phytotoxic.

TABLE 3

Average number of necrotic spots/average percentage affected leaves in each concentration (average of three replications 24, 48, 72 h and one week after treatment)

Sr. No.	Cucurbits	DDT			Carbaryl (Sevin)			Sevimol			Endosulfan (Thioden)			BHC			Malathion			DDVP (Nuvan)			Phosphamidon			Total	Mean
		0.05%	0.10%	0.20%	0.05%	0.10%	0.20%	0.05%	0.10%	0.20%	0.035%	0.07%	0.14%	0.05%	0.10%	0.20%	0.025%	0.05%	0.10%	0.02%	0.04%	0.08%	0.02%	0.04%	0.08%		
1.	Bottle gourd	1.08	1.50	3.58	0.08	0.00	1.33	0.00	0.00	1.74	0.00	0.75	1.74	0.91	2.41	3.41	0.83	1.91	2.75	0.75	1.98	2.74	0.74	1.83	2.08	34.04	1.41
		44.76	55.10	66.87	00.00	0.00	18.04	0.00	0.00	17.45	2.50	39.50	62.33	27.06	140.69	54.97	20.84	54.59	55.60	9.41	44.32	49.58	26.73	53.66	57.37	800.57	33.35
2.	Snake gourd	0.00	0.75	1.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.74	0.74	1.41	3.74	0.46	1.24	1.83	1.66	3.41	4.08	0.25	1.00	1.25	25.47	1.06
		29.42	37.36	48.92	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	45.32	10.68	11.61	44.91	14.05	15.13	60.65	15.26	43.48	58.86	2.67	12.06	13.14	453.16	18.88
3.	Bitter gourd	1.24	1.74	2 50	0.16	0.00	0.00	0.00	0 00	0.00	0.00	0.00	0.63	1.16	1.91	2.66	0.00	0.33	0.58	0.00	0.50	0.75	0.00	0.00	0.00	14.16	0.59
		19.63	30.34	67.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.17	42.33	78.60	81.97	0.00	4.00	7.72	6.78	22.54	26.86	0.00	0.00	0.00	405.95	16.91
4.	Smooth gourd	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0,00	0,00	0.08	0.91	0.08	0.25	0.50	0,00	0,00	0.00	0.00	0.00	0 00	3.82	0.15
		9.27	23.13	28.01	0.00	0.00	0.00	0.00	0.00	0.00	3.27	5.89	3.44	0.00	2.25	28.20	9.45	9.91	16.44	0.00	0.00	0.00	0.00	0.00	0.00	164.26	6.84
5.	Water melon	0.25	1.44	2.08	0.00	0.60	0.00	0.00	0.00	0.16	0.00	0.25	0.41	0.08	0.83	1.91	0.08	6.24	1.24	0.00	0.00	0.00	0.25	0.41	0.66	10.29	0.42
		20.74	59.71	81.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.98	4.11	28.70	59.33	12.62	18.89	39.54	14.00	14.44	15.68	12.79	16.16	22.44	239.04	18.29
6.	Ridge gourd	0.91	1.00	0.91	1.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.84	0.25	0.50	1.74	0.25	0 25	0.91	0.00	0.00	0.08	0.00	0.00	0.16	7 63	0.31
		21.29	53.59	71.65	0.00	0.00	0.00	0.00	0.00	1.66	0.00	0.00	18.35	1.97	10.58	57.53	15.00	14.36	47.65	0,00	0 00	5.38	0.00	0.00	9.55	328.56	13.69
7.	Round gourd	0.00	1.43	1.41	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.41	0.25	1.66	3.08	0.25	0.25	1 33	0.00	0.00	0,25	0.16	0.96	1.75	13.10	0.54
		21.28	33.70	56.93	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.50	6.16	1.88	31.47	54.48	0.00	9.24	18.58	11.15	16.05	26.58	9.57	17.83	30.97	351.98	14.46
8.	Ash gourd	0.00	0.50	1.00	0.00	0,00	0.00	0.00	0.00	0,00	0.00	0.00	0.00	0.44	2.16	2.74	0.50	0.50	0.91	0.00	0.00	0.00	0.24	0.49	0.66	10.14	0.42
		15.20	23.33	50.06	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	13.66	25.73	40.04	68.97	4.59	14.95	15.72	7.70	9.98	17.44	6.60	11.41	20.05	347.93	14.49
9.	Cucumber	0.91	1.83	2.83	0.00	0.00	0.25	1.33	2.33	2.58	0.75	1.49	1.50	1.16	4.58	3.88	0.33	0.66	1.66	0.08	1.24	2.41	0.58	1.58	2.83	37.74	1.53
		45.34	64.56	87.79	0.00	0.00	1.66	11.11	13.97	14.58	0.00	10.95	32.01	12.09	42.36	60.70	5.08	18.16	36.54	8.63	8.86	55.03	9.17	9.38	40.20	588.16	24.50
10.	Pumpkin	0.00	0.00	1.24	0,00	0,00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.58	1.74	0.41	0.25	0.58	0.00	0.00	0.00	0.08	0.50	1.08	5.54	0.23
		17.50	18.59	50.45	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	17.15	6.08	10.35	34.99	4.08	3.64	6.25	9.71	11.28	14.91	23.95	27.01	37.75	294.35	12.26
	Total	3.46	10.10	19.55	0.00	0.00	1.58	1.38	2.33	5.38	0.75	2.49	7.27	5.15	16.12	25.78	3.19	5.88	12.29	2.49	7.13	10.31	2.30	6.77	10.47	–	–
		253.49	398.80	609.79	0.00	0.00	20.86	11.11	13.97	33.69	8.93	59.84	287.54	131.93	296.55	546.05	85.75	162.87	294.69	83.64	170.93	268.33	90.48	148.21	233.87		
	Mean	0.34	1.01	1.95	0.00	0.00	0.15	0.13	0.23	0.538	0.07	0.24	0.72	0.51	1.61	2.57	0.31	0.58	1.22	0.24	0.71	1.03	0.23	0.67	1.04	–	–
		25.34	39.88	60.97	0 00	0.00	2.08	1.11	1.39	3.36	0.89	5.98	26.75	13.19	29.65	54.60	8.57	16.28	29.46	8.36	17.09	26.83	9.04	14.82	23.38		

The necrotic spots produced and leaves affected due to application of DDT were significantly more than those in case of other insecticides except BHC. While sevimol and carbaryl were the safest insecticides in that they produced not only minimum number of necrotic spots but the leaves affected were also significantly less as compared to other insecticides.

The present findings with regard to the phytotoxicity of DDT and BHC are in conformity with those reported by Carrunth and Howe (1948), Crowell and Morrison (1950), Taiwania (1955) and Champ (1966). The safety of DDT and BHC on smooth gourd and pumpkin as reported by Mali (1969), however, is not in agreement with the present findings. On the other hand, Banerjee and Chatterjee (1955) have shown DDT at a concentration of 0.1% to be safe.

The present findings about the safety of carbaryl are supported by Mali (1969), Kadyan *et al.* (1971) and Sood *et al.* (1972).

In the present studies, endosulfan tested at 0.07% and 0.14% concentrations was severely phytotoxic on bottle gourd and cucumber, while on the contrary Sood *et al.* (1972) reported endosulfan to be safe on bottle gourd, round gourd and cucumber. It might be due to higher concentrations tested in this study. It did not cause any injury to water melon is supported by Kadyan *et al.* (1971).

During the present studies malathion used at 0.05% and 0.10% was found severely phytotoxic to bottle gourd, round gourd and cucumber. Sood *et al.* (1972) on the contrary reported this insecticide to be safe on these cucurbits (Table 4). It might be probably due to higher concentrations used since the lower concentration of malathion was moderately phytotoxic to these cucurbits. During the present studies, malathion used at 0.1% concentration was severely phytotoxic to water melon as against moderate phytotoxicity reported by Kadyan *et al.* (1971).

The DDVP (Nuvan) was more phytotoxic to snake gourd, bottle gourd and cucumber, while it was safe to smooth gourd and ridge gourd. Sood *et al.* (1972) reported that DDVP was quite safe to bottle gourd, cucumber and round gourd. It might possibly be due to higher concentrations used in present studies.

Present findings with respect to the phytotoxicity due to phosphamidon on bottle gourd, round gourd and cucumber are in conformity with Sood *et al.* (1972).

REFERENCES

Banerjee, S N. and Chatterjee, B. K. 1955. Studies on the phytotoxic action of BHC and DDT on common cucurbitaceous plants in West Bengal. *Proc. Indian Acad. Sci.* (b), **41** : 227-31.

Carrunth, L. A. and Howe, M. L. 1948. Factor affecting use and phytotoxicity of DDT and other insecticides to squash borer control *J. Econ. Entomol.* **41** : 352-56.

Champ, B. R. 1966. Some effects of DDT, dieldrin, dimethoate and fenthion on growth of cucumbers. *Queensl. J. Agric. Anim. Sci.* **23** : 333-36.

Chapman, R. R. and Allen, T. C. 1948. Stimulation and suppression of some vegetable plants by DDT. *J. Econ. Entomol.* 41 : 616.

Crowell, H. C. and Morrison, H. C. 1950. The phytotoxicity to cucurbits of some new insecticides. *J. Econ. Entomol.* 43 : 14-16.

Kadyan, A. S., Kaushik, S. N. and Gupta, D. S. 1971. Phytotoxicity of some insecticides to muskmelons. *Indian J. Entomol.* 33 : 463-66.

Mali, A. R. 1969. Studies on the phytotoxicity of some of the commonly used insecticides on Jowar, red pumpkin, bottle gourd, and smooth gourd. *Pesticides*, 6 : 34.

Mukherjee, P. B. and Wadhi, S. R. 1956. Further studies on the phytotoxicity of modern organic insecticides. *Indian J. Entomol.* 18 : 332-35.

Shinde, C. B. 1959. Studies on *Aulacophore foveicollis* Lucas, red pumpkin beetle. M.Sc. thesis, Vikram University Ujjain.

Sood, N. K., Kaushik, U. K. and Rathore, V. S. 1972. Phytotoxicity of modern insecticides to cucurbits. *Indian J. Hortic.* 29 : 110-13.

Taiwania, Ho. T. 1955. The toxic effects of DDT and bHC dust to the leaves of water melon. *Taiwania* 6 : 79-84.

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STUDIES OF THE EFFICACY OF STABLE BLEACHING POWDER IN CONTROLLING BACTERIAL BLIGHT OF GUAR IN COMPARISON WITH OTHER ANTIBACTERIAL FORMULATIONS

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ABSTRACT

Stable Bleaching Powder (35% chlorine) at 100 to 1000 ppm, Agallol-3, Emisan-6 and Streptocycline allowed only few colonies of *Xanthomonas cyamopsidis* to develop by Colony Count method in *in vitro* studies. Turbidimetric method also showed that SBP 1000 ppm and Streptocycline gave maximum inhibition. Seed treatment plus one spray with SBP 1000 ppm was the best in reducing disease incidence as compared to all other antibiotics and fungicides tested.

Chlorination of drinking water has been used since long to eliminate microbial contamination. SBP has also been reported as an effective chemical for the control of certain plant bacterial diseases like black rot of cabbage (Patel *et al.*, 1950) and stalk rot of maize (Thompson, 1965). Guar, which is becoming an important crop for its gum being used in industries, is attacked by bacterial blight caused by *X. cyamopsidis*. It was thought worthwhile to test the efficacy of Bleaching Powder for the control of this disease using both seed treatment and foliar sprays.

MATERIAL AND METHODS

Stable Bleaching Powder (SBP), a chemical of M/s Shri Ram Chemical Industries, Delhi; Agrimycin-100, Pfizer Ltd., Bombay; Streptocycline, Hindustan Antibiotic Ltd., Pimpri; Blitox-50, Tata Fison, Bombay; Agallol-3, Bayer India Ltd.; Emisan-6, Excel Industries Ltd., Bombay, and Plantvax-20 EC Uniroyal Chemical, were used. Different concentrations of SBP were prepared on the basis of active chlorine, i. e., 35%, whereas other antibiotics/fungitoxicants were prepared on the basis of commercial formulations.

Effect on the Growth of Bacterium. Colony Count and Turbidimetric methods were used. In the latter, 9 ml nutrient dixtrose broth (NDB) was suspended in test tubes and sterilized. Test chemicals were prepared in sterilized distilled water having 10 times more concentration than the required ones and 1 ml from each concentration was poured in each test tube aseptically. The test tubes were then inoculated with bacterial

cell suspension by adding 2 drops per test tube. Control had sterilized distilled water. Different checks were made by adding different concentrations of the chemicals and no inoculation was done. The test tubes were incubated at 25°C for 72 h and optical density was measured with spectronic-20 at 500 nm.

Per cent growth inhibition was calculated by the following formula :

$$\text{Per cent growth inhibition} = 100 - \left[\frac{\text{O.D. with treatment}}{\text{O. D. with control}} \times 100\right]$$

Effect on Disease Incidence. Studies were undertaken in green house and field of Department of Plant Pathology, Haryana Agricultural University, Hissar, during *Kharif* season of 1978. Randomized block design (RBD) with three replications for each treatment was adopted. Two experiments, one in summer season (April, 1978) in the field and another in rainy season (June, 1978) in green house were conducted. Guar seeds (var. FS 277) were artificially inoculated by dipping for 30 min in bacterial cell suspension (2.28×10^4 cells/ml). The seeds were then air dried in shade and kept for further use. After three days artificially inoculated seeds were treated with different concentrations of SBP and other chemicals by dipping in their solution for 4 h, dried and then sown. To study the efficacy of SBP as foliar spray in disease control, thirty days old plants raised from uninoculated seeds were first spray inoculated with bacterial cell suspension and 24 h after inoculation, the chemicals were sprayed.

Soil Treatment. Soil in pots was mixed with different amount of SBP. In the field, soil was dusted with required amount of SBP before sowing of inoculated seeds.

Observations were taken on seed germination, disease incidence and average grain yield per plant in case of seed and soil treatment while disease incidence and average grain yield per plant were taken in case of foliar spray and seed treatment plus foliar spray. Plants were spray inoculated with bacterial cell suspension only in the treatments where chemicals were sprayed 24 h after inoculations Average of three replications was calculated. Per cent disease index, was obtained by the following formula :

$$\text{Per cent disease} = \frac{\text{Sum of all numerical rating}}{\text{Total no. of leaves counted}} \times \frac{100}{5}$$

Disease rating scale was used as follows :

0 = Healthy leaves

1 = 1 – 10% leaf area covered with disease spots.

2 = 11 – 20% leaf area covered with disease spots.

3 = 21 – 40% leaf area covered with disease spots.

4 = 41 – 60% leaf area covered with disease spots.

5 = More than 60% leaf area covered with disease spots.

RESULTS AND DISCUSSION

The bacterium, *Xanthomonas cyamopsidis*, caused interveinal, round, water soaked appearance on the dorsal surface of guar leaves after one day of inoculation. These became brown, coalesced with each other and resulted in blight phase after 10 days of inoculation.

Toximetric Studies

Colony Count Method. SBP 100 to 1000 ppm, Agallol-3 and Emisan-6 gave the maximum reduction in colony num-

ber being at par with each other statistically. SBP 50 ppm reduced the colony number significantly being at par with Streptocycline (Table 1).

Turbidimetric Method. The data revealed that SBP at 1000 ppm and Streptocycline gave the highest growth inhibition followed by SBP 100 to 250 ppm which were nonsignificant to each other (Table 1). Thind and Payak (1972) reported that SBP at 10, 25 and 50 ppm allowed nil or at the most only one to two colonies showing thereby that the pathogen *Erwinia carotovora* var. *zea* had a very high degree of sensitivity to chlorine. This might be owing to its specificity against various bacterial organisms.

Disease Control Studies

Soil Treatment. Data in Table 2 indicate that SBP treatments gave significant increase in seed germination, disease control and grain yield per plant except 2.5 kg/ha. SBP 12.5 kg/ha showed its superiority over all other treatments in both the seasons. SBP 10 kg/ha also gave good results.

Seed Treatment. A perusal of Table 3 reveals that SBP 500 ppm gave maximum seed germination in summer season which was at par with that of Agallol-3 Disease incidence was reduced to the maximum and grain yield per plant obtained was highest with SBP 1000 ppm which statistically proved similar to SBP 250 and 500 ppm. SBP at 150 ppm or above gave better seed germination among all other treatments.

During rainy season SBP 500 ppm, Agallol-3 and hot water treatment gave maximum seed germination, whereas SBP 250, 1000 ppm and Agallol-3 proved better in disease conrrol over all other treatments. SBP at 100 and 150 ppm was found similar to Streptocycline, Agrimycin-100 and Agrimycin-100+Blitox 50 in seed germination. Similarly, SBP 500 ppm showed no significant difference with Streptocycline, Agrimycin-100 and Agrimycin-100+Blitox 50 in disease control.

Spray. Data in Table 4 reveal that SBP 1000 ppm gave the maximum disease control, whereas SBP 500 ppm and Streptocycline; SBP 250 ppm and Agrimycin-100+Blitox-50; and SBP 100 and 150 ppm were observed next to the best in summer season. SBP 250 to 1000 ppm gave the maximum grain yield per plant.

During rainy season crop SBP 1000 ppm, Streptocycline, Agrimycin-100 and Agrimycin-100+Blitox-50 gave the maximum disease control among all the treatments.

Seed Treatment+Spray. Among all the treatments, SBP 1000 ppm gave maximum disease control (Table 5). SBP 250 ppm, Streptocycline and Emisan-6; and SBP 150 ppm and Agrimycin-100 were found at par with each other in disease control during summer season. Maximum yield was obtained with SBP 250 to 1000 ppm and Streptocycline. SBP 150 ppm also gave significant increase in yield and the results were at par with that of Agrimycin-100 + Blitox-50 and Emisan-6.

During rainy season, SBP 1000 ppm, Streptocycline and Agrimycin-100+Blitox-50 controlled the disease to the maximum. SBP 250, 500 ppm, Agrimycin-100 and Emisan-6 were observed

TABLE 1

Efficacy of SBP and other antibiotics and fungitoxicants against *Xanthomonas cyamopsidis*

Chemicals (ppm)	Colony count method	Turbidimetric method
	No. of colonies per plate	Optical density
SBP (1)	90.66(9.58)	0.090(1.047)
SBP (10)	71.33(8.51)	0.093(1.046)
SBP (25)	13.00(3.73)	0.083(1.041)
SBP (50)	3.66(2.10)	0.065(1.031)
SBP (100)	1.00(1.41)	0.050(1.024)
SBP (150)	0.33(1.14)	0.050(1.024)
SBP (250)	0.00(1.00)	0.041(1.02)
SBP (500)	0.00(1.00)	0.025(1.012)
SBP (1000)	0.00(1.00)	0.003(1.002)
Streptocycline (100)	3.66(2.13)	0.000(1.00)
Agrimycin-100 (100)	28.33(5.41)	0.021(1.01)
Agallol-3 (1000)	0.33(1.14)	—
Emisan-6 (1000)	0.00(1.00)	—
Blitox-50 (1000)	81.00(9.05)	—
Plantvax-20 EC (5000)	30.00(5.57)	—
Control	97.66(9.93)	0.110(1.055)
C. D. at 5% level	(0.38)	(0.009)

Figures in parentheses are $\sqrt{n+1}$ transformed values.
Average of three replications.

TABLE 2

Efficacy of SBP soil treatment on seed germination, bacterial blight incidence and grain yield of guar

	Summer Season			Rainy Season	
Amount of SBP (kg/ha)	Seed germination (%)	Disease index (%)	Grain yield/plant* (g)	Seed germination (%)	Disease index (%)
SBP (2.5)	65.00 (53.76)	16.66 (23.95)	8.36 (3.06)	66.66 (54.74)	19.37 (26.10)
SBP (5)	78.33 (63.55)	16.30 (23.78)	11.69 (3.56)	68.00 (55.55)	18.29 (25.32)
SBP (10)	90.00 (71.91)	10.46 (18.83)	14.23 (3.90)	80.00 (63.51)	12.79 (20.96)
SBP (12.5)	98.33 (85.69)	6.72 (14.93)	15.77 (4.10)	86.66 (68.91)	9.53 (17.97)
Control	60.00 (50.79)	23.40 (28.90)	4.30 (2.30)	28.00 (31.91)	21.05 (27.32)
C. D. at 5% level	(8.56)	(1.67)	(0.15)	(5.33)	(1.36)

Figures in parentheses are angular transformed values.
*Figures in parentheses are $\sqrt{n+1}$ transformed values.
Average of three replications.

TABLE 3

Efficacy of SBP and other chemicals on seed germination, bacterial blight incidence and grain yield of guar (var. FS 277) when used as seed treatment

Chemicals (ppm)	Summer Season			Rainy Season	
	Seed germination (%)	Disease index (%)	Grain yield/plant (g)	Seed germination (%)	Disease index (%)
SBP (10)	61.66(51.76)	22.07(28.01)	3.52(10.78)	30.66(33.62)	19.73(26.37)
SBP (25)	65.00(53.76)	21.90(27.90)	3.42(10.66)	38.66(38.44)	19.80(26.42)
SBP (50)	70.00(56.84)	21.10(27.34)	6.43(14.64)	38.66(38.43)	19.25(26.30)
SBP (100)	76.66(61.14)	18.54(25.52)	8.00(16.42)	56.00(47.46)	16.35(30.86)
SBP (150)	85.00(67.40)	17.28(24.55)	11.00(19.36)	58.66(50.00)	14.46(22.32)
SBP (250)	93.33(75.24)	12.11(20.31)	13.50(21.54)	82.66(65.42)	6.58(14.81)
SBP (500)	96.66(81.39)	8.90(17.39)	14.16(22.10)	93.33(77.77)	8.04(16.50)
SBP (1000)	90.00(71.95)	4.94(12.86)	14.83(22.64)	78.66(62.51)	5.92(13.96)
Streptocycline (100)	83.33(65.95)	13.78(21.77)	9.66(18.11)	56.00(48.45)	8.00(16.42)
Agrimycin-100 (100)	68.33(55.77)	15.55(23.23)	8.50(16.95)	54.66(47.69)	9.42(17.84)
Agrimycin-100+Blitox-50 (100+1000)	78.33(62.29)	15.09(22.83)	11.50(19.81)	58.33(49.83)	8.59(17.01)
Agallol-3 (2000)	98.33(85.69)	11.50(19.82)	12.25(20.48)	90.66(72.29)	6.59(14.85)
Emisan-6 (2000)	78.33(62.48)	12.78(20.93)	8.66(17.11)	82.00(64.92)	12.16(20.38)
Hot water treatment (52°C for 30 min)	85.00(67.40)	18.80(25.67)	6.16(14.37)	93.26(75.00)	15.65(23.31)
Control	60.00 (50.79)	23.33(28.88)	2.50(8.97)	28.00(31.91)	21.38(27.55)
C. D. at 5% level	(6.84)	(1.32)	(1.64)	(6.30)	(1.70)

Figures in parentheses are angular transformed values.

TABLE 4

Efficacy of SBP and other chemicals on bacterial blight incidence and grain yield of guar when used as spray

Chemicals (ppm)	Summer Season		Rainy Season
	Disease index (%)	Grain yield/plant* (g)	Disease index (%)
SBP (10)	20.39(26.79)	3.76(2.18)	19.38(26.12)
SBP (25)	20.13(26.63)	4.36(2.32)	18.86(25.74)
SBP (50)	19.57(26.20)	7.16(2.86)	17.03(24.40)
SBP (100)	17.58(24.75)	8.43(3.07)	14.92(23.26)
SBP (150)	16.48(23.91)	10.20(3.35)	13.81(21.80)
SBP (250)	14.05(21.97)	13.50(3.81)	9.90(18.33)
SBP (500)	10.93(19.25)	14.83(3.98)	11.00(19.35)
SBP (1000)	8.33(16.70)	14.50(3.94)	7.84(16.25)
Streptocycline (200)	12.03(20.25)	12.86(3.72)	5.51(16.60)
Agrimycin-100 (200)	14.81(22.59)	11.13(3.49)	7.66(16.07)
Agrimycin-100+Blitox-50 (100+1000)	14.05(21.97)	12.33(3.65)	5.72(13.84)
Blitox-50(2000)	18.85(25.70)	8.60(3.10)	15.72(20.15)
Emisan-6 (2000)	14.30(22.19)	11.83(3.58)	11.85(23.36)
Control	20.83(27.13)	4.26(2.29)	22.41(28 26)
C. D. at 5% level	(1.03)	(0.19)	(3.51)

Figures in parentheses are angular transformed values.

*Figures in parentheses are $\sqrt{n+1}$ transformed values.

Average of three replications.

TABLE 5

Efficacy of SBP and other chemicals on bacterial blight incidence and grain yield of guar (var. FS-277) when used as seed treatment+spray

Chemicals (ppm)	Summer Season		Rainy Season
	Disease index (%)	Grain yield/plant	Disease index (%)
SBP (10)	21.03(27.29)	4.16(11.78)	19.52(26.22)
SBP (25)	21.06(27.32)	4.50(12.25)	19.06(25.88)
SBP (50)	20.86(27.18)	7.00(15.33)	18.09(25.15)
SBP (100)	17.99(25.09)	8.33(16.78)	14.72(22.57)
SBP (150)	15.92(23.55)	11.83(20.12)	13.77(21.78)
SBP (250)	11.17(19.49)	14.86(22 58)	7.67(16.07)
SBP (500)	7.51(15.92)	15.16(22.92)	6.47(14.67)
SBP (1000)	4.78(12.56)	15.33(23.05)	4.20(11.80)
Streptocycline (100+200)	12.01(20.26)	12.33(22.55)	5.25(13.20)
Agrimycin-100+(100+200)	14.38(22.30)	10.16(18.59)	7.48(15.88)
Agrimycin-100+Blitox-50 (100+1000)	13.68(21.69)	12.00(20.26)	5.09(13.03)
Emisan-6 (2000)	12.18(20.41)	11.16(19.52)	8.20(16.63)
Control	23.33(28.81)	3.33(10.39)	21.05(27.32)
C. D. at 5% level	(1.17)	(1.21)	(1.70)

Figures in parentheses are angular transformed values.

Average of three replications.

similar to each other in reducing the disease incidence significantly.

SBP efficiency towards disease control, more in summer season than rainy season, indicates that seasonal variation appears to be the determining factor in apprehending the disease controlling efficacy of SBP.

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REFERENCES

Patel, M. K., Abhyankar, S. G. and Kulkarni, Y. S. 1950. Black rot of cabbage. *Indian Phytopathol.* 2 : 58-61.

Thind, B. S., and Payak, M. M. 1972. Antibiotics and bleaching powder in the control of bacterial stalk rot of maize. *Hind. Antibiot. Bull.* 15 : 9-13.

Thompson, D. L. 1965. Control of bacterial stalk rot of corn by chlorination of water in sprinkler irrigation. *Crop Sci.* 5 : 369-70.

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FEMALE CRIMINALS IN HARYANA—A SOCIOLOGICAL STUDY

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ABSTRACT

Criminal has always been a source of excitement, awe, fear and bewilderment because of his abnormal behaviour. It becomes more serious when criminal is female, because of the disorganization in central role she plays in establishing, building and maintaining family. In these fifteen case studies, an attempt was made to know the character and causes of female criminality.

Crime against person, i.e., murder was committed by rural women, whereas the illegal trade and sex crimes by urban women. Causes and motives of murders were varied but the victim and murderer were in kinship or neighbourhood relations. Male accomplice were found in majority of the cases but female in none. Motive of illegal trade was either subsistence or greedyness of wealth. Mother was the trainer, in this crime, in majority of cases. But in sex crimes negligence of parents and especially death of mother in childhood made them delinquent. Besides these, familial conflicts, illiteracy, poverty, widowhood and urge for sex satisfaction, defective socialization and unhealth, locality environment and absence of parents in childhood were the main causes of their delinquent behaviour.

In all societies female offences are considered more serious as compared to the same offences committed by males. This is primarily because of the central position women held in the process of socialization (Jackson, 1957; Syed, 1970; Dayal, 1972; Amati, 1975). This central position makes female offences more disfunctional than male offences because the former have greater consequences on the social structure than the latter. Moreover females are inherently moral (Verma, 1973).

Carol Smart (1977) mentioned the beliefs in the insignificance of the action of women; the assumption that the women are inessential and invisible; total neglect of any critical analysis of the common sense; perceptions of female criminality informing classical and contemporary studies responsible for the under development of this particular area of study.

The social context is changing throughout the world and the status of women is also rising. The question of the illegitimate opportunity structure traditionally open to women raises the question of whether changes in women's social and economic roles are leading to higher rates of criminality.

The early seventies witnessed a marked rise in crime among women in India. The proportional increase in women arrests was higher. Between 1971 and 1975, number of women and men arrested increased by 48.5% against 47.3%, respectively. Major offences that landed women in jail were shoplifting, petty thefts, rioting, burglary, dacoity, kidnapping, abduction, breach of trust, cheating and murder. Haryana is no exception. Total cognizable crimes increased from 17578 in 1968 to 31245 in 1975. Offences which landed women in jail were mainly illegal trade, murder, kidnapping and burglary.

The rate, type and form of criminality vary from society to society and from section to section within the same society. Due attention has never been paid to understand the character and causes of female criminality.

An attempt was made to know, the nature of crimes committed; and the different socio-economic and psychological factors leading them to criminal behaviour.

METHODOLOGY

The study was conducted in Haryana State during the year 1977-78. Borstal Jail Hissar, the only confinement place in the State in which women from all other jails are finally sent for undergoing the imprisonment and ultimate rehabilitation, was selected. The study was conducted on fifteen convicted women criminals undergoing imprisonment.

Case study method with socio-cultural approach (Denis, 1966) was used because of the lesser number of cases. The individual cases of women criminals were studied in regard to their age, religion, caste, marital status, background of parental and husband's family, neighbourhood and locality, their feelings towards crime and rehabilitation plan after release etc. Besides this, non-structured questions and depth interview, case judgement jail record file and letters received from inmates were critically examined.

On the basis of information collected from different sources, the detailed case studies, profile and report were prepared.

RESULTS AND DISCUSSION

Nature and extent of crime

Natural differences between man and woman have brought variations in their actions and interactions. This fact applied not only to their socially approved behaviour but also to the deviant or criminal behaviour.

Of the fifteen criminals, there were seven convicts for illegal opium sale, six for murder and two for illicit sex relations. There was only one respondent from Haryana State convicted for illegal opium sale. It can be said from the information gathered that in Haryana State the opium is imported from Uttar Pradesh, Rajasthan and Punjab. Of the seven, five women were with urban background from where they picked up this deviant behaviour. Main motive behind this crime was either to get subsistence or to collect more wealth for better standard of living. Steffensinier and Jordan (1978) reported the rise in female crimes in general but urban women were involved more in

larceny theft. The motives might be the same even in call girls categorised by Shergill (1970). Amongst the convicted for illegal opium sale, all the illiterate women involved themselves for getting their subsistence and literate women for wealth. Respondents were introduced to this crime either by mother or neighbourer. Except one, all were the members of some gang. The crime was being committed in a very planned manner and many persons were involved. None of the respondents was head of any gang. They were simple members and not involved in the planning of crime.

All the six women who committed murders were from Haryana State. In five cases, family members were murdered and in one case, the child of paramour. Ahuja (1970) reported the same trend in his study of female offenders. Although it was murder that dominated amongst the various types of crimes, yet it could not be considered typical of them because in most of the cases the murders were committed not only with the cooperation of male accomplices but motivated, instigated and persuaded by their male accomplices. They were the closest, nearest and dearest relatives, lovers or friends, in whom they had confidence more than what they could have in themselves even. Means used were sword, poison, burning and strangulation. Women in Haryana commit crime of her close relative or within the forwall of house and with the help of accomplice, generally man. Crime is committed in a very henious manner.

Both the women involved in illicit sex relations were widows. In one case, she adopted the profession of a prostitute and forced the teenager daughter-in-law in this trade. In second case, step-mother gave latitude to get rid of step daughter. In both cases, a large number of persons were involved as pimps and clients. It cannot be asserted that illegal sex relations are too less to significance as majority of the cases go unreported. Man is very much involved in this crime but blame is more on woman because of social values.

Socio-cultural milieux

Relative number of Hindu women is higher because of the domination of this religion in the region. The only Muslim woman involved in illegal opium sale was from Uttar Pradesh. Both the women convicted for murders were Sikh. Thus, it may be visualised that Sikh women may commit more murders.

As many as 10 respondents were from upper caste and 5 from scheduled caste. Amongst higher castes, Bania was dominating. The most prominent crime amongst the higher castes was murder followed by opium trade and illicit sex relations. Amongst lower castes, illegal opium sale dominated because of acute poverty and amongst higher castes, because of sheer greediness. Illegal sex relations in lower castes generally go unreported.

Urban women were more prone to illegal opium sale and illegal sex relations, whereas rural to murders. In former case, the anonymity of city life, greediness and poor economic background were contributing while in the latter illegal sex relations and family conflicts. It can be said that in rural areas crimes against person are more, whereas in urban areas these are against property.

As many as 10 respondents were illiterate and 5 of them were involved in illegal opium sale and 2 in illegal sex relations. Both the educated women involved in opium sale were after wealth. But cases of illegal sex relations were for earning livelihood. None of the respondents from lower castes was literate. Sohoni (1974) reported 85.4% convicted women as illiterate Illiteracy seems to be a contributory factor but here family background was stronger than educational institution in fixing the values. Bhatia (1974) also found stronghold of family background.

The profile revealed that most of the crimes (6) were committed by the women in the age group 35 to 45, followed by below 25(4), 25 to 35(3) and 45 and above (2). Christopher and Steven (1972) also support this trend. Women in middle age group are more energetic, emotional and laden with household responsibilities which might be the cause of frustration and taking such drastic steps. In lower age group, two women committed crime which was related to illegal sex relations. None was below the age of 21 years. This might be due to non-reporting of crime committed by unmarried girls. Mukerjee (1955) reported that young people had lost social and moral orientation which was leading to criminal behaviour. In the age group of 35-45, illegal opium sale was more Poor economic condition was the main reason of opium trade in 5 cases. Poverty leads to social insecurity which leads to illegal sex relations and disputes with in-laws. Though three women were having physical ailment yet it was not a cause of criminal behaviour in any case.

None of the respondents was last born. The first born were seven. Of these, two were involved in illegal sex relations. But, the order of birth was not the only cause. Deviant behaviour might be due to the over solicitude and lack of opportunity to develop, adjustment to equals in early age and higher level of anxiety (George and Rajalakshmi, 1971). But, in both the cases of illicit sex relations it was negligency by step parents and in other cases over solicitude was a contributory factor. The middle born might had become delinquent due to the negligence of parents. Dentler and Monroe (1961) reported the association between theft and birth order. No association could be traced between crime and order of birth.

There was not even a single unmarried woman criminal. Sohoni (1974) also reported only 15% unmarried women criminals. The reason may be that traditionally marriage is a sacrament for Indian girls, otherwise they are looked down upon. Widow-hood was positively associated with the deviant behaviour as 7 of the respondents were widows before committing crime. Bhatia (1974) also reported the uprooting of normal life by violent changes, as a factor contributing to delinquency. Marriage is a turning point in the life of Indian girl. After marriage she becomes a wife, a mother and a daughter-in-law. Any maladjustment, in any of these three roles, turn her to delinquent behaviour (Ahuja, 1970; Desai *et al.*, 1970). All those who were widow were poor, socially insecure and humiliated by parents, especially in-laws. In both the cases of illicit sex relations and 4 others, it was the urge of sex satisfaction which led them to deviant behaviour. Thus, it can be said that widows are deprived of the three basic needs, food, sex and company.

Those who were married at an early age bent towards illegal opium sale and illegal sex relations. Their immaturity, innocence and lack of guidance might be the reasons. Those married at higher age were involved in murders because of the maladjustment in family of in-laws Sundram (1976) has also reported the maladjustment in family of in-laws a factor contributing to criminal tendencies. Though the age at marriage gives some clue of the nature of crime (Ahuja, 1970), yet it can not be relied upon because 9 of them were widows and this was a major contributory factor rather than age at marriage.

In six cases either of the parent or both were absent from the childhood. In three cases both parents died in childhood. It was found that the lack of mother led to illegal sex relations, death of father to illegal opium sale and presence of both parents to murders (Mukerjee *et al.*, 1960; Desai *et al.*, 1970; Syed, 1970; Dayal, 1972; Natrajan, 1974; Amati, 1975; Attar, 1975). It is revealed that for a girl in our society mother plays the dominant role in building of her character. Broken home is a major factor determining behaviour of individual.

Parents attitude in childhood was strongly associated with illegal sex relations. Both the respondents were brought up in negligent atmosphere. Lack of real mother was the main cause of their becoming victim of illegal sex relations. Dentler and Monroe (1961) found quality of parent-child relations significantly associated with delinquent behaviour which is found in these cases also.

Occupation was neither related to the nature of crime nor to its extent. But the lower earnings because of lesser days of employment led to economic crisis in their families. Bard (1974) also reported the shattering of economic status of family leading to violence. Steinmetz and Straus (1974) reported the casual occupation and higher unemployment contributing to crimes. Both the conditions were found here also.

All the widows were from nuclear families because they are looked down upon. After the death of male head, woman had to manage every affair of family which required wider contacts. In these cases the lack of protection led them to criminal behaviour. In joint family, there are lesser chances of being delinquent because of protection but the impact of parental family certainly affects her behaviour in-laws family. Changes from nuclear to joint type of family demanded adjustment. The higher sensitivity to social conflict in females might have been a contributory factor as in eight cases, type of family changed after their marriage. Apparently it was not a main cause of delinquent behaviour.

In large size families with more children, there were more familial conflicts and poverty which led to higher number of murder cases, whereas in small size families lack of social control to illegal sex relations. Gupta (1977) found family size and number of children associated with delinquent behaviour.

In four cases husband-wife relationships were not cordial. Two of them murdered their husbands. Main reason for husband-wife conflicts were the non-cooperative, quarrelsome and illegal sex relations of either partner. Sundram

(1976) observed the same reasons for husband-wife conflicts. It is revealed that husband wife relationship is associated with delinquent behaviour.

Environment of locality and neighbourhood was poor in most of the cases and it was worst in cases of illegal opium sellers. Four of them were from scheduled caste. Six of the respondents involved in opium trade were member of a smaller or bigger gang operating in their locality. One who was caught in first instance was also trapped by neighbourer. In one case of illegal sex relations there was forced cluster of clients, whereas in second it was voluntary but in both cases the clients were from locality also. However, none of the murders was a member of any gang; and locality was healthy in five cases.

Parental family of the five women, was found conducive to criminal behaviour. In three illegal opium selling cases mothers were actively involved in the trade, which was the main force dragging them in delinquent behaviour. Jackson (1957) stressed the role of family in deviant behaviour. In one case, brother committed murder while in other mother committed suicide because of the torture of her daughter by latter's husband. In six cases the atmosphere of parental locality and neighbourhood was unhealthy whereas it was worst in husband's. Parental locality and neighbourhood environment was closely associated with criminal behaviour in illegal opium selling cases (Jackson, 1957; Bhatia, 1974). The conviction of parents and close relatives also influenced them (Natrajan, 1974). Attitude of mother towards the crime committed was positive in five cases whereas it was in none of the husband's family. Mothers have given latitude in becoming them delinquent.

Guilt feeling was higher amongst those who had to commit crime and low amongst those who were professional or committed crime in planned manner. Most of the respondents would join their in-laws after release.

It is clearly revealed from the case studies that family, the first training group, and the locality and neighbourhood are responsible for delinquent behaviour. Family not only transmits socially acceptable values to the new generations, it also seeks to prevent the child from being influenced by deviant pattern. The situation becomes worst where mother dies or mother herself is involved in criminal acts. Absence of bread earner shatters the economic foundation of family and death of husband leads to both social and economic insecurity which drags them in conflict to which females are more sensitive. Woman is the worst enemy of woman and man exploits the situation. Crime is the outcome of the action and reactions of not one or two but of a multiplicity of factors.

IMPLICATIONS

The multi-causal nature of the crimes reported bear implications, besides every citizen, for scholars, reform institutions and policy makers.

Every citizen should keep in mind that the criminals are the product of socio-cultural system. It is the situation created by the society that land them in jails. No healthy individual want to stick the label of criminal to himself. He needs

cooperation, sympathy and affection for becoming a nobel citizen.

Present study is an humble attempt in the field of criminology and needs to be verified at macro and micro levels. The hypothesis generated should be tested for establishing generalizations.

Reform institutions would utilize the findings on various aspects of their handling and dealing with criminals. As far as possible persons trained in sociology, psychology and social work should be recruited for positions dealing with criminals. Intensification of occupational training programmes and aftercare should be given top priority in order to make them economically sound and socially adjusted after release.

Social Welfare Agencies have a dual role of preventive and curative nature. The children of broken homes and those living in moral, social and economic danger should be weaned away in time and be placed in the shelter homes, protective homes and rescue homes. Older women should also be looked after and community living for aged be promoted.

In planning and policy formulation special attention be given to education of females, provision of pension for aged, implimentation of already passed social legislations and physical environment of rural and slum areas. The data available on crime is not reliable. Measure be taken to collect reliable data for sound planning for amelioration of the problem.

REFERENCES

Ahuja, R. 1970. Female murders in India—a sociological study. *Indian Journal of Social Work* 31 (3) : 271-84.

Amati, B. H. 1975. Juvenile delinquency—a sociological survey. *Social Welfare* 22(1) : 35-36.

Attar, U. A. 1975. Urbanization and crime. *Social Welfare* 22(3) : 1-3.

Bard, Morton. 1974. The study and modification of interfamilial violence. In : Suzanne K. Steinmetz and Murray A. Straus (eds.)., Violence in the Family, pp. 127-39, New York, Dodd, Mead and Co.

Bhatia, U. V. 1974. Juvenile delinquency—an ecological study. *Social Welfare* 21(6) : 18-19.

Carol Smart, 1977. Women Crime and Criminality. p. 3; London: Kegan Paul.

Christopher, B. and Steven, G. 1972. Black suicide—a report of English cases and controls. *Journal of Social Psychology* 86 : 75-79.

Dayal, Johan, 1972. Sons of lucifer. *Patriot Magazine* 9(352) : 1-2.

Dentler, Robert A. and Monroe, Lawrence J. 1961. Social correlates of early adolescent theft. *American Sociological Review* 26(5) : 733-43.

Denis, Szabo. 1966. The socio-cultural approach to the etiology of delinquent behaviour. *International Social Science Journal* 18(2) : 186.

Desai, H. G., Saurashtra, C. and Bhatnagar, U. 1970. Factors relating to juvenile delinquency. *Educational Review* 5(2) : 74-83.

George, E. I. and Rajalakshmi, Devadas. 1971. Manifest anxiety as a function of birth order. *Journal of Indian Academy of Applied Psychology* 8(2) : 39-40.

Gupta, J. P. 1977. Juvenile delinquency—a new approach. *Women's Era* 5(83) : 21.

Jackson, Tobey. 1957. The differential impact of family disorganization. *American Sociological Review* 22(5) : 505-12.

Mukerjee, N. 1955. Crime and society. *Indian Journal of Psychology* 30 : 23-33.

Mukerjee, K., Ray Chaudhuri, M. and Maitra, A. K. 1960. Influence of father absence during early socialization process-criminal and non-criminals compared. *Sociological Bulletin*, 12 & 13 : 1-8.

Natrajan, V. 1974. A study of factors influencing juvenile delinquency. *Educational Review*, 30(2) : 38-40.

Shergill, 1970. Glamour and thrill have their toll. *Social Welfare* 18(6) : 9.

Sohoni, N. K. 1974. Women prisoners. *Indian Journal of Social Work* 35(2) : 137-48.

Steffensinier, Darrell J. and Jordan, Charlene 1978. Changing patterns of female crime in rural America, 1962-75. *Rural Sociology* 43(1): 87—102.

Steinmetz, Suzanne K. and Straus, Murray A. (eds.) 1974. Violence in the Family. New York, Dodd, Mead and Co.

Sundram, I. S. 1976. Anatomy of suicides. *Social Welfare* 23(3) : 1-2.

Syed, H. 1970. Prostitution—a necessary evil. *Social Welfare* 17(6) : 8.

Verma, Kusum. 1973. Juvenile delinquency—legal and social remedies. *Sunday World* 3 (13) : 6.

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PERFORMANCE OF COWPEA AND *MOTH* FOR FORAGE YIELD UNDER DIFFERENT IRRIGATION LEVELS AND DATES OF PLANTING

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ABSTRACT

In earlier planting, cowpea *(Vigna unguiculata)* yielded significantly more green and dry matter production than *moth (Phaseolus sinensis)* but in latter plantings, the yield of *moth* was quite comparable with that of cowpea. The results also revealed that *moth* when sown early *(March 20)* produced 3.76 q/ha of grains in addition to green forage yield even with no post sowing irrigation. Thus, *moth* could be raised for seed in early summer season. From April onward, both cowpea and *moth* could be raised for forage production. Cowpea required three post sowing irrigations for maximum green and dry matter production, whereas *moth* gave good yields with one or two post sowing irrigations.

In the semi-arid zone, where irrigation water is a limiting factor, rather hot dessicating winds of high velocity are generally experienced, the problem of availability of green fodder becomes more complicated. Ram *et al.* (1971) have reported that cowpea *(Vigna unguiculata)* is a quick growing and nutritious fodder crop of irrigated areas, particularly in summer months. Gill *et al.* (1974), on the other hand, stated *moth (Phaseolus sinensis)* to be very drought resistant forage crop, capable of giving good tonnage of nutritious fodder with one post sowing irrigation. Cowpea was stated to require atleast three post sowing irrigations for better yields. Information on the comparative performance of these crops under different dates of sowing and restricted irrigation is very scarce and has been investigated.

MATERIAL AND METHODS

The experiment was conducted at the University Farm during the summer seasons of 1974 and 1975. The treatments consisted of two crops (cowpea and *moth)*; three dates of sowing (March 25, April 9 and April 29) and four irrigation levels (No, one, two and three post-sowing irrigations). Split plot design was adopted with crops × dates of sowing as main plot and irrigation levels as sub-plots. The treatments were replicated thrice. Varieties HFC 42-1 of cowpea and T 3 of *moth* were sown in lines, 30 cm apart, using 50 kg and 25 kg seed/ha, respectively. A basal dose of 20 kg P_2O_5/ha in the form of single super phosphate was applied before sowing. In case of one irrigation, the crop was irrigated approximately 40 days after

sowing and in case of two irrigations the crop was irrigated after 25 and 48 days of sowing. Three irrigations were applied after 17, 33 and 48 days of sowing depending upon the availability of canal water. The harvesting was done after 65-70 days of sowing and the data on green and dry matter were recorded.

RESULTS AND DISCUSSION

Performance of crops. Cowpea produced significantly higher fresh and dry matter than *moth* in both years (Table 1), however, the variation was more conspicuous in the green fodder production. On an average the dry matter production in case of *moth* was quite comparable to cowpea which might be due to the less water content in the *moth* plant. Gill *et al.* (1974) have also reported similar results. Ram (1970) and Sindhwani (1971) have also reported cowpea as quick growing and nutritious fodder legume in the early summer season.

Date of sowing had significant effect on the green and dry matter production as earlier planting (March 20) produced significantly lower green fodder as well as dry matter during both years (Table 1). Although the green fodder yields from April 9 and April 29 sown crops were at par during 1974, yet April 29 sown crop produced significantly higher dry matter over April 9 sown crop. This might be due to the heavy rainfall (74.8 mm) received in the month of June which coincided with the harvesting in second date of planting. This increased the moisture content of the crop, thereby increasing the green fodder yield which was at par with April 29 sowing, however, it could not influence the dry matter yield, considerably. During 1975 significantly higher green as well as dry matter was obtained in April 9 over April 29 sowing. This might be due to the fact that there was no rainfall during the growing season of the crop during 1975. As such, the crop sown on April 29 was exposed to hot and dry winds (June) for

TABLE 1

Effect of number of irrigations on the green and dry fodder yield (q/ha) of cowpea and moth under different dates of sowing

Treatments	Green fodder		Dry matter	
	1974	1975	1974	1975
Cowpea (HFC 42-1)	197.2	179.9	36.8	33.3
Moth (T 3)	137.2	1 7.5	28.7	33.2
SEm ±	1.95	2.6	0.37	0.48
C D at 5%	5.69	7.19	1.07	N.S.
March 20	113.1	104.4	23.2	21.5
April 9	191.0	216.5	36.5	42.3
April 29	197.5	186.4	38.5	36.1
SEm ±	3.3	5.3	0 6	1.05
C D at 5%	9.68	15.55	1.73	3.07
No post sowing irrigation	122.5	123.8	25.7	26.9
One post sowing irrigation	155.3	165 6	30.4	33.0
Two post sowing irrigations	189.1	186.9	36.6	36..
Three post sowing Irrigations	201.9	198.9	38 3	37.8
SEm ±	3.9	6.1	0.70	1.21
C D at 5%	11.61	17.88	2.02	3.55

a longer period which might have affected the crop adversely. But during 1974 the rainfall received in the month of June benefitted the April 29 sown crop also to achieve good growth. In addition to green fodder the *moth* sown on March 20, during both the years produced about 3.76 q/ha of grains.

Number of irrigations had also significant effect on the green as well as dry matter yield of these crops (Table 1). During first year, significant increase in green fodder yield was recorded upto three post sowing irrigations, however, during second year significant increase in green fodder yield was observed upto two post sowing irrigations only, because of differential weather conditions. As far as dry matter was concerned, significant increase in yield was observed only upto two post sowing irrigations during both the years.

The interaction of crops and dates of sowing was found to be significant during both years (Table 2). During 1974, cowpea gave significantly higher green fodder yield over *moth* in all dates of planting. This might be due to sufficient rainfall received during June which was conducive for the growth of cowpea but not for *moth*. During 1975, the difference in green fodder yield was significant in earlier planting (March 20), whereas in later plantings both the crops were at par. As indicated earlier, in early sowings *moth* could not take sufficient vegetative growth as reproductive phase was set in at very early stage but in later planting dates the vegetative growth was excellent. Similarly, cowpea produced significantly higher dry matter than *moth* in March 20 and April 9 during 1974, but in the late planting of April 29, both the crops were at par in respect of dry matter yield. During 1975, cowpea produced significantly higher dry matter over *moth* in March 20 sown conditions and *moth* produced significantly higher dry matter over cowpea in April 9 and April 29 sown condition. Though the dry matter content in *moth* was more, the dry matter yield was considerably low in early sowing due to poor yield of green fodder. However, in later plantings *moth* excelled the cowpea in dry matter yield during 1975 though the green fodder yield was at par with cowpeas. This was mainly because of higher dry matter content in *moth* crop.

TABLE 2

Effect of crops × dates of sowing on the green fodder and dry matter yield (q/ha)

Treatments	1974			1975		
	March 20	April 9	April 29	March 20	April 9	April 29
			Green fodder			
Cowpea	167.5	215.0	209.2	144.6	210.8	184.2
Moth	68.5	167.1	185.5	64.2	222.1	186.3
C D at 5%	9.85			13.13		
			Dry matter			
Cowpea	32.7	39.1	38.5	27.8	38.6	3.7
Moth	13.7 (3.77)	34.0	38.4	15.2 (3.75)	46.1	38.4
C D at 5%	1.87			2.41		

Figures in parentheses show the grain yield of *moth*.

TABLE 3

Effect of crops × No. of irrigations on the green fodder and dry matter yield (q/ha)

Treatment	1974				1975			
	No irriga-tion	One irriga-tion	Two irriga-tions	Three irriga-tions	No irriga-tion	One irriga-tion	Two irriga-tions	Three irriga-tions
			Green fodder					
Cowpea	138.3	167.2	221.1	262.2	123.3	158.3	208.3	229.5
Moth	106.6	143.3	157.2	141.7	124.4	171.7	165.6	168.3
C D at 5%	11.37				16.13			
			Dry matter					
Cowpea	27.4	32.0	40.6	47.1	24.3	30.1	38.1	40.9
Moth	23.9	38.8	32.5	29.6	27.4	36.3	34.4	34.7
	(3.8)	(3.6)	(4 0)	(3.7)	(3.8)	(3.8)	(3.6)	(4.1)
C D 5%	2.16				2.81			

Figures in parentheses show the grain yield of *moth*.

The interaction of crops and number of irrigations was also found to be significant during both years (Table 3) The green as well as dry matter yields of cowpea during both years increased significantly with every increase in irrigation number. On the other hand, such significant increase in green and dry fodder yield of *moth* was recorded only upto two and one post sowing irrigations during 1974 and 1975, respectively. Gill *et al.* (1974) have also reported that *moth* could be grown in early summer season with less number of irrigations, whereas cowpea required frequent irrigations.

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REFERENCES

Gill, P. S., Kanwar Singh and Paroda, R. S. 1974. Effect of irrigation and phosphorus levels on the yield of summer legumes. *Haryana Agric. Univ. J. Res.* 4(3) : 186-91.

Ram, D. 1970. Effect of number of cuttings and levels of phosphorus and nitrogen on summer cowpea. M. Sc. (Agron) thesis, Punjab Agricultural University, Ludhiana.

Ram, D., Tomer, P. S. and Tripathi, H. P. 1971. Effect of number of cuttings and levels of phosphorus and nitrogen on summer cowpea forage. *Haryana agric. Univ. J. Res.* 1(13) : 39-43.

Sindhwani, S. K. 1971. Consumptive use of early summer fodders grown pure and mixed under different soil moisture regime. M. Sc. (Agron.) thesis, Haryana Agricultural University, Hissar.

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HERITABILITY ESTIMATES OF SOME PRODUCTIVITY TRAITS IN PEARL MILLET

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ABSTRACT

The heritability and genetic advance were estimated to predict the heritable variability in three crosses involving four diverse inbred lines in pearl millet. The high estimates of heritability were an indication of the presence of higher genetic variability and smaller environmental effects. The joint evaluation of heritability and genetic advance values showed that maximum variation in the present study was found for plant height in hybrid H 48 × H 91, followed by days to maturity and grain yield per plant in the hybrid population of H 48 × H 403.

Pearl millet or bajra *(Pennisetum typhoides,* Burm. S & H) is one of the extensively grown crops of this country. The development of hybrid bajra 1 marked a significant step in raising the yield level of this neglected and a poor man's crop. In order to make it more productive, the development of high yielding hybrids with resistance to downy mildew and ergot appears to be the most important single step. Since yield is a complex character and is contributed by several component traits, improvement in the attributes contributing to the yield is the most effective tool for bringing about further improvement in yield level The speed of success in the breeding depends largely upon the heritable variability present in the traits, which in turn depends upon the parental diversity.

In this study, heritability and genetic advance were estimated in a few crosses of pearl millet involving parents identified to be diverse with regard to yield and other productivity components.

MATERIAL AND METHODS

The material consisted of 4 inbred S 6 lines which were diverse and very good combiners, viz., H 48, H 91, H 224 and H 403 and F_1, F_2, B_1 ($F_1 \times P_1$), B_2 ($F_1 \times P_2$) generations of three crosses, viz., H 48 × H 91, H 48 × H 224 and H 48 × H 403.

The material of all the generations was grown in a compact family block design with three replications. The plots had 2, 2, 2, 5, 10, 10 rows each of 3 m long for P_1, P_2, F_1, F_2, B_1 and B_2, respectively. In each row, 15 seeds were sown by *kera* method. From each treatment and each replication, 10 plants were randomly chosen and observations were recorded on days to maturity, plant height (cm), ear density (ratio of grain weight in the ear to the total weight of the ear), grain yield per plant (g) and 1000 grain weight (mg).

TABLE 1

Estimates of heritability and genetic advance for various characters among three crosses in pearl millet

	Days to flower			Plant height			Days to maturity			Ear length		
	H 48 × H 91	H 48 × H 224	H 48 × H 403	H 48 × H 91	H 48 × H 224	H4 8 × H 403	H 48 × H 91	H 46 × H 224	H 48 × H 403	H 48 × H 91	H 48 × H 224	H 48 × H 403
Heritability												
Method-I	—	09.40	75.73	91.82	55.18	59.59	77.79	61.29	98.13	23.42	45.83	24.40
Method-II	06.21	00.59	72.42	91.14	55.79	65.56	64.04	06.14	98.45	00.48	48.58	44.40
Method-III	27 07	—	70.99	90.07	57.54	85.49	60.61	—	99.10	—	54.79	84.51
Units	00.43	00.04	10.75	104.05	25.17	36.15	06.65	03.81	42.90	00.04	03.39	04.01
G.A. (per cent of F_1 mean)	00.74	00.07	20.43	51.56	14.56	14.52	21.84	04.24	55.78	00.12	13.87	16.96
	Ear diameter			Ear density			Grain yield per plant			100 grain weight		
Heritability												
Method-I	37.50	07.50	36.00	30.11	—	—	61.36	60.24	95.15	73.11	17.65	13 83
Method-II	33.75	—	14.00	41.11	—	20.00	51.14	—	76.20	61.32	35.29	06.15
Method-III	50.00	25.00	—	55.56	25.00	60.00	58.03	—	84 40	38.21	80.00	—
Units	00.20	—	00.06	00.03	—	00.03	57.56	—	74.59	01.84	0.67	0.10
G.A. (per cent of F_1 mean)	10.38	—	02.73	04.62	—	04.17	47.68	—	69.19	20.79	8.33	1.55

Means and variances were worked out for parents, F_1, F_2 and back-cross generations. The analysis for compact family design was followed according to Panse and Sukhatme (1957). Heritability estimates for different characters among three crosses were calculated in broad sense, using the formula given by Mahmud and Kramer (1951)—method I, Burton (1951)—method II and Burton (1952) – method III. The expected genetic advance was calculated using the heritability values derived from method II (Burton, 1952).

RESULTS AND DISCUSSION

The estimates of heritability in broad sense were variable with character and in certain cases varied from cross to cross (Table 1). The heritability estimates were high (more than 60%) for days to flower (H 48 × H 403), plant height in all crosses, days to maturity except in H 48 × H 224 cross, grain yield per plant (H 48 × H 403) and 1000 grain weight (H 48 × H 91). They were moderate (40-60%) for ear length (H 48 × H 224 and H 48 × H 403), ear diameter (H 48 × H 91), ear density (H 48 × H 91), grain yield per plant (H 48 × H 91), 1000 grain weight (H 48 × H 224) and low for rest of the crosses for the characters studied. The high estimates of heritability were an indication of presence of higher genetic variability and smaller environment effects, whereas low heritability estimate indicated more effect of environment and less of genetic variability. Also, high heritability indicated relatively small genotype × environment interaction and a broad spectrum of adaptability in the population. The above results in pearl millet are in accordance with the findings of Gill *et al.* (1968), who observed high heritability estimates for plant height, days to flowering, ear length and ear girth. Similar results were also obtained by Nagi (1966) except for ear length. High heritability estimates were observed for plant height by Athwal (1966). Medium to high heritability was reported by Phul and Athwal (1969) for earliness, ear length and medium for plant height. Burton (1951, 1959) found high estimates of heritability for ear length, 100 seed weight and plant height but low for grain yield.

In predicting the utility and value of selection, heritability along with genetic gain are more useful than heritability estimates alone. The estimates of expected genetic advance expressed as per cent of F_1 mean judged by joint evaluation with heritability values showed that maximum exploitable variation in this material was expected for plant height in the cross H 48 × H 91 and days to maturity and grain yield per plant in cross H 48 × H 403.

REFERENCES

Athwal, R. S. 1966. Studies on the inheritance of some quantitative and qualitative characters in pearl millet. M.Sc. thesis, Punjab Agricultural University, Ludhiana.

Burton, G. W. 1951. Quantitative inheritance in pearl millet. *Agron. J.* 43 : 400-17.

Burton, G. W. 1952. Quantitative inheritance in grasses. *Proc. VIth Inter. Grassland Cong.* 1 : 277-83.

Burton, G. W. 1959. Breeding methods in pearl millet *(Pennisetum typhoides)* indicated by genetic variance component studies. *Agron. J.* 49 : 59-62.

Gill, B. S., Gupta, V. P. and Nagi, K. S. 1968. Inheritance of quantitative characters in pearl millet. *J. Res. Punjab agric. Univ.* 5 : 37-41.

Mahmud, I. and Kramer, H. H. 1951. Segregation of yield, height and maturity following a soybean cross. *Agron. J.* 43 : 605-09.

Nagi, K. S. 1966. Inheritance of quantitative characters in pearl millet *(Pennisetum typhoides)*. M.Sc. thesis, Punjab Agricultural University, Ludhiana.

Panse, V. G. and Sukhatme, P. V. 1957. *Statistical Methods for Agricultural Workers.* Indian Council of Agricultural Research, New Delhi.

Phul, P. S. and Athwal, D. S. 1969. Inheritance of grain size and grain hardness in pearl millet. *Indian J. Genet. Plant Breed.* 29 : 184-91.

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ANALYSIS OF VARIATION AND GENETIC DIVERGENCE IN GARDEN PEAS (*PISUM SATIVUM* L.)

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ABSTRACT

Fifty six strains of peas were evaluated for morphological variation and genetic divergence and grouped into six and eight clusters, respectively. On the basis of morphological variation, strains HS 2, EC 13494, Little Marvel, Banarsi Sweet, EC 4761, EC 15408, EC 7854, EC 6609 and EC 9090; while on D^2 basis New Line Perfection, Multifreezer, T 56, EC 7762, EC 9090, HS 2, Market Prize, Bonneville, K-Wonder and Blue Bantom were promising for hybridization. No consistent relationship was observed between genetic divergence and the geographical distribution of strains. Selection of varieties for hybridization, just on the basis of geographic origin, will not be useful. Selecting varieties from each group and testing them in diallel fashion of mating may prove to be highly fruitful.

Being a rich source of proteins and carbohydrates, peas play an important role in human diet particularly in India where most of the people are vegetarian. Inspite of considerable importance, due attempts have not been made to improve its yield potential and quality. Success of a hybridization programme depends on the choice of suitable parents. Variation and genetic divergence existing in the material help in selecting the parents for hybridization (Bhatt, 1973). The present study was planned with the view to analyse the morphological variation and genetic divergence in a collection of garden peas and to identify the promising strains for use in hybridization.

MATERIAL AND METHODS

Fifty six strains of peas were grown in a lattice rectangular design with four replications, at the Vegetable Research Farm. The strains were accommodated in a 3 m long single row plots spaced 65 cm apart and the distance among plants within the row was 60 cm. Observations on 5 randomly taken plants from each plot were recorded for 9 metric traits, namely, plant height (cm), days to 50% flowering node at which first flower appeared, number of branches, number of pods, number of clusters, pod length (cm), number of seeds/pod and green pod yield/plant (g). Randomly 5 pods were taken from early, medium and late pickings for recording pod length and seeds/pod. After testing the significance of difference among the varieties through "F test", the data were subjected to the analysis of morphological variation (Anderson, 1957) and genetic divergence through Mahalanobis's D^2 statistics (Rao, 1952).

Range of index score and the symbols on the glyphs have been shown in Table 1 and scattered diagram of meteroglyph analysis in Fig. 1.

RESULTS AND DISCUSSION

The analysis of variance (Table 2) showed highly significant differences among the genotypes suggesting a good scope of selection. On the basis of morphological variation, 56 strains could be classified into six groups including one single variety cluster. Groups I and II being larger, showed considerable variation among the strains included in them. However, the strains forming group II were more or less similar in their morphological features and were generally above average in performance, particularly for branches/plant and clusters/plant. Interestingly the group III involved all the four varieties comparatively with a high index score (18 to 22). Groups IV and V were with two strains each. However, both the strains of the latter being late in flowering, low yielder and securing quite poor index score, were undesirable for hybridization purpose. Sixth group was represented by a solitary variety with a total score of 16.

TABLE 1

INDEX SCORES OF DIFFERENT CHARACTERS

CHARACTERS	RANGE	INDEX SCORES					
		SCORE I		SCORE II		SCORE III	
		VALUES LESS THAN	SIGN	VALUES	SIGN	VALUES	SIGN
PLANT HEIGHT (CM)	50·9–171·1	91 0	0	91 1 – 131 1	♁	131·2—171 1	♁
NODE AT WHICH FIRST FLOWER APPEARED	4 9 — 11 0	8·9	0	7 0 — 8 9	♂	5·0 — 6·9	♂
BRANCHES/PLANT	0·4 — 2·8	1 2	0	1 3 — 2 0	♂	2 1 — 2 8	♂
PODS/PLANT	9·8 — 23 2	14 4	0	14·4–18 8	♁	18 9—23·2	♁
CLUSTERS/PLANT	8 2 — 16·8	11 1	0	11 2–14·0	♁	14·1—16 8	♁
LENGTH OF POD (CM)	5·2 — 12·0	7 5	0	7·6—9·8	♁	9·9—12 0	♁
SEEDS/POD	3·7 — 7·6	5 0	0	5·1 — 6 3	♀	6·4 — 7 6	♀

TABLE 2

Analysis of variance

S. No.	Characters	Mean squares		
		Replications	Treatments	Error
1.	Plant height	213.77	1169.16*	463.40
2.	Node at which first flower appeared	61 04	6.67*	4.10
3.	Time taken to 50% flowering	17.94	137.74*	59.09
4.	Number of branches per plant	2.39	1.06*	0.51
5.	Number of pods per plant	18359.56	3764.78*	2844.19
6.	Number of clusters per plant	173 01	17.72*	14.15
7.	Length of pod	1.68	1.29*	0.63
8.	Number of seeds per pod	2.48	0.70*	0.56
9.	Green pod yield/plant	141.16	277.21*	222.15

*Significant at 1% level of significance

Choice of suitable strains to be used as parents for hybridization can be briefly discussed. Selecting one strain from each group and crossing them in a diallel fashion might prove fruitful. Since the strains belonging to a larger group showed considerable variation, therefore, one or more strains from each group, depending on their size might be picked up for hybridization. While doing so, due weightage must be given to the index score secured by such strains. Thus, strains HS 2, EC 13494, Little Marvel Banarsi Sweet, EC 4761, EC 15408, EC 7854, EC 6609 and EC 9050 could be identified as promising for hybridization. Their actual worth could, however, be known only through crossing and subsequent testing.

On the basis of D^2 statistics, the 56 genotypes could be grouped into eight clusters including one single variety cluster formed by an exotic culture Blue

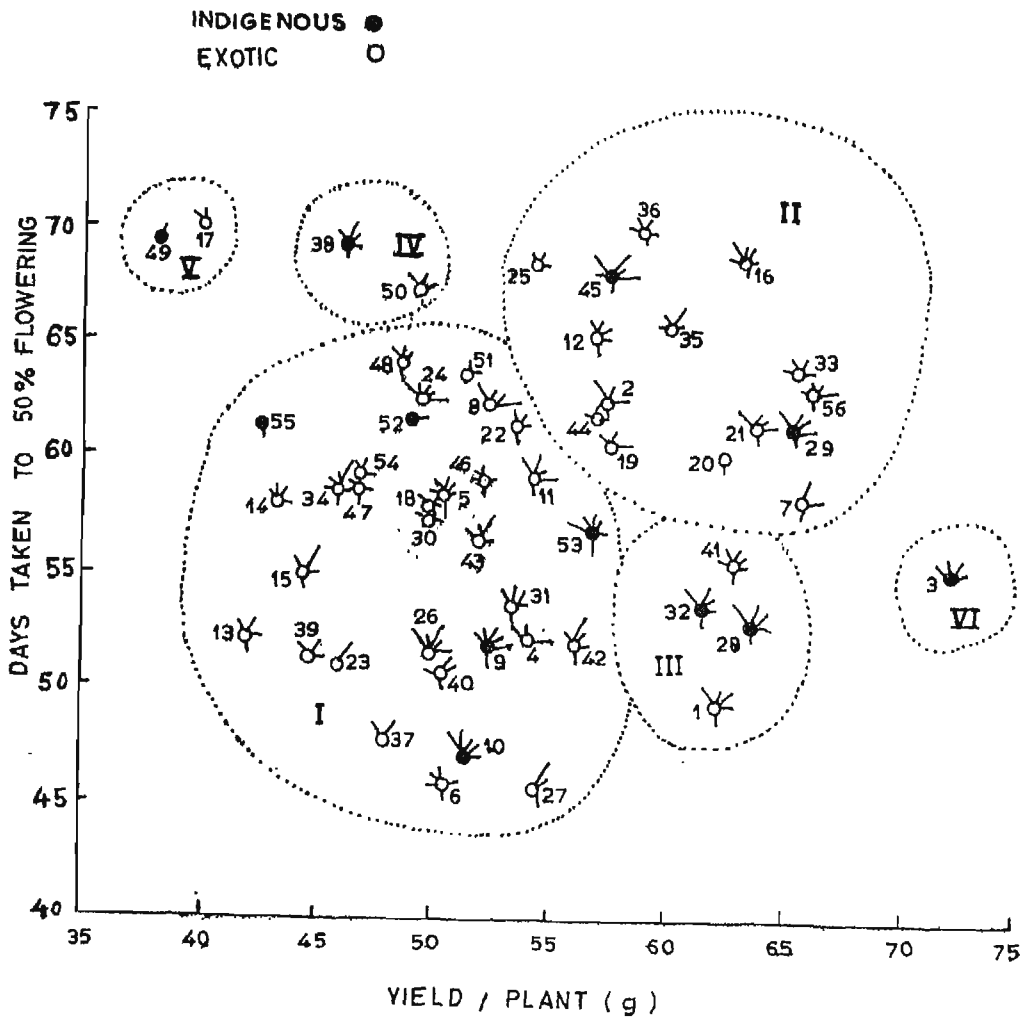


Fig. 1. Scattered diagram in meteroglyph analysis

Bantom (Table 3). The first two clusters comprising 25 and 8 populations, respectively, were the largest. Remaining clusters included an equal number of strains, i. e., 4 each except the group III having 6 strains. The indigenous and exotic cultures were almost equally distributed among these groups suggesting no consistent relationship between genetic divergence on the one hand and geographical distribution of the strains on the other, as reported earlier also (Somayajulu *et al.*, 1970 and Jayaprakash *et al.*, 1974). This implies that selection of parental varieties for hybridization just on the basis of geographical origin will not be fruitful.

It may be mentioned here that peas were introduced from their original home into many other countries. Intensive selection to suit local needs and frequent exchange of germplasm contributed to the grouping pattern of heterogeneous geographic origin into one cluster.

The intra and intercluster distance among various clusters (Table 4) and diagramatic representation of mutual relationship among clusters (Fig. 2) showed a close relationship of clusters I, II, IV, V and VI. Clusters III, VII, VIII and to some extent II also were far apart from each other. Selecting strains from them for crossing is expected to yield high heterotic response and/or better desirable segregates. Intra-cluster distances being much lower than the inter-cluster ones, suggested heterogeneous and homogeneous nature between and within

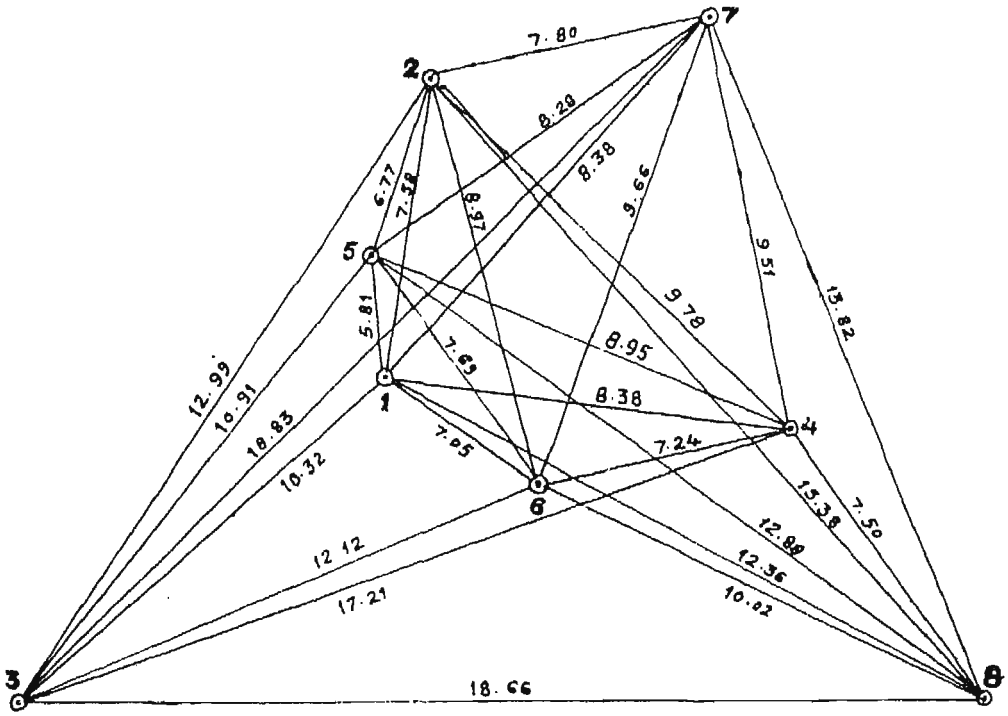


Fig. 2. Mutual relationship among clusters

TABLE 3

Varieties of pea grouped in various clusters

Clusters	No. of populations	Populations included
I	25	Continental (2), HS 2 (3), New Line perfection (7), Little Marvel (10), P 35 (11), Lexton (13), Early Evergreen (14), I. C. 4611 (15), Multifreezer (18), I. C. 31291 (19), Duke of Albany (21), N. P. 29 (23), K 2225 (25), K 1783 (26), Burpeena (30), E. C. 6829 (33), Rempus (34), Yates Early (37), E. C. 8273 (41), Champton (43) Type-56 (48), E. C. 7266 (50), Rapid Growth (51), Asauji (55), Perfection, New Line (56).
II	8	EC 21795 (8 , EC 7279 (12), EC 7262 (36), EC 7854 (38), EC 6609 (45), EC 4801 (49), EC 5730 (52), EC 9090 (53).
III	6	Banarasi Sweet (28), EC 4671 (29), E. C. 15408 (32), Early Badger (1), Type 19 (42), HS 1 (27).
IV	4	Runner (4), K 1533 (22), Market Prize (46), Alderman (47).
V	4	Bonneville (20), Early Superb (40), EC 8266 (44), EC 10890 (55).
VI	4	EC 254 (5), EC 13494 (9), Kelvedon Wonder (24), IC 1477 (31).
VII	4	IC 3911 (16), IC 6617 (17), EC 10748 (35), P 8 (39).
VIII	1	Blue Bantom (6).

Within brackets are serials as shown on meteroglyph.

TABLE 4

Intra (diagonal) and intercluster (above diagonal) distances among various clusters

Clusters	I	II	III	IV	V	VI	VII	VIII
I	4.05	7.58	10.32	8.38	5.81	7.05	8.38	12.36
II		3.59	12.99	9.78	6.77	8.97	7.80	15.08
III			7.31	17.21	10.91	12.12	18.63	18.66
IV				4.37	8.95	7.24	9.51	7.50
V						7.69	8.28	12.88
VI						4.12	9.66	10.02
VII							8.98	13.82
VIII								0.00

TABLE 5

Cluster means for different characters in peas

Characters/clusters	Plant height (cm)	Flower/node	50% flowering	Branches/plant	Pods/plant	Cluster/pod	Length of pod (cm)	Seeds/pod	Yield plant (g)
I	89.29	7.66	58.33	1.12	17.16	12.44	6.96	4.86	53.49
II	73.37	7.77	65.50	1.30	16.75	12.80	7.72	5.36	52.15
III	59.69	6.05	50.90	2.27	15.94	10.50	7.28	5.39	59.08
IV	115.70	10.00	58.05	0.85	16.87	12.72	7.48	5.30	51.65
V	69.92	8.40	58.70	0.95	12.05	9.85	7.57	5.42	53.22
VI	87.92	8.25	56.72	1.55	20.57	14.10	7.10	5.87	51 50
VII	90.35	7.92	64.00	0.87	15.82	12.02	7.85	5.30	52.15
VIII	118.40	9.00	46.00	0.50	15.50	12.40	8.30	5.50	50.70

groups, respectively. This was further supported by an appreciable variation observed for cluster means (Table 5). Plant height and pod length were highest in the single variety group. Number of branches and green pod yield in group III, while branches/plant and seeds/pod in group VI were highest. Similarly, the strains of the group III were dwarf, early, high yielding and had high number of branches.

Since crosses among divergent parents are likely to yield desirable recombinants, a crossing programme should be initiated between the genotypes belonging to different clusters.

Two main points are to be considered : (i) choice of particular cluster from which genotypes are to be used as parents and (ii) selection of particular genotypes from the already selected groups. Clusters separated by the largest statistical distance reflected maximum divergence such as groups III, VII and VIII in the present study. It is logical, therefore, to attempt crosses between the genotypes of these clusters. While selecting individual strains from the already chosen groups, important characteristics like disease resistance, earliness, quality and previous experience of the breeder with the varieties should be given due consideration. Selecting one variety from each group and testing that by a diallel analysis may prove to be highly fruitful. Though the varieties grouped together on the basis of divergence analysis are considered to be more alike in terms of variation for metric traits, in actual practice it does not appear so. The varieties HS 2 and Multifreezer, inspite of having contrasting characters were grouped together. Such varieties, particularly when they belong to a larger cluster may be included in a crossing programme.

Thus, considering these points, varieties, 'New Line Perfection, 'Multifreezer', 'T 56', 'EC 7262', 'EC 9090', 'HS 2', 'Market Prize', 'Bonneville', 'K-Wonder' and 'Blue Bantom' seem to be promising for hybridization.

REFERENCES

Anderson, E. 1957. Semigraphical method for analysis of complex problems. *Proc. Nat. Acad. Sci.* Wash. 43 : 923-27.

Bhatt, G. M. 1973. Comparison of various methods of selecting parents for hybridization in common bread wheat. *Aust. J. Agric. Res.* 24 : 457-64.

Jayaprakash, R. K., Paroda, R. S. and Singh, V. P. 1974. Estimation of Mahalanobis' generalized distance between cowpea cultivars. *Sabrao J.* 6 : 213-17.

Rao, C. R. 1952. *Advanced Statistical Methods in Biometric Research*. Edn. I. John Wiley and Sons, New York. p 39.

Somayajulu, P. L. N., Joshi, A. B. and Murty, B. R. 1970. Genetic divergence in wheat. *Indian J. Genet.* 30 : 47 58.

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RESPONSES OF PEARL MILLET *(PENNISETUM AMERICANUM)* TO GRADED DOSES OF P AND K ON SOILS OF VARIABLE AVAILABLE P STATUS

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ABSTRACT

The response of pearl millet (*Pennisetum americanum*) to graded doses of P and K was studied on variable available P status soils on cultivators' fields. Responses of pearl millet to fertilizer-P on soils, low in available P increased with increasing doses of P upto 39 kg P/ha, in medium available P soils, upto 26 kg P/ha, and in high available P soils upto 13 kg P/ha. The results indicated that maximum response to fertilizer-P might be obtained only when P fixing capacity of the soils was satisfied and sufficient P remained in the soil solution to meet the crop requirement. There were no significant responses to applied K at all the levels of K studied.

Generally, fertilizer recommendations for crops are based on the results obtained under control conditions at research stations where all the essential facilities exist and the management level is high while the conditions on the cultivators' fields are entirely different. So, the experimental findings based on the experiments conducted on cultivators' fields will give more basic data under native conditions which is more meaningful and informative. Considering the importance of all these factors, experiments were conducted on cultivators' fields to assess the responses of hybrid bajra to graded doses of P and K on soils of different available-P status.

MATERIAL AND METHODS

The trials were laid down in Jind block (a national development unit) of Jind district in Haryana continuously for three years from 1974-75 to 1976-77 under the All India Coordinated Agronomic Research Project High Yielding Varieties Programme. Every year surface (0-15 cm) soil samples were collected from 200 randomly selected cultivators' fields scattered throughout the block. The samples were extracted by 0 5 N $NaHCO_3$ and analysed for available P colorimetrically as described by Olsen *et al.* (1954). The soils with available P<10 kg P/ha were rated as low (L), 10 to 24.5 kg P/ha as medium (M) and >24 5 kg P/ha as high (H). For available K, the soils were extracted by Morgan's reagent and analysed by flame photometer. The soils were categorized <125 kg K_2O/ha as low, 125-250 kg K_2O/ha as medium and >250 as high. All the soil samples were found high in

available K so only three PK soil categories, i.e., LH, MH and HH were classified on the basis of available P.

The following 10 treatments were randomized in the fields at each site :

$N_0P_0K_0$	$N_{80}P_{39}K_{50}$
$N_{80}P_0K_0$	$N_{80}P_{26}K_0$
$N_{80}P_0K_{50}$	$N_{80}P_{26}K_{25}$
$N_{80}P_{13}K_{50}$	$N_{80}P_{26}K_{75}$
$N_{80}P_{26}K_{50}$	$N_{120}P_{39}K_{75}$

All the P was applied through single superphosphate (16% P_2O_5), K through muriate of potash (60% K_2O) and half of the N through calcium ammonium-nitrate (25% N) at sowing time and the rest of N was top-dressed 30 days after sowing. All experimental sites were sown within one week with hybrid bajra (*Pennisetum americanum*) variety PHB 14. The crop was harvested at maturity and data on grain yield was recorded separately for each treatment. The number of rows and seed rate per plot were kept same in all the experiments. Adequate irrigations and intercultures were given to keep the fields free of weeds.

Some physical and chemical properties of soil were also determined using standard methods (Jackson, 1973) as reported in Table 1.

TABLE 1

Physico-chemical properties of test plots under experiments

Soil characteristics	Kharif 1974-1975	Kharif 1975-1976	Kharif 1976-1977
LH-Soil series			
pH (1 : 2)	8.8-9.2	8 1-8.3	7.80-8.60
EC (mmhos/cm)	0.15-0.33	0.09-0.36	0.20-0.25
O. C. (%)	0.16-0.29	0.25-0.42	0.08-0.12
Av. N. (kg/ha)	187.7-232.4	268-285	109-146
Av. P (kg/ha)	4·74-9.86	7.2-9.6	7.42-8.48
Av. K (kg/ha)	420-780	480-944	496-820
MH-Soil series			
pH (1 : 2)	8.6-9.0	7.9-8.3	7.9-8.6
EC (mmhos/cm)	0.13-0.63	0.09-0.86	0.20-0.35
O. C. (%)	0.14-0.23	0 28-0.40	0.19-0.25
Av. N (kg/ha)	143.0-250.3	244.0-269.0	112.0-198.0
Av. P (kg/ha)	10.14-20.36	10.8-17.4	10.70-15.90
Av. K (kg/ha)	460-820	448-912	344-500
HH-Soil series			
pH (1 : 2)	8.5-9.1	8.1-8.4	8.40-8.80
EC (mmhos/cm)	0.18-0.31	0.18-0.59	0.20-0.35
O. C. (%)	0.15-0.29	0.23-0.49	0.30-0.75
Av. N. (kg/ha)	17.88-241.4	248-288	252-296
Av. P. (kg/ha)	25.22-54.34	26.4-45.6	26.90-81.62
Av. K. (kg/ha)	580-1120	464-1120	448-800

The data in Table 1 indicates that the experiments were laid out on wide range of soils which were slightly alkaline in nature but low in total salt concentration, poor in organic carbon and low to medium in available N. All the soils were very high in available K and low, medium and high in available P.

RESULTS AND DISCUSSION

The effect of various levels of P and K on bajra grain yield is presented in Table 2. The control plots where no NPK was applied produced the minimum grain yield (Table 2), whereas the highest dose of NPK ($N_{120}P_{39}K_{75}$) produced the highest grain yield in all the soil series.

Low P soils. The bajra grain yield (Table 2) increased with increasing doses of P in combination with 80 kg N and 50 kg K/ha on low P soils. Application of 13, 26 and 39 kg P/ha with 80 kg N and 50 kg K/ha produced 1.51, 4.14 and 6 13 q/ha additional bajra grain, respectively. There was a linear increase in the bajra grain yield upto 39 kg P/ha which was more clear from the equation:

$$Y=18\,092+0.134x+0.007x^2$$

The magnitude of response to per unit of applied P was highest with 26 kg P/ha. There was less response to the application of 13 kg P/ha, which might be due to fixation of applied P on these soils being highly depleted in P content. These experimental findings are in confirmation with the results obtained by Singh *et al.* (1973) in wheat crop and Patel and Sutariya (1972) in bajra. On the other hand, the decrease in the magnitude of response (Table 3) with 39 kg P/ha may be attributed to the reason that the applied amount of P was higher than the optimum and there was no full utilization of the applied P and might also create imbalance of other nutrients.

Medium P soils. Soils of medium-high (MH) category (Table 2) yielded more grain at all the treatment levels in comparison to low-high (LH) category showing the contribution of high initial soil fertility. The bajra grain yield increased significantly upto the level of 26 kg P/ha. Application of 13, 26 and 39 kg P/ha increased the grain yield by 1.89, 4.67, 5.48 q/ha, respectively. In this category of soils also the maximum response was noted with 26 kg P/ha indicating that 13 kg P/ha was low dose than the requirement of the crop, whereas 39 kg P/ha was higher and did not respond to the P application linearly as also indicated by the equation :

$$Y=20.4085+0.2095x-0.0016x^2$$

Results indicate that in medium P soils 26 kg P/ha was the optimum dose for bajra crop.

High P soils. This category of (HH) soil produced (Table 2) the highest grain yield at all the treatments indicating that the high basic fertility status was the important factor in production. The bajra grain yield increased significantly with 13 kg P/ha only, indicating that soils rich in available P required less P application. The response with 13 kg P/ha was linear as indicated by the equation :

$$Y=21.9395+0.3477x-0.0059x^2$$

Application of 13 and 26 kg P/ha produced additional yield of 3.60 and 5.00 q/ha, respectively, whereas there was

TABLE 2

Effect of different levels of P and K on bajra grain yield (q/ha)

Treatments	1974		1975		1976		Mean	Mean
	Yield	Response	Yield	Response	Yield	Response	yield	response
A. Low-high (LH) category								
$N_0P_0K_0$	16.62	—	10.80	—	9.11	—	12.18	—
$N_{80}P_0K_0$	23.45	6.83	17.38	6.58	13.52	4.41	18.12	5.94
$N_{80}P_0K_{50}$	23.55	6.93	17.17	6.37	13.82	4.71	18.18	6.00
$N_{80}P_{13}K_{50}$	25 60	8.98	18.60	7.80	14.88	5.77	19.69	7.51
$N_{80}P_{26}K_{50}$	29.22	12.60	20.47	9.67	17.03	7.92	22 32	10.14
$N_{80}P_{39}K_{50}$	31.50	14.88	22.51	11.71	18.92	9.81	24.31	12.13
$N_{80}P_{26}K_0$	28.50	11 88	20.17	9.37	16.77	7.66	21 81	9.63
$N_{80}P_{26}K_{25}$	29.00	12.38	20.52	9.72	17.34	8 23	22.29	10.11
$N_{80}P_{26}K_{75}$	28.27	11.65	20 40	9.60	17.25	8.14	21.97	9.79
$N_{120}P_{39}K_{75}$	33.33	16.71	24.26	13.66	21 93	12.82	26.57	14.39
C. D. 5%	1.06		0.52		0.49			
B. Medium-high (MH) category								
$N_0P_0K_0$	18.70	—	12.67	—	10.04	—	13.80	—
$N_{80}P_0K_0$	26.65	7.95	19.10	6.43	15.78	5.74	20.51	6.71
$N_{80}P_0N_{50}$	26.65	7.95	19.15	6.48	15.85	5.81	20.55	6.75
$N_{80}P_{13}K_{50}$	28.88	10.18	20.55	6.88	17.90	7.86	22.44	8.64
$N_{80}P_{26}K_{50}$	33.10	14.40	22.71	10.04	19.84	9.80	25 22	11.42
$N_{80}P_{39}K_{50}$	32.22	13.52	25.05	12.38	20.81	10.77	26.03	12.23
$N_{80}P_{26}K_0$	32.20	13.50	22.25	9.58	18.60	8.56	24.35	10.55
$N_{80}P_{26}K_{25}$	35.52	13.82	22.75	10.08	19 22	9.18	24.83	11.03
$N_{80}P_{26}K_{75}$	32.28	13.68	22.40	9.73	18.90	8.86	24.56	10.76
$N_{120}P_{39}K_{75}$	36.22	17.52	27.30	14.63	23.30	13.26	28.94	15.14
C. D. 5%	0.72		0.79		0.64			
C. High-high (HH) category								
$N_0P_0K_0$	19.47	—	13.52	—	12.15	—	15 05	—
$N_{80}P_0K_0$	28.75	9.28	19.85	6.63	18.77	6.62	22.46	7.41
$N_{80}P_0K_{50}$	27.88	8.41	19.25	5.73	18.64	6.49	21.92	6.87
$N_{80}P_{13}K_{50}$	32.55	15.08	22.83	10.41	21.19	9.04	25.52	10.47
$N_{80}P_{26}K_{50}$	34.80	15.33	23.93	10.41	22.08	9.93	26.93	11.88
$N_{80}P_{39}K_{50}$	33.80	14.33	23.33	9.81	22.49	10.34	26.54	11.49
$N_{80}P_{26}K_0$	34.50	15.03	24.15	10.63	21.67	9.52	26.77	11.72
$N_{80}P_{26}K_{25}$	34.22	14.75	24.10	10.58	22 03	9.88	26.78	11.73
$N_{80}P_{26}K_{75}$	33.90	14.43	23.43	9.91	21.17	9.02	26.17	11.12
$N_{120}P_{39}K_{75}$	36.47	17.00	27.52	14.00	25.19	13.04	29.73	14.68
C. D. 5%	1.51		0.96		0.65			

TABLE 3

Per unit responses (q/ha) of applied P to hybrid bajra

	LH	MH	HH
(i) Responses of bajra to added per unit levels of P kg/ha over $N_{80}K_{50}$			
$N_{80}P_{13}K_{50}$	1.51	1.85	3.60
$N_{80}P_{26}K_{50}$	2.63	2.80	1.40
$N_{80}P_{39}K_{50}$	1.99	0.81	−0.38
(ii) Responses of bajra to added per unit levels of K, Kg/ha over $N_{80}K_{38}$			
$N_{80}P_{26}K_{75}$	0.48	0.58	0.01
$N_{80}P_{26}K_{50}$	0.03	0.39	0.15
$N_{80}P_{26}K_{75}$	−0.35	−0.65	−0.76

reduction in grain yield at 39 kg P/ha. These results are in confirmation with the findings of Shekhawat *et al.* (1972).

In general, there was no response to applied K to bajra in all the soil categories due to soils being very rich in available K (Table 1). There was significant response to applied P upto 13 kg P/ha in high-P soils, upto 26 kg/ha in medium P soils and upto 39 kg P/ha in low-P soils. Experimental results clearly indicated that P recommendations should be based on soil test values of each field and there should not be a adhoc-recommendation for a particular crop on regional bases, as this study was done in a compact and homogenous area and many times all the three soil categories were available on a single farm of one farmer. It may be concluded on the basis of this study that highly P deficient soils require higher P fertilization whereas soils which have high native P need less P application.

Response to graded doses of P. The data on responses to applied doses of P on soils of different fertility groups are presented in Fig. 1. The curves showed a linear response to applied-P doses upto 39 kg P/ha in low-P soils, upto 26 kg P/ha in medium-P soils, and upto 13 kg P/ha in high-P soils. The per unit response to applied P (Table 3, Fig. 2), clearly indicate that maximum responses to 13 kg/ha applied P was in high-high (HH) category followed by medium-high (MH) and lowest in low-high (LH). Response to the second increment of 13 kg P/ha was maximum in MH followed by LH and lowest in HH.

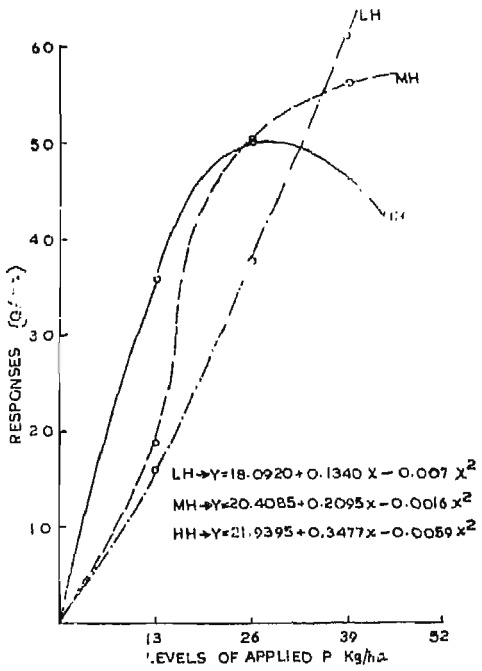


Fig. 1. Responses (q/ha) of applied P to hybrid bajra

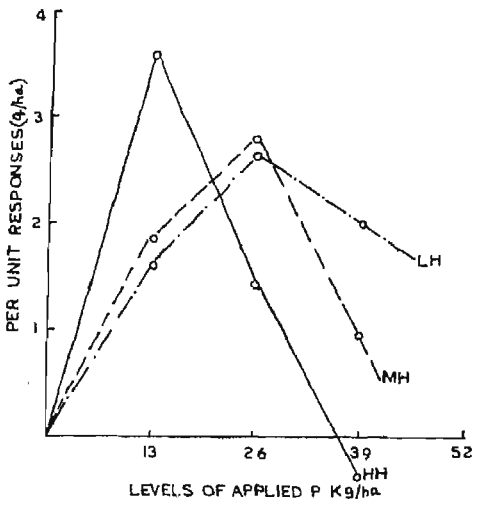


Fig. 2. Per unit responses (q/ha) of applied P to hybrid bajra

And for the third increment of 13 kg P/ha gave higher responses in LH soil group followed by MH and negative responses in HH soil group which might be possibly due to antagonistic effects of high P on the availability of Zn to the plants. There were non-significant responses to per unit applied K @ 25 and 50 kg K/ha and there were negative responses to 75 kg K/ha (Table 2).

Regression equations were also calculated which confirmed the experimental results (Fig. 1).

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REFERENCES

Jackson, M. L. 1973. *Soil Chemical Analysis.* Prentice Hall of India, Private Ltd., New Delhi.

Olsen, S. R., Cole, C. V., Watanabe, F. and Dean, L. A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circular No. 939.

Patel, A. S. and Sutariya, M. H. 1972. Responses of hybrid pearl millet to N, P and K in different agro-climatic zones of Gujarat. *Indian J. Agric. Sci* 42 (II) : 1024-27.

Shekhawat, G. S., Bhari, N. R. and Chundawat, G. S. 1972. Note on effect of NPK and plant spacings on yield of hybrid bajra on grey brown alluvial soils of arid Rajasthan. *Indian J. Agron.* 17(4) : 348-49.

Singh, B. R., Singh, L. and Singh, B. P. 1973. Response of dwarf wheat to graded doses of P and K on soils of different available P status. *J. Agric. Sci.* 80 : 251-53.

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INTEREST OF RURAL WOMEN REGARDING IMPROVED HOME SCIENCE PRACTICES IN DABRA VILLAGE

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ABSTRACT

The present study highlighted foods and cooking, clothing and laundry as the preferred areas of interest. Education had no influence in the choice of interest areas whereas type of family and occupation influenced to a limited extent. The detailed information in home science areas confirmed the observation that rural women were interested in clothing, construction, knitting, repairs and child care practices. It was found that families consumed fairly balanced diet, lacked the introduction of weaning foods for children at right age, used faulty cleaning agents and methods of washing clothes. Daily cleaning of household, age old methods of storage of articles, use of ash for cleaning utensils, confirmed their belief in traditionally deep rooted practices.

Home is the place where one gets maximum comfort and peace. The efficient functioning of the home is greatly dependent upon the proficiency of housewife in the domestic chores. Hence, education of the rural women in various home science aspects is essential to enhance their efficiency in home affairs.

Swaminathan (1975), Chowdhary (1976), and Deulkar (1978) through their studies have emphasised the important role women play at home. Several research studies (Choudhry and Sharma, 1961; Sharma and Singh, 1970) have emphasised the women's role in farm practices. An encouraging finding by Shakunt (1975) had revealed that the respondents perceived the importance of training in different home science areas.

A cursery look at the status of Indian rural homes clearly indicates that these have by and large remained deprived of the inflow of scientific knowledge of home science. It was thought rational at this juncture to have research based evidences regarding the women who perform the dual role as to whether they are interested in these areas, where they have significant involvement. Keeping this in mind, the present study was conducted with the following objectives :

1. To find out the areas of interest and preferences of housewives in home science, agriculture and allied practices.
2. To study the relationship of areas of interest with socio-personal characteristics.
3. To investigate in detail the areas of interest regarding home science practices.

TABLE 1

Distribution of respondents in relation to their socio-personal characteristics (in percentage)

Education				Type of family		Occupation		Land holding		
Illiterates	Primary	Middle	High and above	Individual	Joint	Farming	Non-farming	Small	Medium	Large
65.4	8.6	18.0	8 0	71.4	28.6	54.0	46.0	52.4	46.2	1.4

METHODOLOGY

The study was conducted in Dabra village of Hissar district. About 150 housewives were randomly selected and interviewed personally with the help of structured interview schedule duly pretested before final implementation. The broad areas of study were, foods and cooking, clothing and laundry, home improvements, child care, agriculture and animal husbandry.

The data were processed, tabulated, analysed and the results are presented in the percentage.

RESULTS AND DISCUSSION

Dabra village which is situated at a distance of about 14 kms from the University has an area of 2616 acres, 422 residential houses, 2531 adult population and electricity facilities are availed by majority.

An investigation revealed that majority (65.4%) of the women respondents were illiterate having individual families (71.4%), whereas they have mixed type of occupation like farming/non-farming and most of them have small and medium size of land holding (Table 1).

The preferential interest areas of rural women were worked out regarding improved home science practices It was found that food and cooking, clothing and laundry, home improvement, child care, agriculture and animal husbandry were the order of their preference. It is inferred from Table 2 that food and cooking, clothing and laundry were the most preferred interest areas whereas agriculture and animal husbandry were the least.

TABLE 2

Areas of interest of rural women (in percentage)

Areas of interest	
Food and cooking	73.3
Clothing and laundry	71.3
Home improvement	66.0
Child care	54.6
Agriculture	37.6
Animal husbandry	32.6

(multiple responses)

The relation of interest areas with socio-personal characteristics of rural women is presented in Table 3. It is evident that education of the women had no effect on the preference of areas of interest. Effect of individual type of family was obvious but that can be attributed because individual type of families were prevalent in the area. The type of occupation seemed to had an effect for agriculture and animal husban-

TABLE 3

Relation of interest areas with socio-personal characteristics (in percentage)

Areas of interest	Education				Type of family		Occupation	
	Illiterate	Primary	Middle	High and above	Individual	Joint	Farming	Non-farming
Food and cooking	63.64	10 91	18.18	7.27	65.45	34.55	51.72	48.28
Clothing and laundry	57.00	11.20	23.40	8.40	61.68	38.32	49.53	50.47
Home improvement	64.29	13.09	17.86	4.76	71.43	28.57	41.67	58.33
Child care	80.49	7.33	6.09	6.09	60.97	39.03	53.66	46.34
Agriculture	73.22	12.50	7.14	7.14	58.93	41.07	83.93	16.07
Animal husbandry	89.79	8.18	2.03	0.00	58.18	41.82	81.61	18.39

dry choice; for other areas of interest no marked influence of this factor existed. Thus, it could be inferred that illiterate women having farming as occupation have a bend of mind for agriculture and animal husbandry.

The major objective was to find out the rural women's interest areas in home science aspects. Therefore, the details regarding it were explored under four broad sub-heads enumerated below :

A. Food pattern

The food pattern of rural women was restricted to one single aspect, i. e. possibility of food stuffs consumed by them (Table 4).

TABLE 4

Food stuffs consumed by rural families

Food groups	Percentage
Cereals	95.3
Pulses	95.3
Sugar	93.3
Starchy vegetables	92.6
Fats and oils	91.3
Milk and milk products	86.0
Other vegetables	78.6
Green leafy vegetables	76.6
Fruits	55.3
Eggs and meat	13.3

(multiple responses)

It is evident that more than 90% of the women took cereals, pulses, sugar, starchy vegetables, fats and oils; whereas milk and milk products, other vegetables, green leafy vegetables came next in order of importance. Fruits were taken by a little over 50% of the women whereas eggs and meat by a very small fraction. It could be inferred that food pattern prevalent in this village is quite satisfactory.

Separate interest table for food pattern is not furnished as majority of them were interested to learn about nutrition. Several researchers (Gupta, 1973; Agha, 1974; Devadas, 1974; Gopalan, 1975; Ramanasri, 1975) have emphasised the importance of nutrition education to solve malnutrition in the families.

B. Clothing and laundry

Clothing and laundry being an integral part of home and as much of the importance is laid on this field in home science education, the existing interest in clothing practices and methods of laundering were explored.

(i) **Clothing practices.** Table 5 reveals that majority of the women

(above 95%) were interested in clothing practices.

TABLE 5

Interest of rural women regarding clothing practices (in percentage)

Clothing practices	Interest
Repairs	99.3
Clothing construction	98.6
Knitting (hand and machine)	96.0

(ii) **Laundering.** Table 6 shows that cleaning agents mostly used were soapcakes for cotton clothes; whereas surf and det were used for cleaning woollen and synthetic clothes. It was surprisingly found that methods of washing popularly used for all types of clothes were clothes-beater and boiling in soda water. This highlights the need for training in clothing and their care. This was shown by several researchers like Wingo (1955), Troel Strup (1957), Singh (1971), Kamala and Mathulakshmi (1974).

TABLE 6

Type of clothes in relation to cleaning agents and methods of washing

	Clothes (%)		
	Cotton	Woollen	Synthetic
Cleaning agents			
(a) Surf, det	8.6	91.3	86.6
(b) Soap cake	83.3	2.6	6.6
(c) Liquid soap	25.3	6.6	4.6
(d) Soap flakes	12.6	2.6	3.3
Methods of washing			
(a) Beating on stone	4.0	49.3	49.3
(b) Boiling in soda water	68.6	68.6	68.6
(c) Rubbing the dirty areas	55.3	55.3	55.3
(d) Clothes beater	78.0	78.0	78.0
(e) Soaking overnight	22.6	22.6	22.6

(multiple responses in columns)

C. Household cleaning and storage

Under home improvement, household cleaning and storage was asked specifically as these areas need special improvement.

(i) **Household cleaning.** It is evident from Table 7 that in majority of the cases (above 75%), kitchen, living room and courtyard were cleaned daily whereas more than 50% of them even clean cow/buffaloshed every day. Thus, it could be inferred that most of the women do household cleaning daily with few exceptions.

TABLE 7

Household cleaning by rural women (in percentage)

Part of home	*Daily*	*Periodical*
Kitchen	97.2	2.8
Living room	84.0	16.0
Courtyard	76.0	24.0
Cow/Buffaloshed	63.4	36.6

(ii) **Cleaning of utensils :** Quite a number of cleaning agents like mud, ash, surf, vim and sand are available for cleaning of utensils but it is evident from Table 8 that irrespective of type of utensils the most popular cleaning agent was ash only. In few exceptional cases surf was used for cleaning steel utensils.

(iii) **Storage.** In village condition storage is one of the most neglected area which adds to unnecessary wastage of time and energy. It needs exploration to know the type of storage practices prevalent so that necessary ramification could be suggested for work simplification. Table 9 furnishes the information regarding this aspect and highlights the important features of storage of perishable and non-perishable food stuffs, drinking

water, cleaned utensils, bed linen, woollen and other clothes. It is evident that majority of the women stored perishable food stuffs in open, non-perishable in tins, drinking water mostly in pots, clean utensils on shelf/open, whereas bedlinen, woollen and other clothes in boxes. This shows the traditional method of storage followed from generation to generation. The present findings regarding home improvement are in line with the studies of Bhatia (1967), Misra (1971), Mishra (1973), Dhesi (1973) who reported that very few women have taken to home improvements through modern techniques to their homes.

Separate interest table for household cleaning and storage was not furnished as majority of the women failed to give their interest in separate areas.

D. Child care

(i) **Child care practices.** The intensive child care requires appropriate feeding practices, vaccination and medical care and schooling. Generally, these are the neglected practices in rural areas. It was felt necessary to find out whether they hold interest in these practices or not. Table 10 incorporates the encouraging finding that majority (above 90%) of the women were interested in feeding, schooling and vaccination.

TABLE 8

Cleaning agents used for different type of utensils

Utensils	Cleaning agent (in percentage)				
	Mud	Ash	Vim	Surf	Sand
Brass	4.6	90.6	.66	1.3	4.6
Aluminium	4.6	64.0	6.6	23.3	4.6
Steel	4 6	24 0	10.0	26.6	.66
Indalium	4.6	26.0	4.6	12.6	.66
Copper	4.6	76.6	2 6	.66	8.00

TABLE 9

Types of articles and their storage methods (in percentage)

Type of articles	Methods of storage												
	Basket	Wet cloth	Open	Sand	Tin	Sac	Pot	Shelf	Bed	Box	Almirah	Hang	Bag
Perishable foods	15.3	3.3	72.0	3 3									
Non-perishable foods			4.0	1.3	51.3	26.6	10 6						
Drinking water							94.6						
Cleaned utensils	14.6		38.6					43.4					
Bed linen									14.6	62.0	6.6	15.3	
Woollen										92.6	0.3	1.3	0.66
Other clothes										67.3	6.6	13.3	

TABLE 10

Interest of rural women in child care practices (in percentage)

Child care practices	Interested	Not interested
Feeding	96 6	3.4
Medical care & vaccination	92.0	8.0
Schooling	94.6	5.4

(ii) **Feeding practices.** Table 11 gives the feeding practices followed by rural women for their different age group children confirms the fact that 90% of the women depended on liquid diet for their children below the age group of 2 years and semi-liquid and solid for children above 2 years.

TABLE 11

Feeding practices followed for different age group children (in percentage)

Diet	Age group			
	0-1	1-2	2-3	3-5
Liquid	95.3	92.0	48.0	36.6
Semi solid	4.0	52.6	90.0	66.6
Solid	2.6	18.6	94.0	96.0

(multiple responses in columns)

Suggestions

On the basis of findings the following suggestions can be made for effective implementation of the Home Science Programme :

(i) An integrated approach that incorporates personnel from home science, agriculture and animal husbandry would be made effective for overall development of the family.

(ii) The pattern of consumption of food stuffs prevalent in this area are quite encouraging. This provides for the wider scope of the acceptance of nutrition programmes if planned and implemented according to their interest and food pattern.

(iii) The type of articles and storage methods in most of the cases were faulty as those were deeply rooted practices. Therefore, drastic changes should not be advocated and delicate handling is needed without psychologically disturbing the individual if the change is introduced.

(iv) The majority of women were interested in the proper feeding, medical care and schooling of their children. This natural instrict should be taken as a motivating factor for introducing child care practice programme for harnessing better results.

(v) The feeding practices followed by different age groups highlighted that no supplementary food stuffs were given to children below 2 years. The supplementary feeding programme has wider scope of acceptance as evident by the present finding itself.

REFERENCES

Agha, A.N. 1974. Applied nutrition programme. *Swasth Hind* 18(4) : 116-18.

Bhatia, V. 1967. A study of acceptors and discontinuers of smokeless chulah. *Studies of the rural community (1966-72)*. Lady Irwin College, New Delhi, pp 32-34.

Choudhry, T. P. S, and Sharma, B. M. 1961. Female labour of the farm family. *Agriculture situation in India.*

Chowdhary, D. P. 1975. Women's role in rural development. *Social Welfare* 22(9) : 16.

Deulkar, D. 1978. Home science in higher education and research. *Indian J. Home Sci.* 10(2) : 80-87.

Devadas, R. P. 1974. Scope for nutrition education primary in school lunch programme and curriculum. *Indian J. Nutr. Diet.* 11(6) : 321.

Dhesi, J. K. 1973. Changing villages of Punjab. *The Second Annual Report of the Department of Home Management*, Punjab Agricultural University, Ludhiana.

Gopalan, C. 1975. The nutrition problems in India. *Kurukshetra* 23(9) : 4-6.

Gupta, S. 1973. Small family+good income= Nutrition and health. *Social Welfare 20(4) : 30.*

Kamala, M. R. and Mathulakshmi, K. 1974. Educating rural women in clothing care practices. *Indian J. Home Sci.* 8(1) : 33-36.

Mishra, R. C. 1973. Better household equipment for rural women. *Kurukshetra* 21(15) : 12.

Misra, S. 1971. Study of existing pattern of rural housing. *Studies of the rural community (1966 72)* Lady Irwin College, New Delhi, p. 80.

Ramanasri, B. 1975. The determinants of food habits. *Social Welfare* 22(9) : 13.

Shakunt. 1975. Interest areas, home science training needs and leisure time activities of school going girls. M.Sc. thesis, Haryana Agricultural University, Hissar.

Sharma, D. K. and Singh, T R. 1970. Participation of rural women related to farm business. *Indian J. Exten. Educ.* 4(1 & 2) : 43.

Singh, M. B. 1971. Your clothes and what they do for you. *Indian J. Home Sci.* 5(2) : 87-88.

Swaminathan, M. S. 1975. Home Science colleges need to play a dynamic role. *Indian J. Home Sci.* 9(2) : 33-35.

Troel Strup, A. W. 1957. *Consumer problem and personal finance.* McGraw Hill Book Company, New York, p. 148.

Wingo, C. E. 1955. *The clothes you buy and make.* McGraw Hill Book Company, New York, p. 89.

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STABILITY ANALYSIS FOR OIL CONTENT AND YIELD COMPONENTS IN GROUNDNUT *(ARACHIS HYPOGEAE* L.)

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Groundnut, being an important oilseed crop, occupies a prominent position. So, it is very much desirable to have a genotype which should be able to produce more, consistently year after year over larger areas. Since, pod yield is a complex character, the improvement of its component characters would be most desirable. Further, the study of genotype × environment interaction will be of immense help as it would lead to successful evaluation of stable genotype which could either be released for commercial cultivation or be used in future breeding programme.

The experimental material consisted of eighteen genotypes of groundnut. These genotypes were grown in a randomized block design in three replications during the last three years, i.e., 1972-73, 1973-74 and 1974-75. Hereafter, these three environments would be referred to as E I, E II, E III, respectively. The data were recorded in only two replications for the character under report. Oil estimation was done according to the specifications outlined in A.O A.C. (1960). The data for shelling percentage and oil content were subjected to angular transformation for the purpose of statistical analysis. The data were subjected to pooled regression analysis to test the significance of genotype × environment interaction Further, the stability parameters ($\bar{Y}_i$, b_i and S^2d_i) with regard to individual genotype were estimated using the model proposed by Eberhart and Russell (1966).

Pooled analysis of variance (Table 1) showed that mean squares due to genotypes and environments for all the characters were significant, when tested against genotype × environment interaction. This indicated the existence of variability among the genotypes and environments. The variance due to genotype × environment interaction was also significant for all the traits, when tested against pooled error which indicated that genotypes interacted significantly with the environments. Further, the partitioning of genotype × environment interaction in two components, i.e., linear and non-linear portions, showed that mean squares due to these components were significant for all the traits. The magnitude of linear component was high for 100-kernel weight and oil content. However, exactly reverse was true with respect to shelling percentage. The excess of linear

TABLE 1

Pooled analysis of variance for phenotypic stability in respect of 100-kernel weight, shelling percentage and oil content

Source of variation	d f	Mean sum of squares		
		100-kernel weight	Shelling percentage	Oil content (%)
Genotypes	17	42.70*	11 86*	4.26*
Environment	2	219.86*	158.01*	36.25*
Genotype × Environment	34	17.91*	7.19*	1.38*
Regression	18	14 57*	8.10*	4.15*
Remainder	18	9.86*	9.10*	1.63*
Pooled error	54	0.56	0.25	0.07

*Significant at P=0.05

TABLE 2

Estimates of stability parameters in respect of different genotypes for 100-kernel weight, shelling percentage and oil content

Genotypes	100-kernel weight			Shelling percentage			Oil content		
	$\bar{Y}_i$	b_i	S^2d_i	$\bar{Y}_i$	b_i	S^2d_i	$\bar{Y}_i$	b_i	S^2d_i
NG-386	36.00	- 0.12	1.34	72.00	1.27*	4.67*	49.52	7.94*	0.043
C-421	34.50	0.96*	1.55	74.03	1.05*	0.23	49 89	−1.21*	0.947*
7-1	40.67	0.87*	−0.02	72 67	0.35	3.05*	49.30	0.70	2.207*
RS-69	35.00	0.41	1.61	74.73	1.33*	5.69*	48.48	−6.86	0.030
TG-10	48.33	1.61*	14.67*	76.00	0.87*	5.85*	52.35	−4.32*	0.033
99-5	36.50	0.88*	11.18*	73.83	1.23*	0.74*	48.78	0.51	4.617*
KG-423	37.33	0.10	1.63	74.90	0 54*	0.02	49.76	1.40*	−0.053
G-64-206	41.83	3.14*	12.64*	72 83	1.12*	−0.20	51.09	8.64*	4.877*
Ah 7986	38.33	1.20*	13.16*	67.67	2.88	76.26*	47.69	−5.91*	−0.023
JH-113	37.67	0.67*	9.36*	75.90	0.14	15.77*	49.49	0.63	4.617*
G-969	37.67	0.05	10.34*	74 83	0 50	3.40*	50.28	6.82*	0.127
Ah-8312	36.17	1.59*	16.11*	73.70	0.62*	0.83*	48.80	−4.64*	0.057
TG-4	40.67	1.44*	−0.18	72.13	2.04*	17.93*	50.10	2.48	−0.033
G-65-1038	38.17	0.32	1.33	73.63	1.59*	0.43	50.68	1.90*	3.067*
13-46	42.67	3.59*	25.39*	72.60	1.30*	15.29*	51.28	1.33*	−0.003
G-64-403	34.67	0.21	19.33*	74.67	0.47	0.97*	50.12	11.82*	0.063
D.M.	31.83	0.09	0.71	71.00	0.40	7.46*	48.13	1.33*	0 717*
C-501	40.17	0.99*	19.32*	71.87	0.34	2.50*	48.56	−0.76	5.517*

*Significant at P=0.05

component in 100-kernel weight and oil content suggested the possibility of prediction across the environments. On the other hand, excess of non-linear component for shelling percentage revealed the absence of relationship between genotype × environment interaction and the environment of values. Presence of both linear and non-linear components has been reported in different crops with respect to different traits by many workers (Perkins and Jinks, 1968; Bucio Alanis, 1966; Kapoor, 1972; Yadava and Kumar, 1978). It has also been reported by many workers that when both linear and non-linear mean squares are significant, prediction would be more reliable when only former was significant against the latter (Breese, 1969; Samuel *et al.*, 1970).

The stability parameters (b_i and S^2d_i) were estimated for individual genotype (Table 2). The results revealed that genotype TG 10 recorded the highest 100-kernel weight (48.33 g) followed by genotype 13-46 (42.67 g), G 64-206 (41.83 g) and 7-1 (40.67 g) as compared to the standard variety C 501 (40.17 g). All these genotypes except for 7-1 and the standard C 501 had above average response ($b_i > 1$), which indicated their suitability to only better yielding environments. The genotypes 7-1 and C 501 possessed below average ($b_i < 1$) and average response ($b_i = 1$), respectively and were, therefore, characterized as suitable for poor environments. As regards S^2d_i (deviation from regression), none of the above genotypes except for 7-1 possessed non-significant value and so these genotypes were characterized unstable. For shelling percentage, a genotype TG 10 was sorted out which possessed the highest shelling percentage (76.00), below average response ($b_i = 0.87$) and was unstable as indicated by the significant value recorded for S^2d_i. Further, a genotype C 421 was sorted out with above average shelling percentage (74.03), average response ($b_i = 1.05$) and was also stable. This indicated the suitability of this genotype over all the testing environments. Regarding oil content, again the genotype TG 10 was identified with highest oil content (52.35%). But this genotype neither possessed the average response nor was stable to changing environmental conditions. It was noticed that none of the genotype possessed the average response ($b_i = 1$) and non-significant value for S^2d_i (deviation from regression) for this character, which are the requisites of an ideal variety (Eberhart and Russell, 1966).

The non-significant correlations of linear response (b_i), deviation from regression (S^2d_i) with mean performance ($\bar{Y}_i$) was observed, which suggested that these parameters were governed by independent genetic systems. Similar results have been reported by Kumar (1977) and Yadava and Kumar (1978). It is, therefore, suggested that still more studies are required regarding genetic systems governing the different parameters of genotype × environment interaction, before any precise conclusions can be drawn.

REFERENCES

A.O.A.C 1960. *Official methods of analysis.* 7th ed. Washington. Association of Official Agricultural Chemists.

Breese, E. L. 1969. The measurement and significance of genotype environment interaction in grasses. *Heredity* **24** : 27-44.

Bucio-Alanis, L. 1966. Environmental and genotype-environment components of variability I, Inbred lines. *Heredity* **21** : 387-97.

Eberhart, S. A. and Russell, W. A. 1966. Stability parameters for comparing varieties. *Crop Sci.* **6** : 36-40.

Kapoor, R. L. 1972. A study of adaptability and gene action of some quantitative characters in bajra *(P. typhoides* (B.) S and H). Ph.D. thesis, Haryana Agricultural University, Hissar.

Kumar, P. 1977. Estimates of combining ability and stability parameters in Pearl millet. Ph. D. thesis, Haryana Agricultural University, Hissar.

Perkins, J. M. and Jinks, J. L. 1968. Environmental and genotypic environmental components of variability III. Multiple lines and crosses. *Heredity* **23** : 339-56.

Samuel, J. O., Hill, J., Breese, E. L. and Davis, A. 1970. Assessing and predicting environment response. *J. Agric. Sci.* **75** : 1-9.

Yadava, T. P. and Kumar, P. 1978. Stability analysis for pod yield and maturity in bunch group of groundnut *(Arachis hypogeae* L.). *Indian J. Agric. Res.* **12** : 1-4.

RESEARCH NOTE

Haryana agric. Univ. J. Res., Vol. X, No. 4, pp. 564–565 (December 1980)

EFFECT OF NUMBER OF IRRIGATIONS ON TERMITE* DAMAGE IN WHEAT CROP

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(Received : May 29, 1979; Revised : May 9, 1980)

In a field experiment conducted during 1974–75, the effect of four irrigation programmes to wheat crop on the extent of termite damage during the earing stage (non-compensatory damage) was investigated. One (22 days after sowing), two (22 and 85 days after sowing), three (22, 65 and 105 days after sowing), and four (22, 45, 85 and 105 days after sowing) irrigations were applied to two varieties (C 306 and Kalyan 227) of wheat crop sown in a randomised block design with four replications and plot size of 10 × 5m. Between any two plots, one metre wide buffer area was provided.

The termite damaged tillers in each plot, during the earing stage, were collected and counted at weekly intervals. The total number of effective tillers in each plot at harvest was also determined. This was done by counting the tillers in 4 out of the 20 rows in each plot. While compiling the data, the number of termite damaged tillers for any plot were added up to the number of effective tillers at harvest for that plot The data were subjected to analysis of variance.

It is evident from the data given in Table 1 that the number of termite damaged tillers per plot, as also their percentage, was the highest under conditions of one than under two, three or four irrigations. The values of both these parameters were also higher in plots which received two irrigations than in plots irrigated thrice or four times. Such differences in plots irrigated three or four times were, however, non significant.

The number of effective tillers per plot at harvest was lower in plots irrigated once or twice than in those which received three or four irrigations. For all these parameters, the difference between the two crop varieties was non-significant.

Harris (1961) observed that the plant feeding termites were encouraged by reduction in the vigour of the host plant during periods of drought. The present findings seem to be in conformity with these observations.

*Identified to be *Microtermes obesi* Holmgren

TABLE 1

Effect of number of irrigations applied to wheat crop on *termite damage* in the earing stage

No. of irrigations	Wheat variety		Mean
	C 306	Kalyan 227	
a. Mean number of termite damaged tillers per plot*			
One	571.5(22.92)**	977.5(30.25)	774.5(26.58)
Two	208.5(13.65)	102.2(10 10)	155.3(11.87)
Three	32.0(5.40)	90.0(9.39)	61.0(7.40)
Four	13.0(3 64)	30.0(5.39)	21.5(5.29)
C. D. at 5%			(5.29)
Mean	206.3(11.40)	299.9(13.78)	253.1(12.59)
b. Mean number of effective tillers per plot* at harvest			
One	9450.5(97.18)	10115.2(100.51)	9782.8(98.84)
Two	10371.0(101.79)	10444.0(102.09)	10407.5(101.94)
Three	13244.2(114.93)	14302.5(119.53)	137733.(117.23)
Four	12379.5(111.14)	12863.5(113.40)	12621.5(112.27)
C. D. at 5%			(5.20)
Mean	11361.3(106.26)	11931.3(108.88)	11646.3(107.57)
C. Mean per cent tillers damaged by termites			
One	5.9(13.57)***	9.5(17.48)	7.7(15.52)
Two	2.0(7.66)	1.0(6.24)	1.5(6.95)
Three	0.2(2.57)	0.6(4.48)	0.4(3.52)
Four	0.1(1.65)	0.2(2.64)	0.2(2.14)
C. D. at 5%			(2.92)
Mean	2.1(6.36)	2.8(7.71)	2.5(7.03)

*10×5m

**Mean of $\sqrt{n+1}$ transformed values in the four replications.

***Means of angular transformed values in the four replications.

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REFERENCE

Harris, W. V. 1961. *Termites, their recognition and control.* London : Longmans, 187. pp.

RESEARCH NOTE

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WEIGHT-VOLUME CHANGES AND DISCHARGE THROUGH SEED DRILL OF ALDRIN-TREATED SEED OF WHEAT AND BARLEY

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For checking termite damage in wheat and barley crops, seed treatment with aldrin emulsion has been found to be both very effective and economical (Verma *et al.*, 1978, 1979). The present studies were aimed to find out the weight-volume changes in the aldrin-treated, as compared to untreated seed and also to determine the relative discharge rates, through a seed drill, of these two types of seeds of wheat and barley.

Wheat (variety S 308) and barley (variety C 164) seeds were treated with aldrin emulsion by using 4 and 10 ml aldrin 30 EC per kilogram seed, respectively (Haryana Agricultural University, 1979). For both the crops, seed treatment of weighed 100 g samples, as also of the seed in bulk (for use in seed drill) was done in the evening of 16th December, 1978 and all the tests were done on the subsequent day. The samples were weighed on an analytical balance and their volume (apparent volume) was determined with the help of a graduated cylinder.

Three-row, bullock driven seed drill having a flutted roller type seed metering and dropping mechanism was used. The diameter of the driving wheel of this drill was 90 cm. The calibration of the drill was done by jacking it up and adjusting the seed rate to the recommended values (in terms of untreated seed). For each crop, irrespective of the type of seed used, the seed rate adjustment, throughout the period of the experiment, remained constant. The amount of untreated and aldrin-treated seed of each crop, discharged through all the furrow openers per 25 revolutions of the driving wheel of the drill was then determined. For each type of seed, the process was repeated 15 times and the mean values were used for making comparisons. Considering 20 cm row to row spacing for each crop, the seed drill covers an area of 42.2 sq m. per 25 revolutions of the driving wheel for which the observations were taken.

The data on weight and volume measurements as well as discharge rate through the drill, for the two types of

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TABLE 1

Weight, volume and discharge rate through seed drill of untreated and aldrin-treated seed of wheat and barley

Parameter	Replications	Wheat seed		Barley seed	
		Untreated	Aldrin treated	Untreated	Aldrin-treated
Mean wt. (g) of the same seed samples, before and 16h after treatment with aldrin emulsion	10	100.0	101.0	100.0	103.4
Mean volume (ml) of the samples as above	10	119.0	130.0	149.4	161.6
Mean wt. (g) of seed discharged through drill in 25 revolutions of driving wheel	15	384.2	340.6 (337.1)*	291.1	265.6 (256.8)*
Increase (%) in weight following treatment of seed with aldrin emulsion	10	1.1		3.4	
Increase (%) in volume following treatment of seed with aldrin emulsion	10	9.3		8.2	
Reduction* (%) in the quantity of seed discharged through drill when aldrin-treated seed was used in place of untreated seed	15	12.3		11.8	

*In terms of untreated seed

seeds of wheat and barley are given in Table 1. On the basis of this information the following conclusions were drawn.

1. Treatment of wheat or barley seed with aldrin-emulsion resulted in its increased weight and volume. The increase in weight was observed to be relatively lesser (1.1 %) in case of wheat than in barley (3.4 %) but the trend for increase in volume of the seed was just the reverse – it being more (9.3 %) in wheat than in barley (8.2 %). The use of higher quantity of the insecticide as well as water (10 ml aldrin 30 EC + 115 ml water per kg seed; Verma *et al.*, 1979) in case of barley than in wheat (4 ml aldrin 30 EC + 46 ml water per kg seed; Verma *et al*, 1975) might account for more increase in weight of the treated seed in the former than in the latter case. It is, however, rather difficult to assign a precise reason for the differential change in volume of the treated seed in these two crops.

2. As compared to the untreated seed, aldrin-treated wheat as well as barley seed had considerably lesser (12.3% in wheat and 11.8% in barley) discharge rate through the seed drill. These findings clearly suggest that there is a need for changing the calibration of the drill when aldrin-treated seed is to be used in place of untreated seed.

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REFERENCES

Haryana Agricultural University. 1979. Haryana Agricultural Diary for the year 1979. Hissar, p. 160.

Verma, A. N., Kashyap, R. K., Bhanot, J. P. and Khurana, A. D. 1979. Effect of seed treatment and soil application of aldrin and BHC on germination, termite damage and yield of barley. *Indian J. Entomol.* 41 : 164-69.

Verma, A. N., Khurana, A. D. and Bhanot, J. P. 1975. Chemical control of termites in wheat with BHC and aldrin applied by different techniques. *Haryana agric. Univ. J. Res.* 5 (3) : 200-08.

Verma, A. N., Khurana, A. D. and Bhanot, J. P. 1978. A new method to check termite damage in wheat crop. *International Symp. on Arid Zone Res. & Dev.* held at Central Arid Zone Research Institute, Jodhpur (India) from 14th to 18th Feb., 1978, p. 153.

RESEARCH NOTE

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EFFECT OF GIRDLING DIFFERENT PARTS OF VINE ON FRUIT BUD FORMATION AND BUD KILLING IN THOMPSON SEEDLESS GRAPE (*VITIS VINIFERA* L.)

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Thompson Seedless is one of the important grape cultivars which tops in quality. However, shy bearing in this cultivar seems to be a major problem. Formation of limited number of flower buds and bud killing have been reported to accentuate this menace (Bindra, 1977 and Chundawat *et al.*, 1977).

Girdling, by altering the level of carbohydrates, thereby raising C/N ratio in the shoots, may increase fruit bud differentiation (Faulkner, 1966). Such a condition may also reduce bud killing. Therefore, the present investigations were undertaken to find out the effect of girdling on fruit bud initiation and bud mortality.

Sixteen uniform vines were selected for the four treatments, viz., trunk girdling, arm girdling, cane girdling and control. Girdling was done one week before full bloom with the help of sharp knife by giving a 0.5 cm wide cut. Trunk girdling was done about 45 cm above ground. In arm girdling, all the four arms were girdled. Similarly in case of cane girdling all the fruiting canes left after pruning were girdled. Four vines were kept under each treatment.

Bud samples were collected in August, 1978. Fifth to tenth buds from 8 shoots/vine were collected for this study. Thus, a total of 48 buds were sampled from each vine. Buds were removed from the shoots with the help of a sharp blade by giving a parallel cut through the woody portion. Care was taken to remove woody portion as small as possible along with the buds without any injury to the buds.

The bud samples under different treatments were collected in specimen tubes containing F. A. A. (Formalin Aceto Alcohol) solution for killing. The buds were observed under dissecting microscope and were categorized as fruitful, vegetative or dead buds as described by Bindra and Chauhan (1976).

About 25 % of the buds differentiated into flower buds (Table 1), while about 50% remained vegetative and the rest were killed. All the girdling treatments significantly improved the fruitfulness of buds as compared to control.

The per cent vegetative buds were minimum with trunk girdling followed

TABLE 1

Effect of girdling on fruit bud induction and bud mortality in Thompson Seedless grapes

Treatments	Total No. of buds examined	Fruitful (%)	Vegetative buds (%)	Dead buds (%)
Trunk girdling	144	49.80 (44.89)	30.33 (33.37)	19.87 (26.49)
Arm girdling	144	44.05 (41.58)	34.12 (35.74)	21.83 (27.85)
Cane girdling	144	50.00 (45.00)	35.60 (36.62)	14 40 (22.29)
Control (Ungirdled)	144	25.33 (30.21)	49.30 (44.60)	25.37 (30.24)
C. D. at 5%		(1.92)	(1.75)	(1.21)

Figures in parenthesis are angular transformations

by arm and cane girdling. All the girdling treatments significantly reduced the vegetative buds as compared to control. Trunk girdling significantly decreased the number of vegetative buds as compared to arm and cane girdling but the differences among arm and cane girdling were not significant. The reduction in vegetative buds as a result of girdling was obviously due to the fact that all the three treatments effectively increased flower buds by changing vegetative to flower buds.

There was a significant decrease in the per cent dead buds with all girdling treatments when compared to control. In cane girdling, the dead buds were the minimum (14.40 %), which were significantly lower than that in trunk (19.87%) and arm (21.83%) girdling.

REFERENCES

Bindra, A. S. 1977. Flower and flower bud drop in Thompson Seedless grapes. Effect of application of graded doses of N, P, K fertilizers. *J. Res. Punjab agric. Univ.* 14 (2) : 175-77.

Bindra, A. S. and Chauhan, J. S. 1976 Flower bud killing in Anab-e-Shahi grapes, effect of cultural practices. *Indian J Hortic.* 33 : 33-36.

Chundawat, B. S., Khera, A. P., Chitkara, S. D. and Jindal, P. C. 1977. Causes of unproductivity in Thompson Seedless grapes. I. Relationships between petiole nutrient content and yield. *Haryana agric. Univ. J. Res.* 7 (1-2) : 32-36.

Faulkner, R. 1966. A review of flower induction experiments and trials 1948-63. *In U. K. Forest Comm. Rep. on Forest Res. for the year ended March, 1965.*

RESEARCH NOTE

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EFFECT OF ADDITIONAL IRRIGATION ON POPULATION OF *HETERODERA AVENAE* AND WHEAT YIELD

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Heterodera avenae, causing 'Molya' in wheat and barley, poses a serious pest problem in countless pockets throughout the district of Mohindergarh and parts of Gurgaon district of Haryana State. Recently, infestations of this nematode have been reported from new areas of Rohtak and Bhiwani districts adjacent to the border of Mohindergarh district (Bhatti *et al.*, 1980).

Keeping in view the economic importance of *H. avenae*, Bhatti and Dalal (1973) tested Telone, Nemagon (60 EC), Dasanit 5-G and D-D mixture for its control and reported their cost-benefit ratios ranging from 1 : 0 97 to 1 : 1.45, which, obviously, are uneconomical. An idea was visualised that additional irrigations, if applied post-harvest and pre-plant, might lower the soil temperature, resulting in early larval emergence and reduction in the viability of the infective second-stage juveniles. With this objective, two additional irrigations each were applied post-harvest and pre-plant of wheat cv. Kalyan Sona. Post-harvest irrigations were applied on 15th and 28th May; pre-plant irrigations on 1st September and 15th October, 1974, and general pre-sowing irrigation on 4th November, 1974. All the treatments, including control, were replicated four times and randomised. The data on pre-plant, post-harvest cyst population/200 ml soil and wheat yield are given in Table 1.

TABLE 1

Influence of post-harvest and pre-plant irrigation on *Heterodera avenae* population and yield of wheat cv Kalyan Sona

Treatment	Pre-plant *cyst population/ 200 ml soil	Post-harvest cyst population/200 ml soil	Mean grain yield kg/ha	% increase or decrease in grain yield over control
Post-harvest (Two irrigations)	12	12	3765.00	+36.2
Pre-plant (Two irrigations)	10	30	2365.00	−14.4
Control	10	12	2765.00	—
SEm.			216.70	
C. D. at 5%			690.00	
C. V. %			14.61	

*Cyst content = 266 eggs and larvae/cyst

The results indicate that plots receiving two additional post-harvest irrigations registered 36.2% increase in grain yield over the control and also differed significantly from the pre-plant and control treatments. However, nematode population buildup in post-harvest and control was almost similar. It reveals that post-harvest irrigations might have improved the fertility status of the soil but had no effect on *H. avenae*. The yield of pre-plant irrigations decreased by 14.4% over control and statistically there was no difference between the two. Moreover, the nematode population buildup in pre-plant was two and a half times higher than that in control. The observations reveal that additional pre-plant irrigations influenced the larval emergence resulting in more invasion and multiplication and thereby a reduction in the wheat grain yield.

Based upon only one year's data it may be stated that post-harvest irrigations may not influence multiplication of *H. avenae* cysts but may contribute to good growth of wheat crop phenologically. Whereas additional pre-plant irrigations may stimulate increased larval emergence and massive invasion resulting in reduction of the grain yield and multiplication of *H. avenae* cyst population.

REFERENCES

Bhatti, D. S , Dahiya, R. S., Gupta, D. C. and Malhan, Indra. 1980. Plant-parasitic nematodes associated with various crops in Haryana. *Haryana agric. Univ. J. Res.* **10** : 413-14.

Bhatti, D. S. and Dalal, M. R. 1973. Yield responses in wheat to nematicidal treatments in a soil highly infested with cyst nematode. *Haryana agric. Univ. J. Res.* **2** : 231-32.

VETERINARY AND ANIMAL SCIENCES

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EFFECT OF VARIOUS LEVELS OF POULTRY EXCRETA, IN SUPPLEMENTARY CONCENTRATE MIXTURES FOR NALI LAMBS, ON MEAT QUALITY AND QUANTITY*

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ABSTRACT

The average dressing percentage, chemical composition, organoleptic evaluation and connective tissue content in the meat of 30 stall fed nali lambs (15 male and 15 females), randomly divided into 5 groups (6 in each with equal No. of male and females) received *ab lib* lucerne hay with supplementary concentrate mixtures having different levels of autoclaved poultry excreta (APE), were compared. In supplementary concentrate mixtures the groundnut cake protein from control ration was replaced by APE at 100, 75, 50 and 25 per cent levels which was about 28, 21, 14 and 7 per cent of the ration. Incorporation of APE upto 21 per cent in lamb ration did not affect the dressing percentage much but addition at higher level seems to reduce the carcass yield significantly. The carcass yield in male and female lambs of the same group did not differ significantly except APE 50 where it was significantly lower in males than female lambs. Inclusion of APE even upto 28 per cent did not have any effect on chemical composition of meat. However, a significantly higher crude protein content in the meat of male lambs than females, may be attributed to sex difference. Organoleptic evaluation and connective tissue content of meat also have shown that the APE incorporation in lamb rations did not have any adverse effect on meat quality and was comparable to that of control diet.

There are some isolated reports (Bhatia, 1971; Srivastava and Roy, 1971) indicating that supplemental feeding improved the mutton production. Using concentrates for supplementary feeding to sheep is costlier and this offers competition to human beings So to economise the supplemental feeding for sheep, it is necessary to use cheaper agro-industrial byproducts/wastes in concentrate mixtures. Poultry waste has been shown to be good source of nitrogen for ruminants (Rodrigues and Zorita, 1967; El-Sabban *et al*, 1970; Fontenot *et al.*, 1971). Incorporation of these wastes in the rations of sheep and beef cattle did not affect the carcass yield significantly (Cuevas, 1969; Fontenot *et al.*, 1971; Denisov *et al.*, 1973; Meregalli *et al.*, 1971). In the light of above

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reports this work was undertaken to study the effect of incorporation of autoclaved poultry excreta (APE) in the supplementary ration of growing lambs on carcass quality and quantity.

MATERIAL AND METHODS

Thirty weaned nali lambs ($3\frac{1}{2}$-4 months old) comprising of 15 male and 15 females were randomly divided into 5 groups consisting of 6 lambs in each (3 male and 3 females) in a long term feeding trial lasting 16 weeks. The lambs were housed in individual stalls provided with mangers and water buckets. Details of supplementary concentrate rations provided to the lambs and chemical composition of rations is given in Tables 1 and 2, respectively. The control ration consisted of 16% crude protein having groundnut cake as a protein source. In experimental rations the crude protein from groundnut cake was replaced by autoclaved poultry excreta (APE) at 100, 75, 50 and 25% levels which was 27.26, 20.47, 13.63 and 6.79% of the ration. The rations were isonitrogenous and nearly isocaloric. As poultry excreta was rich in calcium and phosphorus, the

TABLE 1

Composition of supplementary rations (% air dry basis)

Sr. No.	Ingredients	Control	APE 100	APE 75	APE 50	APE 25
1.	Groundnut cake	24.39	—	6.07	12.19	18.31
2.	Autoclaved-poultry excreta	—	27.26	20.47	13.63	6.79
3.	Wheat bran	16.00	16.00	16.00	16.00	16.00
4.	Barley	20.00	20.00	20.00	20.00	20.00
5.	Maize	27.61	25.74	26.46	27.18	27.90
6.	Molasses	9.00	9.00	9.00	9.00	9.00
7.	Bone meal	1.00	—	—	—	—
8.	Biomindif	1.00	1.00	1.00	1.00	1.00
9.	Common salt	1.00	1.00	1.00	1.00	1.00
		100.00	100.00	100.00	100.00	100.00

TABLE 2

Chemical composition of lucerne hay, APE and supplementary rations (% dry matter basis)

Sr. No.	Nutrients	Lucerne hay	Autoclaved poultry excreta	Control	APE 100	APE 75	APE 50	APE 25
1.	Dry matter	96.67	92.75	94.27	94.04	94.37	94.29	94.00
2.	Crude protein	19.40	34.10	16.10	16.80	16.27	16.45	16.45
3.	Ether extract	3.60	2.58	6.10	5.02	5.65	5.50	5.80
4.	Crude fiber	30.50	13.10	8.80	9.90	9.05	8.90	10.50
5.	Nitrogen free extract	35.41	17.53	61.53	54.03	57.96	60.00	58.01
6.	Ash	11.09	24.52	7.47	14.25	11.07	9.16	9.24
7.	Calcium	3.70	6.00	2.87	4.88	3.71	3.30	1.90
8.	Phosphorus	1.40	3.30	1.90	2.65	2.40	2.25	1.95

control ration was balanced for calcium and phosphorus by adding bone meal. The animals were given weighed quantity of supplementary rations (100 g first 12 days, 200 g next 60 days and 250 g for last 40 days per head per day). Lucerne hay and water was provided *ad lib.*

Carcass evaluation

At the end of the experimental period all the animals were slaughtered in 6 lots of 5 each on alternate days for carcass quantity and quality evaluation. Eighteen hours prior to the slaughter the feed and water were withdrawn. Body weights were recorded before slaughter. The net meat yield was determined. The samples of gastrocnemius and lower portion of longisimus dorsii muscles were dissected out and kept in plastic bags sealed and preserved in deep freezer for further chemical analysis.

Organoleptic evaluation

The procedure for the organoleptic test of Cole and Lawrie (1975) was followed with slight modification. The meat samples from each animal were cut into small uniform pieces. These meat pieces from each animal were wrapped in aluminium foils and cooked in oven at 180°C for three hours, after which they were allowed to cool and offered to judges. The judges comprised of 6 individuals of almost same age (26-28 years). The characters which were taken into consideration were colour, flavour, tenderness, chewing, fragmentation, juicyness, and residue. Each character was further subdivided into 9 criteria, such as very acceptable (9), acceptable (8), slightly acceptable (7), medium acceptable (6), neither acceptable nor non-acceptable (5), slightly non-acceptable (4), moderately non-acceptable (3), non-acceptable (2), very non-acceptable (1), bearing marks mentioned against each character. If the sample was the best in a particular character, that was considered to score 10/10. The meat was evaluated for each character and also for total score.

Connective tissue

The score obtained in organoleptic evaluation was compared with the chemical method by estimating the connective tissue. The longisimus dorsii muscle of each animal after thawing was cut into small pieces. Total nitrogen was determined by micro-kjeldahl procedure. The connective tissue content was estimated by method of Bailey, (1954).

Analytical methods

Samples of feed and meat were analysed for proximate constituents according to AOAC (1970) methods. Calcium and phosphorus in supplementary rations, lucerne hay and APE were estimated by methods suggested by Talpatra *et al.* (1940).

The data were subjected to analysis of variance (Snedecor and Cochran, 1968). Differences among treatment means were tested for significance by Duncan's new multiple range test (Steele and Torrie, 1960).

RESULTS AND DISCUSSION

Carcass evaluation : Average dressing percentage

Average dressing percentage (including edible organs) for different groups, male and female lambs of each group alongwith average daily gain are given in Table 3. The highest dressing percentage was obtained in APE 50 (46.64) and

TABLE 3

Average body weight gains and dressing percentage of lambs

Sr. No.	Body weight and carcass weight	Control	APE 100	APE 75	APE 50	APE 25
1.	Initial weight (kg) (Group)	11.68	11.31	12.16	13.58	11.34
2.	Final weight (kg) (Group)	21.91	18.11	19.60	24.43	19.64
3.	Daily gain (g) (Group)	95^{a}	64^{b}	71^{ab}	100^{a}	79^{ab}
4.	Dressing (%) (Group)	45.19^{a}	41.82^{b}	44.52^{ab}	46.64^{a}	45.19^{a}
	(i) Male	47.49	42.94	44.98	44.43^{a}	45.43
	(ii) Female	44.32	40.70	44.56	48.95^{b}	44.95

Means superscript with different letters in a row and on columns differed significantly ($P<0.05$)

was followed in that order by control (45.91), APE 25 (45.19), APE 75 (44.52) and APE 100 (41.82). The dressing percentage in control, APE 50 and APE 25 was alike but significantly higher than in APE 100. In APE 75 the dressing percentage was slightly higher than APE 100 and lower than other groups but differences were not significant. Average dressing percentage differed slightly among male and female lambs of control, APE 100, APE 75 and APE 25, but the female lambs of APE 50 had significantly ($P<0.05$) higher carcass yield than male lambs. In this study the addition of poultry excreta upto 21% in lamb ration did not affect the dressing percentage significantly but addition at higher level seems to reduce the carcass yield. Similarly, Cuevas (1969) reported that there was no significant differences in carcass yield where cotton seed meal was replaced with dried poultry manure only upto 15% in fattening wethers. On contrary to this Fontenot *et al.* (1971) observed that the carcass yield and back fat thickness of lambs were not significantly affected even upto 50% broiler litter in lamb rations. In case of cattle, Denisov *et al.* (1973) noted that the slaughter yield in cattle was higher for the groups given 15 or 25% poultry droppings. Meregalli (1971) reported that there were no differences between groups in carcass yield when soyabean meal was replaced by 25% dried poultry droppings to fattening bulls.

Chemical composition of meat

The chemical analysis of meat for dry matter, crude protein, ash and ether extract for the whole groups as well as for male and female lambs in each groups are presented in Table 4. Although the dry matter, ash and ether extract content of meat differed slightly for all treatments but no significant differences were observed either due to treatment or due to sex. The crude protein content of meat did not vary significantly in control and experimental groups. Crude protein content in meat of male lambs was significantly ($P<0.05$) higher than female lambs in all groups, except that in APE 50 in which it was not significantly different.

These findings reveal that the incorporation of poultry excreta does not have any effect on chemical composition of meat, except significantly ($P<0.05$) higher crude protein content in meat of male lambs than females, which may be attributed to the sex differences.

TABLE 4

Protein, fat and ash contents of meat (DM basis)

Sr. No.	Nutrients		Control	APE 100	APE 75	APE 50	APE 25
1.	Dry matter	Group	25.36	23.33	25.48	26.69	26.18
		Male	25.14	22.33	25.26	25.34	26.[illegible]
		Female	25.59	23.93	25.70	28.05	26.19
2.	Crude protein	Group	69.92	72.25	75.10	73.86	72.66
		Male	72.62[a]	75.39[a]	77.87[a]	74.37[a]	75.20[a]
		Female	67.22[b]	69.12[b]	72.33[b]	73.85[a]	70.12[b]
3.	Ash	Group	3.45	2.65	3.41	2.74	2.73
		Male	4.35	2.62	3.20	2.57	2.98
		Female	2.55	2.69	3.63	2.92	2.48
4.	Ether extract	Group	16.76	14.32	13.93	13.19	14.13
		Male	16.90	14.11	11.18	13.93	13.36
		Female	16.63	14.53	14.76	13.46	14.13

Means superscript with different letters differed significantly ($P<0.05$) on vertical columns

TABLE 5

Average dry matter consumption, cost of ration and cost of meat production

Sr. No.		Control	APE 100	APE 75	APE 50	APE 25
1.	Dry matter consumed (kg) Lucerne hay*	61.82	55.44	59.69	70.66	58.80
	Concentrate mixture	23.18	22 37	22.96	23.18	23.18
2.	Cost of concentrate mixture/ 100 kg (Rs.)	99.00	63.00	71.90	81.00	90.00
3.	Cost of meat production (Rs./kg)	4.53	4.26	4.05	3.92	4.43

*Cost of lucerne hay Rs. 30/- per quintal

Organoleptic test and connective tissue

The average per cent score for control was higher (72.22) than experimental groups values which ranged from 66.60-69.08; but the differences were not significant. Similarly, there was no significant difference due to sex, although slight differences were observed. The average values of connective tissue content of longisimus dorsii muscle were in the range of 0.80-0.96, 0.79-0 92 and 0.80-1.07 in groups, male and female lambs, respectively. No significant differences either due to treatments or due to sex were observed in the connective tissue content of meat samples. As far as quality of meat is concerned our findings are in line with the reports of Fontenot *et al.* (1971) and Merwe *et al.* (1975) in lambs; and Drake *et al.* (1965), El-Sabban *et al.* (1970), Muftic *et al.* (1969, 1970), Meregalli *et al.* (1971), Batsman (1973) and Mattos *et al.* (1974) in cattle, when the poultry waste was incorporated in the animal rations.

Economics of meat production

Dry matter consumed from lucerne hay, concentrate mixture and relative economics of meat production on different experimental rations is presented in

Table 5. The cost of meat production/kg was lowest in APE 50 and was followed in that order by APE 75, APE 100, APE 25 and was highest in control. It indicates that the cost of meat production was reduced when APE was incorporated in lamb rations. It was substantially less than control in APE 50 ration which had about 14% APE.

These findings based on organoleptic, chemical and economic evaluation of meat indicate that the poultry excreta incorporated rations does not have any adverse effect on meat quality and produces the meat of as good quality as produced on control ration containing groundnut cake and per unit cost of meat production is reduced.

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REFERENCES

A.O.A.C. 1970. Official Methods of Analysis. 11th ed. Association of Official Analytical Chemists, Washington, D. C.

Bailey, K. 1954 *The Proteins*. ed. Neurath, M. and Bailey, K. Vol. II, Part B. Academic Press, Inc., New York.

Batsman, V. 1973. Dried poultry droppings in feeds for cattle. *Molochnoe, Myasnoe Skotovodstvo*. 6 : 28-29 *(Nutr. Abstr. Rev.* 44 : 477*)*.

Bhatia, D. R. 1971. Effect of supplementary feeding of concentrate mixture with two levels of energy and protein on growth and carcass yield of Malpura lambs. Central Sheep and Wool Research Institute. Ann. Rpt. pp. 42-43.

Cole, D. J. A. and Lawrie, R. A. 1975. *Meat*. Butterworth and Co., Ltd., London.

Cuevas, S. 1969. Poultry droppings as a source of protein for fattening sheep. *Rev. Mex. Prod. Anim*, 2: 27-30. *(Nutr. Abstr. Rev.* 40 : 693*)*.

Denisov, N. I., Kirilov, M. P. and Sorokin, N. A. 1973. Processed poultry droppings in feeds. *Zhivotnovodstvo* 2 : 45-47. *(Nutr. Abstr. Rev.* 44 : 66*)*.

Drake, C. L., McClure, W. H. and Fontenot, J. P. 1965. Effects of levels and kind of broiler litter for fattening steers. *J. Anim. Sci.* 24 : 879 (Abstr.).

El-Sabban, F. F., Bratzler, J. W., Long, T. A., Frear, D. E. H. and Gentry, R. F. 1970. Value of processed poultry waste as feed for ruminants. *J. Anim. Sci.* 31 : 107-11.

Fontenot, J. P., Webb, K. E., Libke, K. G. and Buchler, R. J. 1971. Performance and health of ewes fed broiler litter. *J. Anim. Sci.* 33 : 283 (Abstr.).

Mattos, J. C., Periera, W. M , Barbosa, C. and Compos, B. 1974. Live weight grain and carcass quality of young crossbred bulls reared on pasture and in confinement on rations based on poultry droppings and residues from maize threshing. *Bol. Ind. Anim.* 31 : 173-84 *(Nutr. Abstr Rev.* 46: 572).

Meregalli, A., Olivetti, A., Antongiovanni, M., Sottini, E. and Aleandri, M. 1971. Dried poultry droppings for production of light cattle. *Aliment. Anim.* 15 : 37-50 *(Nutr. Abstr. Rev.* 42 : 313).

Merwe, H. J. Vander, Pretorius, P. S. and Toit, J. E. J. DU. 1975. Use of poultry droppings in growing rations for lambs. *Agro-animalia* 7 : 65-68 *(Nutr. Abstr. Rev.* 46 : 1035).

Muftic, R. I., Dzinic, M and Bugarski, D. 1969. Broiler litter as basic ingredient of rations in the fattening and pre-fattening of young Black Pied cattle. 4. *Veterinaria (Sarajevo)* 18 : 467-72 *(Nutr Abstr. Rev.* 41 : 268*)*

Muftic, R., Dzinic, M. and Bugarski, D. 1970. Broiler litter as basic ingredient of rations for fattening young cattle. 5. *Veterinaria (Sarajevo).* 19 : 311-14. *(Nutr. Abstr. Rev.* 41 : 1072*)*.

Rodrigues, G. J. and Zorita, T. E. 1967. Poultry droppings for feeding ruminants. 2. Trials with growing cattle. *Rev. Nutrition animal, Madrid.* 5 : 25-35 *(Nutr. Abstr. Rev,* 38 : 1336*)*.

Snedecor, G. W. and Cochran, W. G. 1968. *Statistical Methods.* 6th ed. Allied Pacific, Bombay.

Srivastava, V. K. and Roy, A. 1971. The influence of season, birth age and nutrition on the organ weights of Magra lambs. *Indian J. Anim. Sci.* 41 : 1060-65.

Steele, R. G. D. and Torrie, J. H. 1960. *Principles and Procedures of Statistics.* McGraw Hill Book Co , New York.

Talpatra, S. K., Ray, S. C. and Sen, K. C. 1940. Estimation of phosphorus chlorine, calcium, magnesium, sodium and potassium in food-stuffs. *Indian J. Vet. Sci.* 10 : 243-58.

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A NOTE ON THE PERFORMANCE OF CORRIEDALE X NALI CROSSBRED LAMBS UNDER FEED LOT EXPERIMENT

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ABSTRACT

Data pertaining to growth, wool and mutton characteristics were collected from the feed lot experiment on post weaning male lambs of Corriedale and Nali crosses. The average growth rate at different ages were found superior in case of suckled lambs compared to milk fed lambs. The postweaning daily gain was found better in milk fed animals compared to suckled lambs. The staple length, fibre length, number of crimps per two centimeter, fibre diameter and medullation percentage were 5.45±0.20 cm, 7.75±0.27 cm, 4.65±0.23, 27.70 μ and 22%, respectively. The average grease fleece weight at six month of age was more in suckled lambs than milk fed ones. The dressing percentage in suckled and milk fed lambs were 41.52 and 40.07, respectively. The average of various carcass cuts and meat bone ratio were studied and suckled lambs were found superior to milk fed in these traits. There was no difference between the two groups for the growth of liver and kidney.

Nali is the famous carpet wool producing breed of sheep predominantly found in Haryana State. The production in terms of better wool quality and heavier lambs is low in comparison to exotic animals. So, to improve these traits cross breeding with exotic breed viz , Corriedale rams was undertaken. In this investigation, attempts were made to study the performance of Corriedale × Nali crosses for growth, wool and mutton characteristics under feed lot experiment.

MATERIAL AND METHODS

The experiment was conducted in the sheep breeding section of the Animal Breeding Department, Haryana Agricultural University, Hissar. Thirty three Corriedale × Nali half bred male lambs were put to feed lot experiment for the period of three months after weaning at 90 days of age. In the preweaning period, 23 lambs were allowed to suckle their dams upto 90 days and the remaining 10 lambs were fed cow milk artificially. They were fed with 250 g of concentrate (150 g in the morning and 100 g in the evening) having 14% DCP and 75% TDN The green fodder supplied during the experimental period was green bajra and anjan grass which was given *ad lib.* to all animals. The animals were weighed regularly at an interval of 15 days upto 6 months period and daily gain weight was calculated upto this age. The meat component was studied

by slaughtering animals at 6 months age. The laboratory technique followed for meat component study was as described by Chowdhary (1973). Wool samples were collected from the left mid-side region of the lambs at 6 months of age. The analysis of the fleece traits was carried out according to the standard procedure at the wool laboratory of this department. The statistical analysis was done according to the procedure described by Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

The average body weight of lambs at different ages are presented in Table 1. The perusal of the table indicated that the average body weight at different ages in case of milk fed lambs were less in comparison to suckled lambs. The overall average weights at weaning, 4th month, 5th month, and 6th month were found to be 10.47±0.53, 11.75± 0.44, 13.86±0.48 and 15 38±0.54 kg, respectively. The preweaning and post-

TABLE 1

Average values on growth, body measurements and wool traits in Corriedale X Nali, (CN) lambs from weaning to 6 month of age

Parameters	CN	CN (milkfed)	Overall
1. Wt. at weaning (kg)	13.74±0.48	7.20±0.54	10.47±0.53
2. Wt. at 4th month (kg)	14.74±0.43	8.75±0.58	11.75±0.44
3. Wt. at 5th month (kg)	16.91±0.42	10.82±0.68	13.86±0.48
4. Wt. at 6th month (kg)	18.17±0.49	12.58±0.78	15.38±0.54
5. Preweaning daily gain (g)	121.00	43.50	82.25
6. Postweaning daily gain (g)	52.54	58.32	55.43
7. Body length (cm)			
a) Weaning	48.26±0.6	39.90±0.76	44.03±0.71
b) 4th month	53.50±0.68	43.30±0.91	48.30±0.72
c) 5th month	57.64±0.73	48.00±0.95	52.82±0.81
d) 6th month	60.74±0 61	52.40±1.13	56.57±0.87
8. Wither height (cm)			
a) Weaning	48.65±0.67	40.30±0.73	44.43±0.67
b) 4th month	51.43±0.69	42.70±0.68	47.07±0.64
c) 5th month	53.69±0.59	45.60±0.61	49.64±0.59
d) 6th month	55.39±0.62	48.56±1.09	51.88±0.67
9. Grease fleece wt. (kg)	1.14±0.05	0.74±0.08	0.94±0.05
10. Staple length (cm)	—	—	5.45±0.20
11. Fibre length (cm)	—	—	7.75±0.27
12. Crimps/2 cm	—	—	4.65±0.23
13. Fibre diameter (μ)	—	—	27.70
14. Medullation %	-	-	22.00

weaning daily gain in suckled and milkfed lambs were 121.0, 43.50 g and 52.54, 58.32 g, respectively.

The daily gain in milk fed lambs during preweaning period was low compared to suckled lambs, whereas in the postweaning period the rate of gain was more in case of milkfed lambs under similar environmental conditions. It indicates that the milkfed animals had the potentiality for growth but due to non availability of mother's milk their gain was inferior to the suckled lambs during preweaning period. The average daily preweaning gain in Indian sheep ranged between 24 g in Bihar sheep to 103 g in Muzaffernagari breed with an average of 86.6 g. The postweaning gain ranged between 33 g in Nellore to 77 g in Muzaffernagari (Anonymous, 1975).

Body Measurements

The body measurements with respect to body length and height at wither, at weaning, 4th month, 5th month and 6th month in suckled and milkfed lambs are presented in Table 1. The superiority of suckled lambs was also observed in these characters. The overall averages of body length and height at weaning, 4th month, 5th month and 6th month were 44.03±0.71, 44.43±0 67, 48.30±0.72, 47.07±0.64, 52.82±0.81, 49 64±0.59 and 56.57±0.87, 51.88±0.67 cm, respectively. The result presented here indicate longer body length and height in wither than the results reported by Singh *et al.* (1971) in Nali X Nali, Nali X Nellore and Nali X Mandya.

Fleece Traits

The average grease fleece weights in the suckled and milkfed lambs at 6th month of age are presented in Table 1. The overall average was 0.94±0.05 kg. The correlation of the grease fleece weight with the body weight at 6th month of age was calculated and it was found significant (0.41). Other workers have also reported similar results (Chopra and Chopra, 1972 and Wadyal and Balaine, 1971). Wool yield is the function of the surface area of the animal. The surface area and body weight are highly correlated. So, the heavier sheep are expected to produce more wool. As there was no difference in wool characteristics between the milkfed and suckled lambs, the data were pooled for calculating average values. The staple length, fibre length, number of crimps per two centimeters, fibre diameter and medullation percentage were observed as 5.45± 0.20 cm, 7.75±0.27 cm, 4.65±0.23, 27.70 μ and 22%, respectively (Table 1). These observations are on the lower side of the findings as reported by Sri Ram *et al.* (1978) for staple length and fibre length, whereas the number of crimps reported here are on higher side.

Mutton Traits

The average values for the different carcass traits have been presented in Table 2. It was noted that the suckled lambs were superior to milkfed lambs in almost all traits. The dressing percentage in suckled and milkfed lambs was obtained to be 41.52 and 40.07 having an overall average of 40.79. The results revealed a significant positive correlation (0.97) between live weight and dressing weight (Table 3). So, there was an increase in carcass weight with increase in live weight. Similar results were reported by Acharya (1966), and Erokhin and Shatskii (1971).

TABLE 2

Average values for carcass characteristics in CN lambs

Genetic group	Dressed carcass wt. (kg)	Dressing percentage	Fore Saddle		Hind Saddle		Edible organ		Meat bone ratio
			Neck & fore limb (kg)	Thorax & brisket (kg)	Loin-flank (kg)	Thigh-Croup (kg)	Liver (kg)	Kidneys (kg)	
CN	6.49±0.27	41.52	2.05±0.09	1.72±0.06	0.45±0.02	2.36±0.12	0.200±0.01	0.060±0.06	3.33
CN (milkfed)	4.56±0.33	40.07	1.46±0.09	1.20±0.09	0.32±0.12	1.58±0.12	0.190±0.03	0.040±0.60	2.58
Overall	5.73±0.29	40.79	1.81±0.09	1.61±0.09	0.40±0.03	2.03±0.12	0.190±0.03	0.060±0.00	2.78

TABLE 3

Correlation between body weight at 6th month with wool and carcass traits

	Wool weight at 6th month	Dressing weight	Fore saddle	Hind saddle
Live wt. at 6th month	0.41	0.96	0.97	0.84
Dressing weight	—	—	0.99	0.47
Fore saddle	—	—	—	0.94

Carcass Cut

The averages of various cut have been presented in Table 2. The overall averages were 1.81 ± 0.09, 1.61 ± 0.09, 0.40 ± 0.03 and 2.03 ± 0.12 kg for neck and fore limb, thorax and brisket, loin and flank, and thigh and croup, respectively. The correlation study was performed between live weight at 6th month of age with fore and hind saddle and also between the two saddles. The relationship was found positively significant. The result also indicated little difference between the two quarters. This is in conformity with the observation of Rouse *et al.* (1970) who reported symmetry in sheep carcasses.

The meat bone ratio in the suckled and milkfed lambs were estimated as 3.33 : 1 and 2.58 : 1 (Table 2). The results indicate that the proportion of actual edible meat was more in case of suckled lambs compared to milkfed lambs. The means of liver and kidney alongwith their standard error are given in Table 2. There was no difference in this character in suckled as well as milkfed lambs. It revealed that the development of the organs were related with age rather than the body weight of the lambs.

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REFERENCES

Acharya, R. M. 1966. Proceeding of Seminar on Animal Breeding. Indian Council of Agricultural Research, Calcutta.

Anonymous 1975. Proceeding of the Third Workshop on All India Coordinated Research Project (sheep breeding), Palampur.

Chopra, S. C. and Chopra, S. C. 1972. Factors affecting wool characteristics in Nali and Lohi sheep. *Indian J. Anim. Sci.* 42 : 393-96.

Chowdhary, S. S. 1973. Evaluation of carcass traits in Nali, Lohi, Magra and Hissardale X Magra breed of sheep. M. Sc. thesis, Haryana Agricultural University Hissar.

Erokhin, A. I. and Shatskii, A. D. 1971. The effectiveness of crossing fine/coarse wooled ewes with meat wooled ram in Bashkir. *U. S. S. R. Zhivot novodstvo* 33 : 57-59. (*Anim Breed. Abstr.* 40 : 4554).

Rouse, G. H., Topal, D. G., Vetter, R. L., Rust, R. E. and Wickersham, T. W. 1970. Carcass composition of lambs at different stages of development. *J. Anim. Sci.* 31 : 848-55.

Singh, J., Balaine, D. S. and Kanaujia, A. S. 1971. Physical measurements and their relationship with the dresses carcass weight in post weaning fattened Nali and Lohi lambs and their crosses with Nellore and Maddya. *Indian Vet. J.* 48 : 773-79.

Snedecor, G. W. and Cochran, W. G. 1968. *Statistical Methods.* Allied Pacific Private Ltd., Bombay.

Sri Ram, Balbir Singh, Balaine, D. S. and Chopra, S. C. 1978. A note on fleece characteristics of Nali purebred and its crosses with corriedale. *Indian Vet. J.* 55 : 403-10.

Wadyal, S. S. and Balaine, D. S. 1971. Studies on physical measurements, body weight and fleece weight in Nali and Lohi sheep. *Indian J. Anim. Sci.* 41 : 671-74.

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SOME OBSERVATIONS ON THE CARDIOVASCULAR DYNAMICS OF BUFFALOES (*B. BUBALIS*)

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ABSTRACT

A study was undertaken to record some of the cardiovascular parameters in healthy buffalo calves of about one year in age. The average values recorded in respect of different parameters were : cardiac out put, 14.96 l/min (119.88 ml/kg/min); cardiac index, 5.56 l/min/m^2; stroke volume, 253.99 ml; stroke index, 2.06 ml/kg; left ventricular minute work, 25.74 kg/m/min; right ventricular minute work, 3.69 kg/m/min; left ventricular stroke work, 0.45 kg/m/stroke; right ventricular stroke work, 0.063 kg/m/stroke; systemic peripheral resistance, 1.03 PRU/kg (671.49 dynes sec/cm^{-5}); Pulmonary vascular resistance, 0.14 PRU/kg (93.08 dynes sec/cm^{-5}); carotid artery pressure 122 mm Hg; left ventricular pressure 123 mm Hg; Jugular pressure 5 mm Hg; right auricular pressure 11 mm Hg; right ventricular pressure 27 mm Hg; and pulmonary artery pressure 17 mm Hg.

Comparative physiology has much to contribute to our understanding of the circulation. There have been only a few reported studies on some aspects of cardiovascular functions in normal cattle (Doyle *et al.*, 1958; Fisher and Dalton, 1961) and in buffaloes (Sodhi and Singh, 1973; Bhutani and Nangia, 1976; Rao, 1977). An attempt was made to record observations on some of the normal cardiovascular hemodynamics in normal buffalo calves.

MATERIAL AND METHODS

Six healthy buffalo male calves of about one year of age having body weight in the range of 80 to 135 kg were maintained and fed under standard feeding and management practices. The dye dilution technique of Fisher and Dalton (1961) using T 1824 (Evans blue) was adopted for inscription of the indicator dilution curve and subsequent determination of cardiac output.

The intra vascular and intra cardiac pressures were recorded by the help of radio-opaque cardiac catheter (7 F NIH tip) connected to mercury manometer in conjunction with kymograph. The position of the catheter at a particular site was confirmed under fluoroscopy. Frequent thoracic radiography was performed to confirm the position of catheter. Jugular vein and carotid artery were used for measuring pressure on the right and left side of the heart, respectively. Cardiac output, cardiac index, stroke volume and stroke index were

calculated by the formulae described by Bhutani and Nangia (1976). Peripheral resistance was determined in dynes sec/ cm^{-5} (Best and Taylor, 1975) and as mm Hg/ml/min kg body weight (Ringer *et al.*, 1974). Pulmonary vascular resistance was calculated by substituting mean pulmonary artery pressure (mm Hg) with mean arterial pressure. Ventricular work was calculated by the formulae described by Liu (1965).

Left and right ventricular stroke work (kg/m/stroke) were calculated by dividing the ventricular minute work by heart rate (beats/min), respectively.

RESULTS AND DISCUSSION

The mean values of the various parameters studied have been presented in Table 1.

The mean values of cardiac output and cardiac index were found to be 14.96 l/min (119 88 ml/kg/min) and 5.56 l/min/m^2, respectively. These values fell in the range of values reported by Sodhi and Singh (1973) and Bhutani and Nangia (1976).

The mean values of intra vascular and intra cardiac pressures (mm Hg) were; jugular venous pressure, 5.0; right

TABLE 1

Mean values alongwith standard errors of various parameters of cardiovascular dynamics in buffalo calves

Parameters	Units	Mean values	Standard errors	Range
Cardiac output	(l/min)	14.96	1.50	11.50-20.76
Cardiac output	(ml/kg/min)	119.88	6.30	105.50-144.16
Cardiac index	(l/min/m^2)	5.56	0.24	4.84-6.31
Stroke volume	(ml)	253.99	18.47	214.42-310.45
Stroke index	(ml/kg)	2.06	0.10	1.79-2.28
Left ventricular work	(kg/m/min)	25.74	2.77	17.82-34.63
Right ventricular work	(kg/m/min)	3.69	0.48	2.94-5.06
Left ventricular work	(kg/m/stroke)	0.45	—	0.32-0.64
Right ventricular work	(kg/m/stroke)	0.06	—	0.04-0.09
Total peripheral resistance systemic	(PRU/kg)	1.03	0.06	0.08-1.17
Systemic	(dynes Sec/cm^{-5})	671.49	54.26	431.17-750.54
Pulmonary	(PRU/kg)	0.14	0.01	0.12-0.16
Pulmonary	(dynes sec/cm^{-5})	93.08	6.21	65.44-103.87
Carotid artery pressure	(mm Hg)	122.00	6.14	108.00-143.00
Left ventricular pressure	(mm Hg)	123.00	12.85	67.5-143.00
Jugular pressure	(mm Hg)	5.00	0.75	4.00-8.00
Right auricular pressure	(mm Hg)	11.00	1.32	7.00-15.00
Pulmonary artery pressure	(mm Hg)	17.00	0.89	14.00-20.00
Right ventricular pressure	(mm Hg)	27.00	2 96	20.00-37.00

arterial pressure, 11.0; right ventricular pressure, 27.0; pulmonary artery pressure, 17.0; carotid artery pressure, 122.0 and left ventricular pressure, 123.0. The mean values recorded here fell in the range of values reported by Rao (1977) in buffalo males.

The resistance to blood in the pulmonary circulation was about one seventh that of the systemic circulation. This might be due to the fact that there were no high resistance arterioles, the pulmonary capillaries were large and numerous, the pulmonary vessels were easily distended passively and large portions of the pulmonary bed were only partially used normally (Best and Taylor, 1975). The work performance of the left ventricle was much higher than that of right ventricle which was quite understandable.

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REFERENCES

Best, C. H. and Taylor, N. B. 1975. *The physiological basis of medical practice*. 9th ed. The Williams and Wilkins Co., Baltimore.

Bhutani, R. K. and Nangia, O. P. 1976 Cardiac output in buffalo-calves. *Indian J. Anim. Sci.* 46 : 113.

Doyle, J. T , Patterson, J. L. Jr., Warren, J. V., Detweiler, D. K. and Reynolds, M. 1958. Hemodynamics observations on the cow. *Fed. Proc.* 17 : 38.

Fisher, E. W. and Dalton, R. G. 1961. Determination of the cardiac output of cattle and horses by injection method. *Br. Vet. J.* 117 : 143.

Liu, C. K. 1965. In examination of the cardiac patients. ed. Luisada, A. A. 1965. McGraw Hill Book Co., New York.

Rao, Ramakrishana O. 1977. Studies on cardiac surgery following traumatic pericarditis in bovines. Ph. D. thesis, Haryana Agricultural University, Hissar.

Ringer, R. K., Aulerich, R. J. P., Hmen, R. and Coegger, E. A. 1974. Cardiac output, blood volume and other cardiovascular parameters in mink. *J. Anim. Sci.* 38 : 121.

Sodhi, S. P. S. and Singh, A. 1973. Cardiac output in buffalo-calves. *Indian J. Anim. Sci.* 43 : 128.

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PERITONEOGRAPHY BY DOUBLE CONTRAST IN CANINE

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ABSTRACT

Double contrast peritoneography using air and an aqueous contrast material was done. While in immediate radiographs, the peritoneal folds and the contours of the abdominal organs were visualised; in later radiographs, the parenchyma of the organs could be visualised. The method could be explored in the diagnosis of conditions involving structural and functional abnormalities of some abdominal organs.

Double contrast radiography is a technique in which a negative and a positive contrast material is combined and introduced to obtain more minute details of the area. The method is standardised for stomach as well as colon (Ichinkava, 1972). Rudy *et al.* (1968), exploiting the subject contrast of the thorax introduced pleurography which in effect gave almost the same effect as double contrast. Double contrast radiography does not seem to have been attempted in peritoneum though simple peritoneography has been attempted elsewhere (Meyers, 1970 and Doench *et al.*, 1973).

An attempt was made to visualise the peritoneum using a combination of air and 70% W/V sodium iothalamate* in normal dogs. The technique was further explored for visualization of some abdominal organs, following experimentally treated surgical disorders.

MATERIAL AND METHODS

Trials were conducted in 25 normal dogs of both sexes with average weight of 22 kg (5 kg to 30 kg). They were divided into 2 groups of 15 and 10. Double contrast peritoneography was done in 15 dogs in their normal state, 8 of them being anaesthetised and the rest awake. The animals were held vertically and 70% W/V sodium iothalamate was injected into the peritoneal cavity at the dose rate of 1 ml per kg body weight with a short 20 gauge needle. The needle was withdrawn after air was injected to create pneumoperitoneum. The animals were then slowly rolled so as to spread the contrast material and radiographs taken on left and right lateral recumbency as well as sternal recumbency at zero hour, $\frac{1}{2}$ h, 1 h, 2 h, 4 h, 6 h, 10 h, 24 h and then daily for 7 days.

In 10 animals conditions like renal artery occlusion, blockage of ureter,

*Conray 420-May & Baker Ltd., Bombay, India.

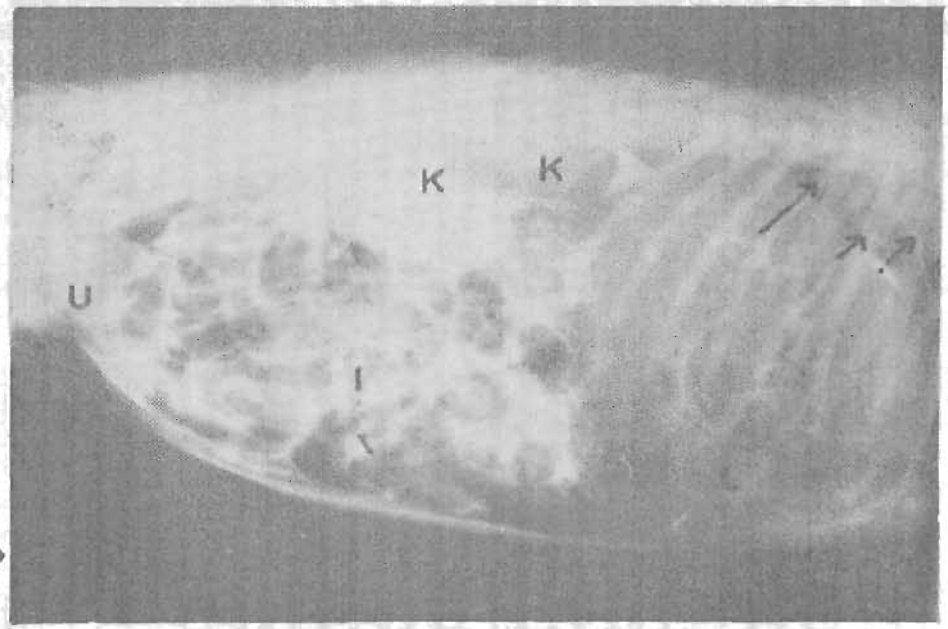


Fig. 1. Immediate (zero hour) radiograph showing the peritoneal folds and outlining some abdominal organs (L-liver, K-kidney, S-spleen, I-intestine, U-urinary bladder).

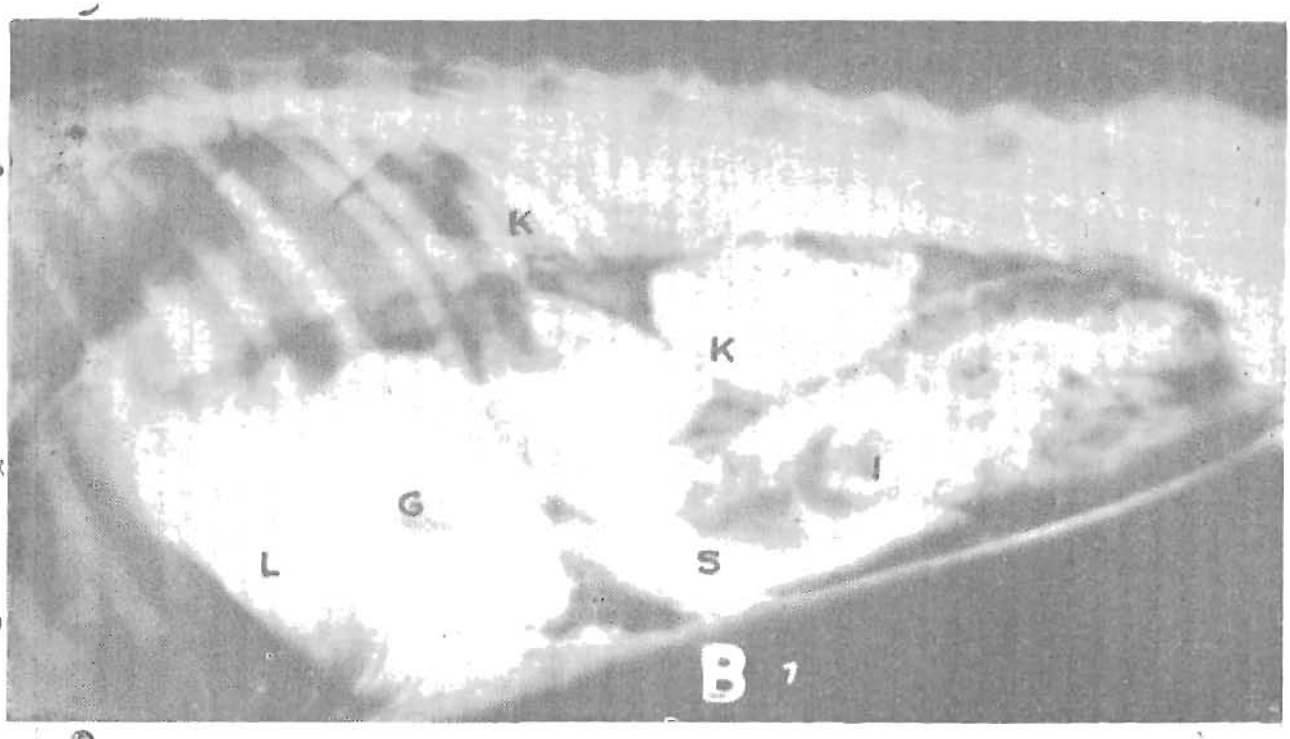


Fig. 2. Right lateral radiograph after 4 h. Note increased density of some abdominal organs (L-liver, S-spleen, K-kidney, G-gastrum, I-small intestine).

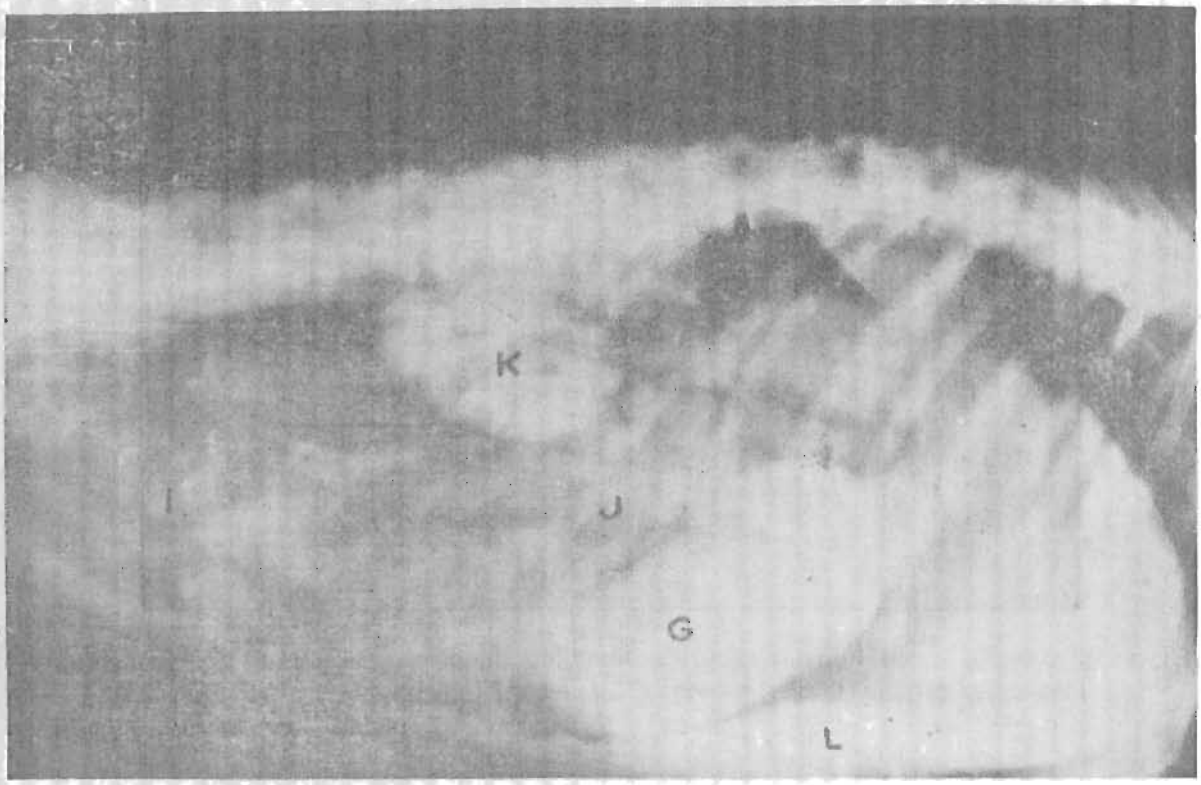


Fig. 3. The same on left lateral radiograph.

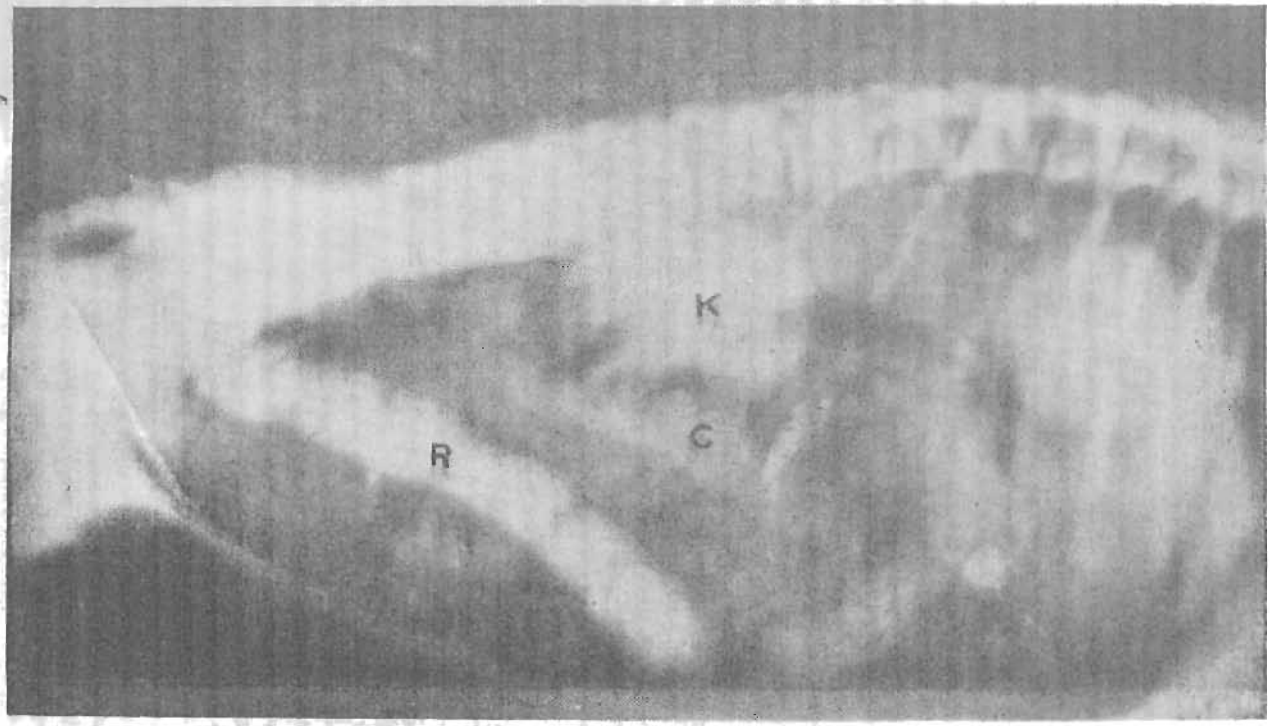


Fig. 4. A right lateral radiograph after 24 h showing prominently the lowel bower (K-kidney, G-gastrum, C-colon, R-rectum).

and extra-mural obstruction of intestine were created experimentally before double contrast peritoneography was done in the same manner described above.

RESULTS

All the animals tolerated the procedure without any apparent adverse reaction. Immediate skiagrams revealed contrast material lining the abdominal cavity and layering the organs therein, especially kidney and intestine. The loops of intestine and mesentric folds could be clearly visualised (Fig. 1). Depending upon the view and the position of the animal. the kidney, the liver and the intestine could be clearly visualised. In female, the genital organs could be visualised in vertical head-down position (Figs. 6 and 7).

Delayed radiographs showed the loss of definition, the material being evidently resorbed. Kidney and urinary bladder were marked simulating somewhat a picture of infusion urography. Four hour radiographs in most cases marked out the loops of jejunum and part of illum and the liver whose density had increased possibly due to the resorption of contrast material. The material was totally eliminated from the peritoneal cavity (Figs. 2 and 3). Elimination was slightly delayed in anaesthetised animals. Their bladder was less frequently evacuated.

On ten and twentyfour hour radiography the lower alimentrary canal, the colon and the rectum, became more prominent. The bowel walls were more radio opaque and stood out clearly against the air in the body cavity, like a pencil drawn diagram (Fig. 4). Renal excretion was almost insignificant after 24 h while the bowel wall retained the contrast often upto a week. The contents of the colon too had a tint of contrast material.

In the second group, where the renal artery was occluded, kidney was not

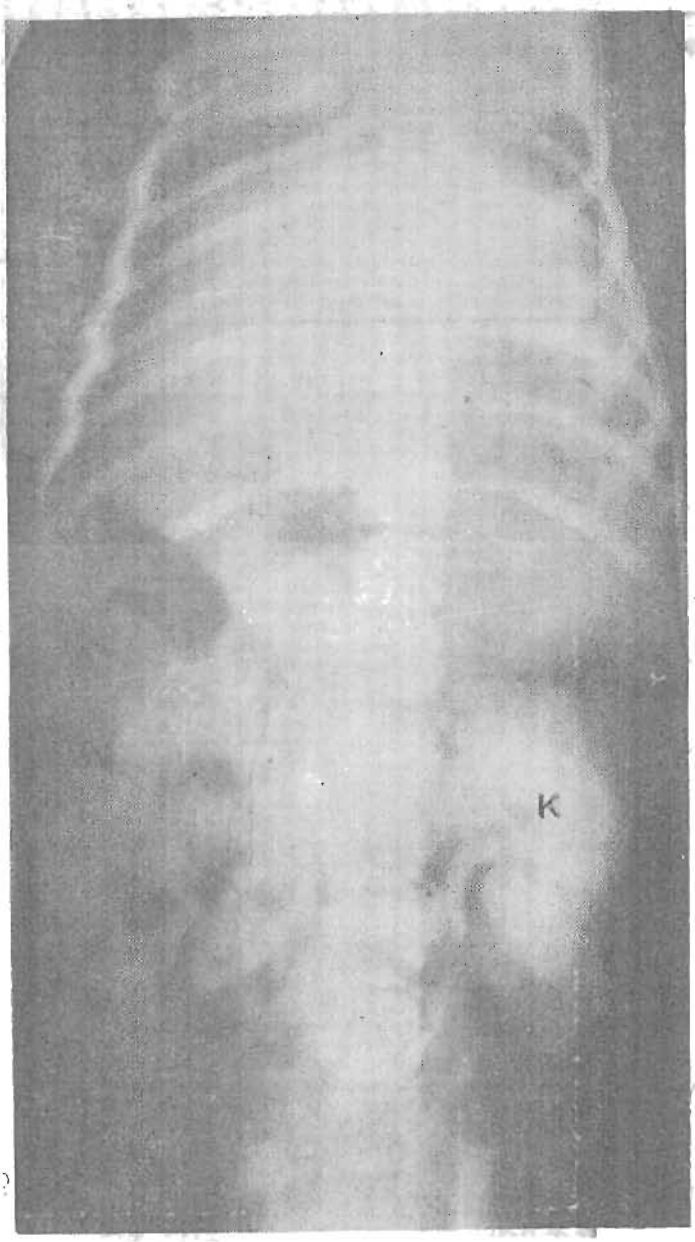


Fig. 5. A 4 h radiograph in animal with induced ureteral obstruction.

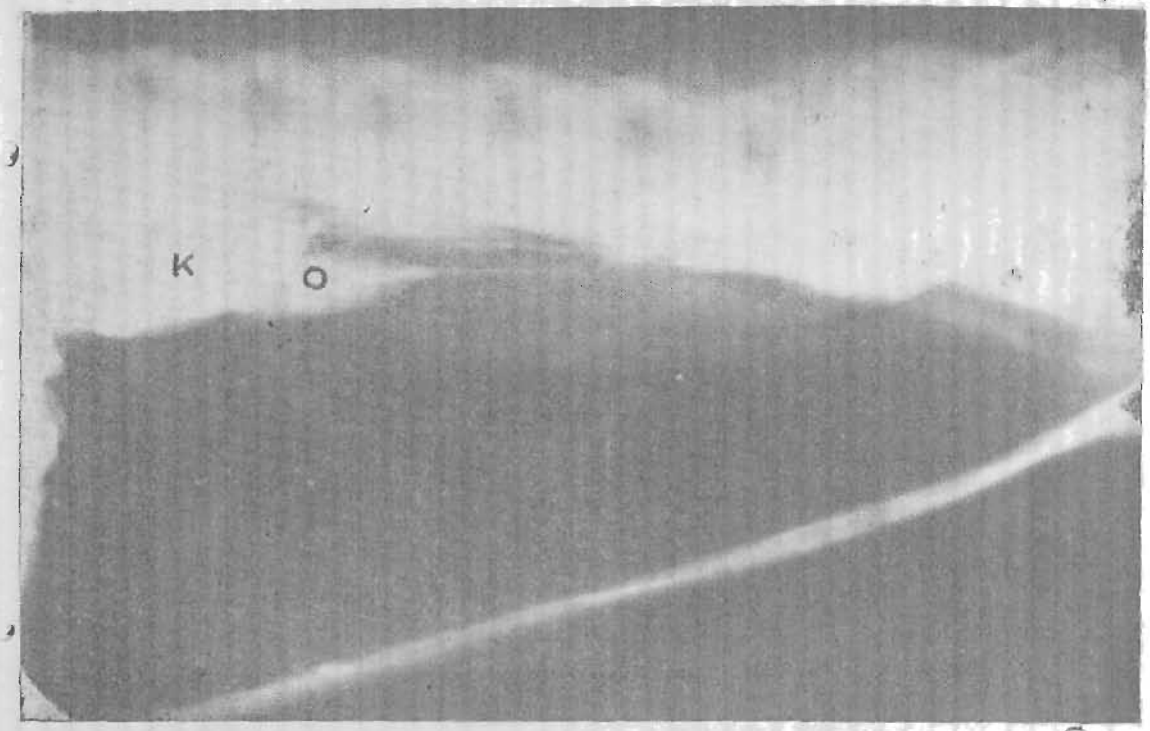


Fig. 6. A vertical head down lateral radiograph immediately following double contrast peritoneography (O-ovary)

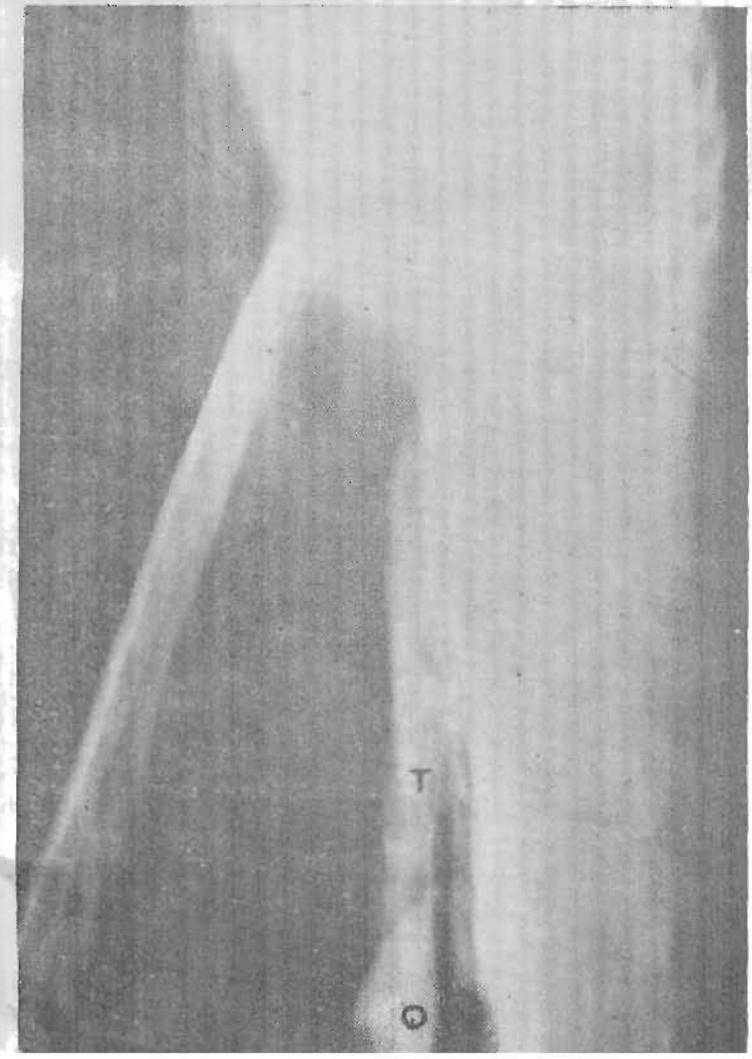


Fig. 7. Same animal 6 h later (O-ovary, T-tubular genitalia, K-kidney).

identified except on the radiograph taken at zero hour. In case of ureteral obstruction, the renal pelvis was marked out with enlarged ureter (Fig. 5) on the fourth hour. The extra luminal obstruction on the intestine could be spotted clearly on the fourth hour radiographs.

DISCUSSION

The results of the present study go a long way to prove the utility of double contrast radiography of peritoneum. This evidently has an edge over sin ple peritoneography as established by Meyers (1970) in a more precise visualisation of abdominal organs. By this method, the boundaries of visceral organs were outlined by the contrast material and they stood out distinctly against the negative contrast of air. Secondly, a limited quantity (10 ml in usual cases) of iothalamate was used in the present study as against a higher quantity (150–200 ml for human subject) used by Meyers (1970). The results revealed that more than visualisation of peritoneal pouches the method found its use examining the visceral organs.

The idea of double contrast peritoneography is based on the principle of pleurography carried out elsewhere (Rudy *et al.*, 1968). However, it became apparent that the elimination of contrast material was slower from the abdominal cavity than from the plural cavity. Though pleurographs aid delineation of plural boundaries, peritoneography apparently could be exploited further. As observed in the present study, the delayed radiographs could provide additional information on the various abdominal organs, their anatomical and to some extent their functional status. Since the bowel was marked out and that too in descending order, a series of radiographs at intervals upto 24 or 48 h could prove useful for diagnostic purposes. Whether this phenomenon was due to direct absorption of the material into the wall or due to its partial elimination through bile or whether both the factors operated simultaneously remains to be determined.

Replications were, however, limited and further study is in progress for use of different contrast material and their combinations This work could be at best considered a pointer to a new means of diagnostic radiography.

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REFERENCES

Doench, K., Frischkorn, R. and Roseow, U. 1973. (in german). *Fortschr. Roentgenster.* 118 : 413-17. (Abst. *Radiology* 110-247).

Ichinkava, H. 1972. *The advantages and disadvantages of double contrast studies of the stomach.* Ist ed. H. Shirakabe. George Thieme. Verlag Sluttgard (Germany).

Meyers, M. A. 1970. The spread and localization of acute intraperitoneal effusions. *Radiology* 95 : 547-54.

Rudy, R. L., Bhargava, A. K. and Roenigk, W. J. 1968. Contrast Pleurography – A new technique for the radiographic visualisation of the pleura and its various reflections in dogs. *Radiology* 91 : 1034-36.

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EFFECT OF FLOOR AREA AND MANGER LENGTH ON THE GROWTH AND BEHAVIOUR OF MURRAH BUFFALO HEIFERS IN LOOSE HOUSING SYSTEM

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ABSTRACT

An experiment of 2×2 factorial block design was conducted to find out the effect of loafing area (3.86 and 1.76 m^2 per animal) and manger length (73 and 53 cm per animal) on the growth, feed efficiency and behaviour of buffalo heifers in loose housing system. The average weekly increase in body weight and body measurements were not significantly influenced by the treatments. Animals provided with greater open area, spent significantly lesser time in standing/walking during 24 h period than those on reduced area. The findings of this experiment indicated that the animals rested longer when provided with more open area as compared to those with lesser area. Frequency of micturition and defaecation during 24 h period did not differ significantly due to treatments. On the basis of the experiment, it is recommended that the buffalo heifers may be raised on loafing area of 1.76 m^2 and manger length of 53 cm per animal in loose housing system.

Housing cost per animal varies with the floor area alloted to individual animals. Every animal needs a minimum of floor area for its optimum growth and well-being. The floor area alloted to each animal should be fixed after taking into consideration the cost on one hand and comfort and health on the other. Kooner *et al.* (1969) recommended open floor area of 9.29 to 11.62 m^2 per heifer. Sastry and Thomas (1976) recommended open floor area of 4 m^2 per heifer. The recommended manger length is 60 to 75 cm per heifer (Kooner *et al.*, 1969). However, the above recommendations were not based upon any research work done under Indian conditions. The objectives of the present investigation were to find out the effect of different open floor areas and manger length on the growth and behaviour of Murrah buffalo heifers in loose housing system.

MATERIAL AND METHODS

Sixteen Murrah buffalo heifers between 20 to 39 months of age were selected in quadruplets according to uniformity in body weight (Table 1). One member from each quadruplet was assigned at random to either of four treatment combinations : a_1 b_1-open floor area 3.86 m^2 and manger length 73 cm per animal; a_1 b_2-open floor area 3.86 m^2 and manger length 53 cm per animal; a_2 b_1-open floor area 1.76 m^2 and manger length

TABLE 1

Experimental animals

Treatments*	Heifers Number	Date of birth	Initial body weight (kg)
a_1 b_1	194	15-3-75	278
	267	5-10-76	216
	218	6-7-75	206
	236	16-2-76	196
Average			224
a_1 b_2	196	1-4-75	310
	204	22-4-75	250
	231	26-12-75	190
	259	14-9-76	158
Average			227
a_2 b_1	192	1-3-75	262
	228	31-10-75	214
	229	3-11-75	218
	219	9-7-75	188
Average			220.5
a_2 b_2	193	11-3-75	278
	203	22-4-75	260
	223	14-9-75	190
	355	30-1-76	178
Average			226.5

* a_1 b_1=open floor area 3.86 m^2 and manger length 73 cm per animal

a_1 b_2=oper floor area 3.86 m^2 and manger length 53 cm per animal

a_2 b_1=open floor area 1.76 m^2 and manger length 73 cm per animal

a_2 b_2=open floor area 1.76 m^2 and manger length 53 cm per animal

73 cm per animal; and a_2 b_2-open floor area 1.76 m^2 and manger length 53 cm per animal. Covered floor area was the same (1.9 m^2 per animal) for all the four groups. The experiment was conducted for a period of 120 days from June 18 to October 18, 1978. Prior to trial, the animals were given 15 days of adjustment period during which they were under various effects but no observations were taken. The experiment was planned as 2×2 factorial block design with open floor area (a) and manger length (b) as main effects. There were two levels under open floor area (3.86 and 1.76 m^2 per animal, respectively) and two levels under manger length (73 and 53 cm per animal, respectively).

Four animals of each treatment combination were housed together in loose house type of pen. Each pen had a covered area with asbestos roofing and open area.

All the animals were offered chopped green jowar *ad lib.* between 10 AM and 4 PM. At 6 PM leftover green jowar was removed and its weight was recorded. Wheat *bhusa* was offered *ad lib.* after 6 PM. The leftover wheat *bhusa* was removed at 9 AM next morning and its weight was recorded. Wheat *bhusa* was fed from June 18 to July 31, 1978. Thereafter, the feeding of wheat *bhusa* was stopped and only green jowar was fed as a roughage *ad lib.*

Animals were fed according to their nutritional requirements as per the recommendation of Sen and Ray (1971). Concentrate mixture was fed to the heifers in order to supply the nutrients (DCP and TDN) which were not met through roughages. Roughages were fed in group while concentrate mixture individually.

Two types of concentrate mixtures were fed during the experiment (Table 2). Concentrate mixture-I was fed from June 18 to August 8 and concentrate mixture-II from August 9 to October 18, 1978. Concentrate was fed once daily at 9 AM. The amount of the concentrate mixture fed was revised fortnightly depending upon the body weight of heifers.

TABLE 2

Approximate composition of feeds on dry matter basis (average of 4 samples)

Name of feed	Crude protein (%)	Crude fibre (%)	Ether extract (%)	Nitrogen free extract (%)	Ash (%)
Green jowar	6.24	31.02	2.03	53.13	7.84
Wheat *bhusa*	2.39	39.55	1.02	42.97	14.07
Concentrate mixture-I*	40.69	8.72	8.43	36.05	6.10
Concentrate mixture-II**	32.97	6.12	6.70	48.21	6.00

*Contains groundnut cake 100 parts, mineral mixture 2 parts and salt 2 parts

**Contains groundnut cake 75 parts, wheat bran 25 parts, mineral mixture 2 parts and salt 2 parts

Observations taken during the experiment were : initial and final body weight and body weight at fortnightly intervals, initial and final body measurements (height, length, heart girth and posterior girth), feed intake and behavioural traits.

Intake of green jowar and wheat *bhusa* by the different groups were recorded daily. Intake of concentrate mixture by individual animals was also recorded daily.

Representative samples of green jowar, wheat *bhusa* and compounded concentrate mixtures were taken at weekly intervals. Samples of four consecutive weeks were mixed together and analysed for proximate principles (Table 2). Digestibility values as reported by Sen and Ray (1971) were used to estimate the DCP and TDN in the feed. Feed efficiency in terms of nutrients required for each kg gain in live weight was estimated for each group of animals.

The behavioural observations on each animal recorded at monthly interval were : time spent in lying down, standing and eating during 24 h period; frequency of micturition and defaecation during 24 h period; and incidence of agonistic behaviour. The incidence of agonistic behaviour in the animals of different groups were recorded by the number of encounters between animals in each group. Encounters were observed during 8 h (8 AM to 4 PM) of the day at fortnightly intervals during the trial.

The initial value of body weight and body measurements were substracted from the final values and the differences were divided by the number of weeks (17) to get the weekly gain in weights and body measurements for each animal. Initial weight of the animals did not differ significantly due to treatments. Therefore, data were analysed as randomised block factorial design experiment.

RESULTS AND DISCUSSION

The average weekly increase in body weight and body measurements were not significantly influenced by the treatments (Table 3). Findings indicate that provision of lesser open floor space with area 1.76 m^2 per animal in loose house did not hamper growth of buffalo heifer unduly.

Kooner *et al.* (1969) recommended an open area of 9.29 to 11.62 m^2 per

TABLE 3

Average weekly increase in body weight and measurements*

Treatments	No. of animals	Average weekly increase in				
		Body weight (kg)	Heart girth (cm)	Posterior girth (cm)	Body length (cm)	Height at withers (cm)
a_1	8	4.67±0.25	0.63±0.04	0.98±0.08	0.40±0.03	0.34±0.03
a_2	8	4.58±0.18	0.68±0.04	1.23±0.09	0.40±0.03	0.32±0.02
b_1	8	4.57±0 16	0.64±0.05	1.14±0.13	0.38±0.04	0.32±0.02
b_2	8	4.68±0.26	0.67±0.03	1.07±0.05	0.41±0.02	0.34±0.03
$a_1 b_1$	4	4.40±0.26	0.58±0.05	0.91±0.15	0.36±0.04	0.28±0.03
$a_1 b_2$	4	4.94±0.41	0.68±0.05	1.05±0.07	0.44±0.03	0.39±0.01
$a_2 b_1$	4	4.73±0.16	0.78±0.08	1.36±0.15	0.40±0.06	0.36±0.02
$a_2 b_2$	4	4.43±0 34	0.69±0.05	1.08±0.07	0.39±0.02	0.28±0.36

*None of the treatment means differed significantly

heifer. On the basis of the findings of the present experiment, this could be reduced to 1.76 m^2 per buffalo heifer. The recommended manger length of 69 cm per heifer by Sainsbury (1967) could be reduced to 53 cm without any adverse effect on the growth of the buffalo heifer. Keys *et al.* (1978), reported that the lowering of feed bunk space from 81 to 20 cm per head reduced average daily gain per day in yearling Holstein heifers. Friend *et al.* (1977) reported that dairymen could have 30 per cent more cows than free stalls. They further suggested that dairymen could increase the number of cows per unit of feed bunk without adversely altering the behaviour or production.

The roughages were group-fed to animals during the experiment. Concentrate mixture was fed individually to each animal daily. The average dry matter, DCP and TDN intake per day was more or less the same for different treatments (Table 4). The average dry matter and TDN consumed per kg gain in body weight of buffalo heifers was 70 and 40 g, respectively, more under lesser open area (a_2) as compared to greater area (a_1). The requirement of DCP per kg gain in body weight was the same for the two levels of open area and manger length. Since the data on feed intake was based upon the average of the group, it was not possible to test the differences statistically. Heitman *et al.* (1961) reported significant differences in rate of gain and feed conversion in favour of greater space allowance per hog.

The average daily intake of nutrients and efficiency of nutrient conversion was nearly the same for buffalo heifers allowed 73 and 53 cm of manger length each (Table 4). Friend *et al.* (1977) reported that the individual dry matter intakes were the same at 0.5 m and 0.25 m of feed bunk per cow.

Animals provided with greater open area spent significantly ($P=0.05$) lesser time in standing during 24 h period than those on reduced area (Table 5). The

TABLE 4

Nutrient intake and feed efficiency of buffalo heifers on different treatments

Treatment	No. of animals	Average daily intake			Nutrient per kg gain in body weight		
		Dry matter (kg)	DCP (kg)	TDN (kg)	Dry matter (kg)	DCP (kg)	TDN (kg)
a_1	8	6.95	0.48	3.86	2.63	0.17	1.46
a_2	8	6.98	0.46	3.88	2.70	0.17	1.50
b_1	8	6.99	0.46	3.88	2.71	0.17	1.51
b_2	8	6.94	0.48	3.86	2.62	0.17	1.45
$a_1 b_1$	4	6.98	0.46	3.87	2.80	0.18	1.56
$a_1 b_2$	4	6.92	0.50	3.84	2.47	0.16	1.37
$a_2 b_1$	4	7.00	0.46	3.89	2.61	0.17	1.45
$a_2 b_2$	4	6.95	0.46	3.87	2.78	0.18	1.54

TABLE 5

Average time figures in parentheses are per cent of time spent in eating, standing and lying down by buffalo heifers during 24 h period

Treatment	No. of animals	Eating (min)	Standing (min)	Lying down (min)
a_1	8	431.26±13.37 (29.95)	279.84±18.70* (19.43)	728.91±19.80 (50.62)
a_2	8	406.87±14.16 (28.26)	335.59±16.09 (23.30)	697.50±18.82 (48.44)
b_1	8	429.38±13.92 (29.82)	312.26±20.11 (21.68)	698.44±22.73 (48.51)
b_2	8	408.75±14.04 (28.38)	303.28±12.41 (21.06)	729.97±16.42 (50.56)
$a_1 b_1$	4	447.18±16.49 (31.05)	272.81±21.07 (18.95)	720.00±34.47 (50.00)
$a_1 b_2$	4	416.31±20.62 (28.84)	286.88±7.58 (19.92)	737.81±24.27 (51.24)
$a_2 b_1$	4	411.56±21.29 (28.58)	352.00±19.92 (24.44)	676.88±30.21 (47.00)
$a_2 b_2$	4	402.19±21.59 (27.93)	319.69±21.94 (22.21)	718.12±21.35 (49.87)

*Significant at P=0.05

findings of this experiment indicate that the animals rested longer when provided with more open area as compared to those with lesser area.

As compared to the animals on lesser open floor area, animals on greater area spent significantly ($P=0.01$) longer time in eating and lying down during day (Table 6). It appears that the animals under greater open area were more comfortable during the day and as a result they spent greater time in eating and resting and lesser time in standing during the day time.

The average time spent in eating, standing and lying down by buffalo heifers during night was not significantly influenced by the treatments (Table 7). It appears that the eating and resting behaviour of the buffalo heifers were not influenced by the treatments during the night This might be due to the fact that the animals in all the groups were quite comfortable during the nights and had no heat stress as during the day time.

The effect of the interaction between manger length and open floor area was found to be statistically non-significant on the variables under investigation.

The time spent in eating roughages and concentrate was not significantly influenced by the treatments (Table 8). The average time spent in eating roughage during 24 h was 6 h and 11 min. Lewis and Johnson (1954) reported that Brown Swiss cows spent on an average 5 h and 12 min in eating silage/hay. It has been reported by Webb *et al.* (1963) that cows in loose housing system spent on an average 6 h and 15 min in eating roughages during 24 h period.

In the present experiment, there was an increase of 25 min in eating time during 24 h period as a result of an increase in floor area from 1.76 to 3.86 m^2 per animal (Table 5). There was also an increase in eating time of 21 min as a result of increase in manger length from 53 to 73 cm per animal during 24 h period. Khristov (1975) studied the effect of floor area on the time spent in eating by young cattle. He reported that time spent in eating increased from 8 per cent at 1.4 m^2 to 16 per cent at 3.1 m^2 of slatted floor area per animal. There was a fall in average daily gain of the cattle after reaching 300 kg body weight at 1.4 m^2 of floor area per animal.

Friend *et al.* (1977) reported that lowering feed bunk space from 0.81 to 0.20 m per head reduced the total eating time per day. Yearling Holstein heifers provided with 0.81, 0.41, 0.27 and 0.20 m feed bunk space per head spent 4.82, 4.72, 4.30 and 3.55 h per day per head, respectively, in eating from the feed bunk. They concluded that the linear feed bunk of 0.2 m per cow was sufficient to ensure desired amount of eating time when individuals had feed in bunk 21 h per day. The time spent in lying down by buffalo heifers in the present experiment was within the range of the findings of other workers on dairy cows in loose housing (Hafez, 1962; Schmisseus *et al.*, 1966; Fraser, 1974). Hafez (1962) reported that cattle spent 9 to 12 h per day in lying down. Schmisseus *et al* (1966) reported that Holstein cows on an average rested for 12 h and 21 min in loose housing system and 10 h and 40 min in free stalls. Fraser (1974) reported that cattle rested for about 9 to 12 h of the 24 h period.

TABLE 6

Average time figures in parentheses are per cent of time spent in eating, standing and lying down by buffalo heifers during 6 AM to 6 PM

Treatment	No. of animals	Eating (min)	Standing (min)	Lying down (min)
a_1	8	285.00±6.80** (39.58)	159.84±4.39** (22.20)	275.16±10.68* (38.22)
a_2	8	255.47±5.90 (35.48)	214.25±8.46 (29.75)	250.31±8.98 (34.77)
b_1	8	274.22±8.52 (38.08)	190.35±12.36 (26.44)	255.47±11.95 (35.48)
b_2	8	266.25±8.14 (36.98)	183.80±11.70 (25.53)	270.00±9.00 (37.50)
$a_1 b_1$	4	290.62±9.50 (40.36)	164.07±7.24 (22.79)	265.31±16.44 (36.85)
$a_1 b_2$	4	279.37±10.21 (38.80)	155.63±4.46 (21.62)	285.00±14.03 (39.58)
$a_2 b_1$	4	257.81±8.30 (35.81)	217.50±14.76 (30.21)	245.62±18.21 (34.11)
$a_2 b_2$	4	253.12±9.50 (35.15)	212.00±10.42 (29.44)	255.00±9.56 (35.41)

*Significant at P=0.05
**Significant at P=0.01

TABLE 7

Average time figures in parentheses are per cent of time spent in eating, standing and lying down by buffalo heifers during 6 PM to 6 AM*

Treatment	No. of animals	Eating (min)	Standing (min)	Lying down (min)
a_1	8	146.25±7.33 (20.31)	120.00±8.00 (16.66)	453.75±10.56 (63.03)
a_2	8	151.41±10.41 (21.03)	121.87±8.41 (16.92)	447.10±12.73 (62.11)
b_1	8	155.16±7.76 (21.55)	121.41±8.67 (16.86)	442.97±11.46 (61.52)
b_2	8	142.50±9.61 (19.79)	120.47±7.72 (16.73)	457.97±10.69 (63.60)
$a_1 b_1$	4	156.56±6.74 (21.74)	108.75±12.51 (15.10)	454.69±18.26 (63.15)
$a_1 b_2$	4	135.94±11.60 (18.88)	131.25±12.26 (18.23)	452.81±13.64 (62.89)
$a_2 b_1$	4	153.75±15.31 (21.35)	134.06±9.36 (18.62)	431.25±13.69 (59.90)
$a_2 b_2$	4	149.06±16.37 (20.70)	109.69±12.00 (15.23)	463.12±18.15 (64.32)

*None of the treatment means differed significantly

TABLE 8

Average time figures in parentheses are per cent of time spent in eating roughages and concentrates by buffalo heifers during 24 h period*

Treatment	No. of animals	Time spent in eating		Total time spent in eating (min)
		Roughage (min)	Concentrate mixture (min)	
a_1	8	380.16±10.27 (26.13)	51.10±3.61 (3.51)	431.26±13.37 (29.64)
a_2	8	363.75±13.31 (25.00)	43.12±5.30 (2.96)	406.87±14.15 (27.96)
b_1	8	380.16±11.53 (26.13)	49.22±3.20 (3.38)	429.38±13.92 (29.51)
b_2	8	363.75±12.23 (25.00)	45.00±3.17 (3.09)	408.75±14.04 (28.09)
$a_1 b_1$	4	392.81±12.38 (27.00)	54.37±3.90 (3.74)	447.18±15.49 (30.73)
$a_1 b_2$	4	367.50±15.23 (25.26)	47.81±6.19 (3.29)	415.31±20.62 (28.54)
$a_2 b_1$	4	367.50±18.99 (25.26)	44.06±3.86 (3.03)	411.56±21.29 (28.30)
$a_2 b_2$	4	360.00±21.38 (24.74)	42.19±1.79 (2.90)	402.19±21.59 (27.64)

*None of the treatment means differed significantly

In the present experiment, the average time spent in eating, standing and lying down during 24 h period by buffalo heifers was 7, 5.1 and 11.9 h, respectively. On an average, each heifer spent 7.5 h in lying down during night (6 PM to 6 AM) and 4.4 h in lying down during the day (6 AM to 6 PM). Harker *et al.* (1966) reported that cattle in tropics lie down mostly at night.

Under greater and lesser open floor areas buffalo heifers spent 50.62 and 48.44 per cent of the time in lying down (Table 5). Khristov (1975) reported that young cattle fattened on slatted floor spent 52 per cent ot the 24 h day in lying down with most space and 57 per cent with the least. They further reported that the animals spent 32 to 35 per cent of the time in standing during 24 h period.

In the present experiment, buffalo heifers spent about 21 per cent of the 24 h period standing. This was similar to the findings of Kilgour *et al.* (1975). They reported that calves spent 21.8 per cent of the time in standing during 24 h period. Hedlund and Roels (1977) reported that the lactating Holstein cows housed in stanchion stalls spent on an average 45 per cent of the time in lying down during the 15 h of day time. The average time spent for resting by dairy cows in free stalls decreased due to decrease in the availability of free stalls per cow.

Friend *et al.* (1977) reported that the average time spent in resting by dairy cows in free stalls were 14.2, 13.2, 10.4 and 6.9 h per day for free stalls of 1.0, 0.83, 0.67, 0 50 and 0.33 per animal, respectively. Behaviour of cows was altered when less than 0.67 free stall or 0.2 m linear feed bunk was available per cow.

In the present experiment, the frequency of micturition and defaecation in different groups were studied. Frequency of micturition and defaecation during 24 h period did not differ significantly due to treatments (Table 9). On an average each heifer voided urine seven times and faeces nine times during 24 h regardless of the treatment. The average daily incidence of micturition and defaecation in cattle has been reported to be 9 and 12 to 18 times, respectively (Hafez, 1962; Fraser, 1974). The difference could be due to variation in species, age, physiological status, management and climate. Grazing and lactating Holstein cows voided urine and faeces 9 4 and 15 times, respectively, during 24 h period (Hardison *et al*, 1956). Schmisseus *et al.* (1966) reported that the Holstein Friesian cows in loose housing averaged 7 urinations and 13 defaecations per 24 h period. The free stall cows averaged approximately 5.5 urinations and 11 defaecations per 24 h. They observed a high tendency of defaecation being followed by urination within 1 to 2 min.

There was no incidence of agonistic behaviour in buffalo heifers in any group. In this experiment, animals were housed together in group of four in each pen and were fed roughages free-choice. Concentrate feeding was done individually. Further more, they were farm born and familiar to each other. This might be the reason for the lack of any encounter between the animals in each group.

An attempt was made to study agonistic behaviour on the assumption that limiting the floor area and manger length might lead to encounters/agonistic behaviour in buffalo heifers. But, the experiment indicated lack of incidence of agonistic behaviour. Hence, it is concluded that provision of open floor area and manger length to the extent of 1.76 m^2 and 53 cm per animal, respectively, does not cause any problem as a result of aggressive behaviour. Hafez

TABLE 9

Average frequency of micturition and defaecation during 24 h period by buffalo heifers on different treatments*

Treatment	No. of animals	Frequency of micturition	Frequency of defaecation
a_1	8	6.97±0.10	9.36±0.13
a_2	8	7.09±0.10	9.56±0.19
b_1	8	7.03±0.12	9 39±0.10
b_2	8	7.03±0.09	9.53±0.21
a_1 b_1	4	7.00±0.20	9.34±0.14
a_1 b_2	4	6.94±0.06	9.37±0.24
a_2 b_1	4	7.06±0.16	9.44±0.16
a_2 b_2	4	7.12±0.16	9.69±0.37

*None of the treatment means differed significantly

(1962) reported that agonistic behaviour was less marked in young calves than in older animals. He suggested that the new members should be introduced to small herd when they were young in order to avoid, excitement and fighting.

On the basis of the experiment, it si recommended that the buffalo heifers may be raised on open floor area of 1.76 m^2 and manger length 53 cm per animal in loose housing system without any adverse effect on their growth and well-being.

REFERENCES

Fraser, F. A. 1974. *Farm animal behaviour.* The MacMillan Publishing Company Inc. New York, 196 pp.

Friend, T. H., Polan, C. E. and McGilliard, M. L. 1977. Free stall and feed bunk requirements relative to behaviour, production and individual feed intake in dairy cows. *J. Dairy Sci.* 60 : 108-16.

Hafez, E. S. E. 1962. *The behaviour of domestic animals.* Baitliere, Tindall and Cox Ltd. London, 619 pp.

Hardison, W. A., Fisher, H. L., Graf, G. C. and Thompson, N. R. 1956. Some observations on the behaviour of the grazing lactating cows. *J. Dairy Sci.* 39 : 1735-41.

Hedlund, L. and Roels, J. 1977. Behaviour of lactating dairy cows during total confinement. *J. Dairy Sci.* 60 : 1807-12.

Heitman, H. (Jr), Hohn, L., Kelly, C. F. and Bond, T. E. 1961. Space allotment and performance of growing finishing swine raised in confinement. *J. Agric. Sci.* 20 : 543.

Keys, J. E., Pearson, R. E. and Thompson, P. D. 1978. Effect of feed bunk stocking on weights gains and feeding behaviour of yearling Holstein heifers. *J. Dairy Sci.* 61 : 448-54.

Khristov, V. 1975. Behaviour of young cattle fattened on slatted floors. I. with different floor area. *Zhivotnov'd Nauki* 12(4) : 24. *(Nutr. Abstr. Rev.* 46(10) : 8285).

Kilgour, R., Winfield, C. G., Kathryn, J. B., Millord, M. M., Langen De, L. and Hudson, J. S. 1975. Behaviour of early weaned calves in indoor individual cubicles and group pens. *N. Z. Vet. J.* 23 : 119-23.

Kooner, D. S., Murthy, V. V. N. and Sundarasan, D. 1969. Dairy cattle housing. Farm bulletin No. 23 : Punjab Agricultural University, Ludhiana, 35 pp.

Lewis, R. C and Johnson, J. D. 1954. Observations of dairy cows activities in loose housing. *J. Dairy Sci.* 37 : 269-75.

Sainsbury, D. 1967. *Animal health and housing.* Williams and Wilkins Co., Baltimore, 329 pp.

Sastry, N. S. R. and Thomas, C. K. 1976. *Farm animal management.* Vikas Pub. House, 391. pp.

Schmisseus, W. E., Albright, J. L., Dillon, W. M., Kehrberg, E. W. and Morris, W. H. M. 1966. Animal behaviour responses to loose and free stall housing. *J. Dairy Sci.* 49: 102-04.

Sen, K. C. and Ray, S. N. 1971. *Nutritive value of Indian cattle feed and feeding of animals.* Bulletin No. 25, Indian Council of Agricultural Research, New Delhi, 133 pp.

Webb, F. M., Colenbrender, V. F., Blosser, T. H. and Waldern, D. E. 1963. Eating habits of dairy cows under drylot conditions. *J. Dairy Sci.* 46 : 1433-35.

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EFFECT OF SUPPLEMENTING AMINO ACIDS IN SWINE DIETS ON CARCASS COMPOSITION

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ABSTRACT

Carcass composition was influenced by the dietary protein levels more so when the lower level of lysine (12 Vs 14%) was fed. Pigs fed 16% C. P. in the diet showed leaner carcasses as compared to those fed the lower levels. The principal increase was in moisture and protein.

Carcasses of pigs fed 14% protein diet with added lysine alone or with methionine showed a tendency for greater leanness through increased moisture and decreased fat. It was also observed that addition of methionine gave no additional advantage over the addition of lysine alone. However, addition of lysine with or without methionine, tryptophan or threonine to a 12% protein diet improved carcass leanness by increasing moisture and protein.

Saw dust proved to be a reliable and accurate yet simple method of determining carcass composition in swine.

The effect of a balanced diet on rate of gain and feed efficiency of pigs has often been studied but its effect on tissue composition during growth and fattening needs further investigation.

The study of carcass composition is a quantitative method of determining leanness There is adequate evidence in literature that the relative proportion of carcass constituents is influenced by the diet (Osborn and Mendel, 1914; Ashton *et al*, 1955; Brooks and Thomas, 1959).

The present study was undertaken to see the effect of dietary protein levels and amino acid supplementation of low-protein diets on carcass composition of growing swine at 54 kg body weight.

MATERIAL AND METHODS

To study the effect of dietary protein levels and amino acid supplementation of low protein diets on carcass composition, 84 pigs were used. During the experiment, the pigs were kept in 0.47 × 1.17 m raised pens with expanded metal floors. Each pen provided 0.55m^2 of floor space and was equipped with an automatic waterer and removeable feeder. The pigs were dewormed, treated for external parasites and allowed a 7 days adjustment period before being fed the experimental diet.

Trial-1. Forty two Yorkshire pigs, 8 weeks old and weighing approximately 20.43 kg were allotted to treatment at random. The composition of diets is

presented in Table 1. Treatment consisted of the following : (1) 16% C. P. diet (positive control), (2) 14% C. P. diet (negative control), (3) 14% C. P. diet + lyamine (0.77% lysine), (4) 14% C. P. diet + lyamine (0.90% lysine), (5) 14% C. P. diet + lyamine + DL-methionine (0.77% lysine and 0.50% methionine) and (6) 14% C. P. diet + lyamine + DL-methionine (0.90% lysine and 0.50% methionine).

Trial-2 Forty two Hampshire, Duroc and crossbred pigs, 8 weeks old and weighing approximately 20.5 kg were allotted treatments at random. The composition of diets is presented in Table 2. Treatments consisted of following : (1) 16% C. P. diet (positive control), (2) 12% C. P. diet (negative control), (3) 12% C. P. diet + lyamine (0.77% lysine), (4) 12% C. P. diet + lyamine (0.90% lysine), (5) 12% C. P. diet + lyamine + DL-methionine (0.77% lysine and 0.50% methionine), (6) 12% C. P. diet + lyamine + L-tryptophan (0.77% lysine + 0.15% tryptophan) and (7) 12% C. P. diet + lyamine + L-threonine (0.77% lysine + 0.50% threonine).

The pigs were slaughtered in both trials at 54 kg body weight.

Immediately following slaughter, the right side of all carcasses were wrapped in plastic bags and placed in a freezer having a temperature of approximately —23.3°C for about 48 h.

Carcass composition was determined by (i) saw dust analysis as reported by Oslage and Farries (1963); and (ii) ground carcass analysis as reported by Morris and Moir (1963) which involved reducing the entire right side to a single homogenous sample.

In order to obtain meat saw dust samples for chemical analysis, each of the frozen sides was sawed into one inch slices on a Hobart electric meat saw, with a 92 inch saw blade containing 5 teeth per linear inch. The side was progressively sliced from the hind foot toward the neck, sawing transversely to the long axis of the side.

A large part of the saw dust that accumulated during the sawing of each side was collected and thoroughly mixed. From this, a small composite (100 g approximately) sample was placed in a plastic bag, identified and stored at —17.8°C. The saw was carefully washed and dried following the slicing of each side.

Immediately after sawing, the slices were ground in a 45 horse power Auto 801 meat grinder. Each side was ground three times through the coarse plate (1/2 inch tapered holes) and once through the fine plate (1/8 inch tapered holes).

The samples of the ground carcass were collected as follows : (a) that part which came through the fine plate was termed ground carcass fine (GCF), and (b) that part which remained behind the plate and contained considerable bone and cartilage was called ground carcass coarse (GCC). The weights of GCF and GCC from each side were recorded. A weighed composition of the carcass was calculated using the relative proportions of these portions. Composite samples (approximately 100 g) from each of GCF and GCC were taken, sealed in separate plastic bags, identified and stored at —17.8°C for subsequent chemical analysis. The grinder was carefully washed and dried following grinding of each side.

TABLE 1

Percentage composition of experimental diets - Trial 1

Ingredient	Diet identification					
	1	2	3	4	5	6
Ground yellow maize	75.80	81.23	80.98	80.59	80.81	80.50
Soyabean meal	20.90	15.47	15.42	15.55	15.49	15.54
T. M. salt[a]	0.50	0.50	0.50	0.50	0.50	0.50
Limestone	1.40	1.40	1.40	1.40	1.40	1.40
Biophos.	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin mix[b]	0.15	0.15	0.15	0.15	0.15	0.15
Antibiotic[c]	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	—	—	0.30	0.56	0.30	0.30
DL-methionine	—	—	—	—	0.10	0.10

[a]Supplied per 100 kg diet, 4.8 g salt, 400 mg zinc, 200 mg manganese, 165 mg iron, 24 mg copper, 5.5 mg iodine, and 11 mg cobalt.

[b]Supplied per kg mix 272, 400 USP units vitamin A, 40, 860 USP units vitamin D_3, 4540 IU vitamin E, 2.27 mg vitamin B_{12}, 0.56 g riboflavin, 2.27 g calcium pantothenate, 2.72 g niacine, 45.40 g choline, and 13 62 g BHT.

[c]Supplied per kg diet 110 kg chlorotetracycline 110 mg sulphamezathine and 55 mg penicillin.

TABLE 2

Percentage composition of experimental diets - Trial 2

Ingredient	Diet identification						
	1	2	3	4	5	6	7
Ground yellow maize	78.50	86.75	86.16	85.90	85.93	86.14	86.05
Soyabean meal	20.90	9.89	9.89	9.89	9.89	9.89	9.89
T. M. salt[a]	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Limestone	1.35	1.40	1.40	1.40	1.40	1.40	1.40
Biophos.	1.00	1.06	1.07	1.07	1.06	1.06	1.06
Vitamin mix[b]	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Antibiotic[c]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	—	—	0.58	0.84	0.58	0.58	0.58
DL-methionine	—	—	—	—	0.24	—	—
L-tryptophan	—	—	—	—	—	0.03	—
DL-threonine	—	—	—	—	—	—	0.12

[a], [b], [c] same as in Table 1.

The saw dust and ground carcass samples (both fine and coarse) were analysed for proximate composition according to procedures outlined by A.O.A.C. (1960).

The fine and coarse ground carcass samples were separately analyzed. The proximate analysis of ground carcass was determined as follows :

$$\% \text{ Protein (GC)} = \frac{\% \text{ Protein (GCF)} \times \% \text{ GCF}}{100} + \frac{\% \text{ Protein (GCC)} \times \% \text{ GCC}}{100}$$

Chilled carcass weight and proximate analysis results were used to determine the total protein, ether extract, ash, and water deposited in the carcasses.

The data were analyzed by the method of least squares (Harvey, 1960). Dunnet's procedure and L. S. D. tests were used to compare the treatments as suggested by Steel and Torrie (1960).

RESULTS AND DISCUSSION

Carcass composition was determined in trial 1 from saw dust and by grinding the entire right side of each carcass. Only saw dust was used to determine carcass composition in trial 2 because significant positive correlations were found between proximate analysis results from saw dust and ground meat during trial 1.

The effect of amino acid supplementation on carcass composition is presented in Tables 3, 4 and 5. Analysis of variance for carcass composition are given in Tables 6 and 7.

Effect of Dietary Protein Levels

Carcasses of pigs fed 16% C. P. diet showed a larger per cent of the carcass as protein ($P<.05$) and moisture ($P<.25$) and smaller total carcass ash and fat than of those fed 14% C. P. diet (Table 3). Pigs fed 14% C. P. diet deposited 5.8% less protein ($P<.20$) and 1.8% less moisture ($P<.25$) in their carcasses than pigs fed the 16% C. P. diet. The total ether extract in the carcass was not different for pigs fed the two diets.

The ground carcass analyses (Table 4) gave similar results when compared with those of saw dust method (Table 3). There were, however, no significant differences for treatment means for any of the criteria of response studied. Results were more uniform with saw dust than ground carcass, possibly because of sampling problems with the coarse part that remained behind the plate.

Carroll *et al.* (1936) who ground the entire carcass for analysis reported results that are in agreement with those in present study.

Significant changes in carcass composition were observed when the protein content of the diet was further reduced to 12% in trial 2. The per cent protein and moisture of carcasses from pigs fed the 16% C. P. diet were larger than those of the pigs fed the 12% C. P. diet ($P<.005$). Pigs on the lower protein level showed a larger per cent of the carcass as ether extract and as ash than pigs fed the higher protein levels ($P<.005$).

Further, it was observed that total protein and moisture deposited in carcasses of pigs fed the 16% C. P. diet

TABLE 3

Effect of amino acid supplementation on carcass composition (saw dust method - Trial 1)

	Diet identification						
C. P. (%)	16.00	14.00	14.00	14.00	14.00	14.00	
L-lysine (%)	.77	.63	.77	.90	.77	.90	
L-methionine (%)	.26	.24	.24	.24	.29	.29	
L-cystine (%)	.24	.21	.21	.21	.21	.21	
Item							S. E. of mean
Protein (N × 6.25) (%)	14.59	13.74	14.22	13.97	14.07	14.62	± 0.22
Total protein (kg)	5.56	5.33	5.66	5.24	5.58	5.48	± 0.13
Ether extract (%)	27.05	28.72	26.45	24.16	26.02	25.30	± 1.12
Total ether extract (kg)	10.35	11.16	10.62	9.27	10.08	9.55	± 0.69
Ash (%)	2.40	3.34	2.52	2.40	2.61	2.44	± 0.24
Total ash (kg)	0.91	1.28	1.00	0.90	1.02	0.91	± 0.10
Moisture (%)	55.94	54.92	56.81	59.44	57.29	57.72	± 1.08
Total moisture (kg)	21.35	21.06	22.60	22.02	23.15	21.60	± 0.76

TABLE 4

Effect of amino acid supplementation on carcass composition (ground carcass method - Trial 1)

	Diet identification						
C. P. (%)	16.00	14.00	14.00	14.00	14.00	14.00	
L-lysine (%)	.77	.63	.77	.90	.77	.90	
L methionine (%)	.26	.24	.24	.24	.29	.29	
L-cystine (%)	.24	.21	.21	.21	.21	.21	
Item							S. E. of mean
Protein (N × 6.25) (%)	15.27	14.94	15.68	15.43	15.59	15.76	± 0.23
Total protein (kg)	5.63	5.80	6.25	5.77	6.20	5.92	± 0.22
Ether extract (%)	28.01	29.84	27.46	26.51	27.89	26.92	± 1.02
Total ether extract (kg)	10.74	11.60	11.13	10.10	10.90	10.15	± 0.68
Ash (%)	2.48	3.15	2.32	2.76	2.42	2.36	± 0.28
Total ash (kg)	0.94	1.21	0.80	1.08	0.95	0.88	± 0.10
Moisture (%)	53.82	51.95	54.55	53.99	54.18	55.05	± 0.92
Total moisture (kg)	20.53	20.18	21.68	20.09	21.77	20.63	± 0.72

TABLE 5

Effect of amino acid supplementation on carcass composition (saw dust method – Trial 2)

	Diet identification							
Protein (%)	16.00	12.00	12.00	12.00	12.00	12.00	12.00	
L-lysine (%)	.77	.48	.77	.90	.77	.77	.77	
L-methionine (%)	.26	.22	.22	.21	.33	.21	.21	
L-cystine (%)	.24	.18	.17	.17	.17	.17	.17	
L-tryptophan (%)	.20	.11	.12	.12	.12	.15	.12	
L-threonine (%)	.62	.44	.44	.44	.44	.44	50	
Item								S. E. of mean
Protein (N × 6.25) (%)	15.06	13.49	14.85	15.07	15.21	14.85	14.96	±0.25
Total protein (kg)	6.05	4.60	5.88	5.66	5.75	5.79	5.49	±0.23
Ether extract (%)	24.71	30.34	26.77	25.23	25.55	27.44	26.70	±1.12
Total ether extract (kg)	9.89	10.25	10.43	9.22	9.32	10.71	9.89	±0.55
Ash (%)	2.64	2.86	2.51	2.37	2.82	2.36	2.63	±0.17
Total ash (kg)	1.05	1.01	0.97	0.87	1.02	0.92	0.96	±0.06
Moisture (%)	57.58	53.22	55.87	57.32	56.42	55.44	55.70	±0.92
Total moisture (kg)	23.08	18.22	21.82	21.11	20.55	21.66	20.42	±0.83

TABLE 6

Analysis of variance for carcass composition – Trial 1

Item	Mean square[a] (ground meat)			Mean square[a] (saw dust)		
	Block (6)	Treatment (5)	Error (30)	Block (6)	Treatment (5)	Error (30)
Protein (N × 6.25)(%)	0.53	0.64[c]	0.38	0.83	0.87*	0.34
Total protein (kg)	0.22	0.43	0.33	0.69	0.18[e]	0.10
Ether extract (%)	13.51	9.72[b]	7.37	8.56	17.73[d]	8.86
Total ether extract (kg)	5.36	2.34	2.70	3. 8	3.30	2.87
Ash (%)	1.44	0.70	0.57	0.66	0.92[d]	0.06
Total ash (kg)	0.26	0.15[d]	0.07	0.07	0.15*	0.06
Moisture (%)	5.14	7.90	5.98	6.13	17.88[d]	8.24
Total moisture (kg)	1.26	3.80	3.17	2.42	4.39	3.43

[a] Numbers in parentheses represent degrees of freedom.

[b] $P < .25$; [c] $P < .20$; [d] $P < .10$; [e] $P < .15$; * $P < .05$.

TABLE 7

Analysis of variance for carcass composition — Trial 2

Item	Mean squares[a]		
	Block (4)	Treatment (6)	Error (30)
Protein (N × 6.25) (%)	0.41	2.07***	0.37
Total protein (kg)	1.80	1.37***	0.32
Ether extract (%)	4.76	21.22*	7.96
Total ether extract (kg)	4.84	1.83	1.84
Ash (%)	0.18	0.24[b]	0.17
Total ash (kg)	0.03	0.02	0.03
Moisture (%)	3.49	12.50*	5.13
Total moisture (kg)	22.57	13.61[c]	4.24
Protein (%, DM)	4.28	30.51**	7.86
Ether extract (%, DM)	6.58	29.07*	11.90
Ash (%, DM)	1.31	1.16	1.07

[a] Number in parentheses represents degrees of freedom.

[b] P<.25; [c] P<.016; *P<.05; **P<.01; ***P<.005

were significantly greater when compared with those of pigs fed the 12% C. P. diet (P<.005). Total ether extract and ash in the carcass, however, were not different for the two groups.

These results are in agreement with those reported by Kropf *et al.* (1959) and Wagner *et al.* (1963). Wyllie *et al.* (1969) who used ground carcass for analysis reported a trend toward leaner carcasses for pigs fed low levels of protein in the diet which is contrary to the above findings.

Effect of Amino Acid Supplementation

Trial-1. The protein, ash, ether extract and water content of carcasses of pigs fed 16% C. P. diet and 16% C. P. diet supplemented with amino acids were similar. However, pigs fed the supplemented diets showed more protein (P<.20) and moisture (P<.10) and less ether extract and ash (P<.05) in their carcasses as compared to those fed the 14% C. P. diet. An amino acid imbalance was observed in terms of decrease in protein content of carcasses by 8% when pigs were fed 0.90% lysine in the diet as compared to those fed 0.77%. The level of lysine in the diet, however, did not affect moisture, ether extract and ash content of carcasses.

Ground carcass analyses gave results that were identical with those obtained by saw dust analyses. Lysine supplementation increased the carcass content of protein and moisture. Pigs fed the 14% C. P. diet produced carcasses that were fatter than those fed the 16% C. P. or supplemented diets.

The highly significant positive correlations between protein (r=0.96), ether extract (r=0.95) and ash (r=0.76) of saw dust and ground carcass in trial 1 (Table 8) indicated that grinding of carcasses provided no additional information about carcass composition over that provided by the saw dust when studying the treatment effects.

TABLE 8

Simple correlation coefficients between carcass composition of saw dust and ground carcass

Item		Ground carcass
Saw dust	(moist)	
	Protein (%)	0.69**
	Ether extract (%)	0.92**
	Ash (%)	0.56**
	Moisture (%)	0.72**
Saw dust	(dry)	
	Protein (%)	0.96**
	Ether extract (%)	0.95**
	Ash (%)	0.76**

**P<.01

Trial-2. The effect of amino acid supplementation of a 12% C. P. diet on carcass composition was more marked than that of supplementing a 14% C. P. diet.

Dunnet's t-test revealed no differences in the protein, ether extract, ash and moisture content of carcasses of pigs fed amino acid supplemented diets and those of pigs fed the 16% C. P. diet.

The carcasses of pigs fed the 12% protein diet supplemented with amino acids were higher in protein and moisture than those of pigs fed the 12% protein diet (P<.05). The supplementation had no effect on ether extract and ash content of the carcass. It was further observed that addition of DL-methionine, L-tryptophan or DL-threonine to a 12% C. P. diet supplemented with lysine (0.77%) did not increase the carcass content in protein and moisture.

Carcasses of pigs fed the higher level of lysine (0.90% total dietary lysine) showed greater percentage of protein and moisture than did those of pigs fed the lower level (0.77%). The total protein and moisture (5.44 kg and 3.25 kg, respectively) deposited was greater for pigs fed the lower level of lysine, indicating that an imbalance of amino acids occurred when more than the required amount of the first limiting amino acid was present in the diet.

The results given above are in agreement with those reported by Vipperman *et al.* (1963), Cahilly *et al.* (1963), Jurgens *et al.* (1967), and Ostrowski (1969).

REFERENCES

A. O. A. C. 1960. *Official methods of analysis* (9th Ed.). Association of Official Agricultural Chemists, Washington, D. C.

Ashton, G. C., Kastelic, J., Acker, D. C., Jensen, A. H., Maddock, H. M., Kline, E. A. and Catron, D. V. 1955. Different protein levels with and without antibiotics for growing finishing swine : Effect on carcass leanness. *J. Anim Sci.* 14 : 82-93.

Brooks, C. C. and Thomas, H. R. 1959. Supplements to peanut oil meals for growing fattening swine. *J. Anim. Sci.* 18 : 1119.

Cahilly, G. M. Jr., Miller, R. F., Kelly, R. F. and Brooks, C. C. 1963. Effect of various levels of dietary lysine on certain blood phenomena, muscle development, and muscle-protein biological value of growing swine. *J. Anim. Sci.* 22 : 726-32.

Carorll, W. E., Garrigan, W. P., Mitchell, H. H. and Haines, W. H. 1936. Protein in the ration influences composition of pork. III. *Exp. Sta. Ann. Rpt.* 1935-36 : 93.

Harvey, W. H. 1960. *Least square analysis of data with unequal subclass numbers.* ARS-20-B, Agr. Res. Service, U. S. Deptt. of Agriculture.

Jurgens, M. H., Hudman, D. B., Adams, C. H. and Peo Jr., E. R. 1967. Influence of a dietary supplement of lysine fed at two levels of protein on growth, feed efficiency and carcass characteristics of swine *J. Anim. Sci.* 26 : 323-27.

Kropf, D. H., Bray, R. W., Phillips, P. H. and Grummer, R. H. 1959. Effect of protein level and quality in swine rations upon growth and carcass development. *J. Anim. Sci.* 18 : 755-62.

Morris, J. G. and Moir, K. L. 1963. *Methods of determining the chemical composition of dead animals* Symp on carcass composition and appraisal of meat animals 2-1, C.S.I.R.O. Melborne, Australia.

Osborn, T. B. and Mendel, L. B. 1914. Amino acids in nutrition and growth. *J. Biol. Chem.* 17 : 325.

Oslage, H. J. and Farries, F. E. 1963. A new method for total carcass analysis of new born calves with the aid of deep freezing. *Ztoche. Tierphysiol. Tiererndhrung. Fittermittela.* 17 : 343-50.

Ostrowski, H. 1969. The effects of dietary supplementation with lysine and methionine on body and tissue composition in pigs. *Anim. Prod.* 11 : 521-32.

Steel, R. G. D. and Torrie, J. H. 1960. *Principles and procedures of statistics.* McGraw-Hill Book Co., Inc., New York.

Vipperman, P. E., Brooks, C. C., Kelly, R. F., Graham, P. R. and Thomas, H. R. 1963. Effect of dietary lysine level on muscle size and composition in swine. *J. Anim. Sci.* 22 : 674-78.

Wagner, G. R., Clark, A. R., Hays, V. W. and Speer, V. C. 1963. Effect of protein-energy relationship on the performance and carcass quality of growing swine. *J. Anim. Sci.* 22 : 202-08.

Wyllie, D., Speer, V. C., Evans, R. C. and Hays, V. W. 1969. Effects of starter protein level on performance and body composition of pigs. *J. Anim. Sci.* 29 : 433-38.

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AN EXPERIMENTAL STUDY ON PARTIAL URETHRAL TRANSPLANTATION IN COW CALVES*

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ABSTRACT

Autogenous vein grafts revealed slight cellular reactions. In untreated homogenous vein grafts, there was infiltration of urine in all the cases between 14 to 26 postoperative days. Histopathological examination revealed that necrotic changes of homogenous vein grafts were effective upto 20 to 43 days.

Pressure necrosis and perforation of urethral wall are common complications following urethral obstruction. Complications usually result in subcutaneous accumulation of urine on the ventral abdominal wall around the sheath and umbilicus. In advance stages, complete necrosis and sloughing of the subcutaneous tissue and skin have also been observed.

Morrick *et al.* (1951) tried substitution of bladder and urethra with caecum and ileum, respectively, in dogs with variable success. Robinette (1973) reported a surgical technique for replacement of urethra with silicone rubber prosthesis in 24 male cats with satisfactory to excellent results.

MATERIAL AND METHODS

Calves aged between 1 to 2 years were used for this study and were apparently healthy and kept under identical environmental, feeding and managemental conditions and randomly divided into three groups, each having 6 animals as follows :

Group I-Autogenous venous grafts

Group II-Untreated homogenous venous grafts

Group III-Treated homogenous venous grafts

All the animals were fasted overnight. Light narcosis was produced by intravenous administration of 6% chloralhydrate. The animals were restrained in the surgical cradle on supine recumbency.

Group I. Saphenous vein was used as an autogenous venous grafts for the partial urethral transplantation.

Collection of Saphenous Vein

After controlling the animal properly, the area just above stifle joint on the medial aspect of the thigh was shaved

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and prepared for aseptic surgery. Linear infiltration of 2% procaine hydrochloride was done at the operative site. A 5 to 7 cm long cutaneous incision, very close and parallel to the saphenous vein, was made. After blunt resection, the vein was exposed and the portion devoid of any branches was choosen for transplantation graft (Fig. 1). Two hemostats were applied on either end of the vein and then by giving a small incision in the lower portion of vein a polythene catheter of 3 mm diameter was inserted into the vein and a 4 to 5 cm long vein piece was removed. Both the cut ends of the vein were ligated and cutaneous wound was closed with interrupted mattress sutures. The vein collection on the polythene tube was kept in sterile normal saline solution.

Urethrotomy and Grafting

Post-scrotal urethrotomy under local infiltration of 2% procaine hydrochloride solution was carried out on dorsal recumbency. After exteriorizing the urethra, the urethrotomy was done just above the point where the retractor penis muscles attach with the penis. Urethrotomy incision was extended upto 4 to 5 cm in length. Then, the mucosa of the exposed urethra was scratched with the help of scalpel. The polythene tube having the vein was inserted in the upper part of the urethra and the vein was adjusted over the urethra with

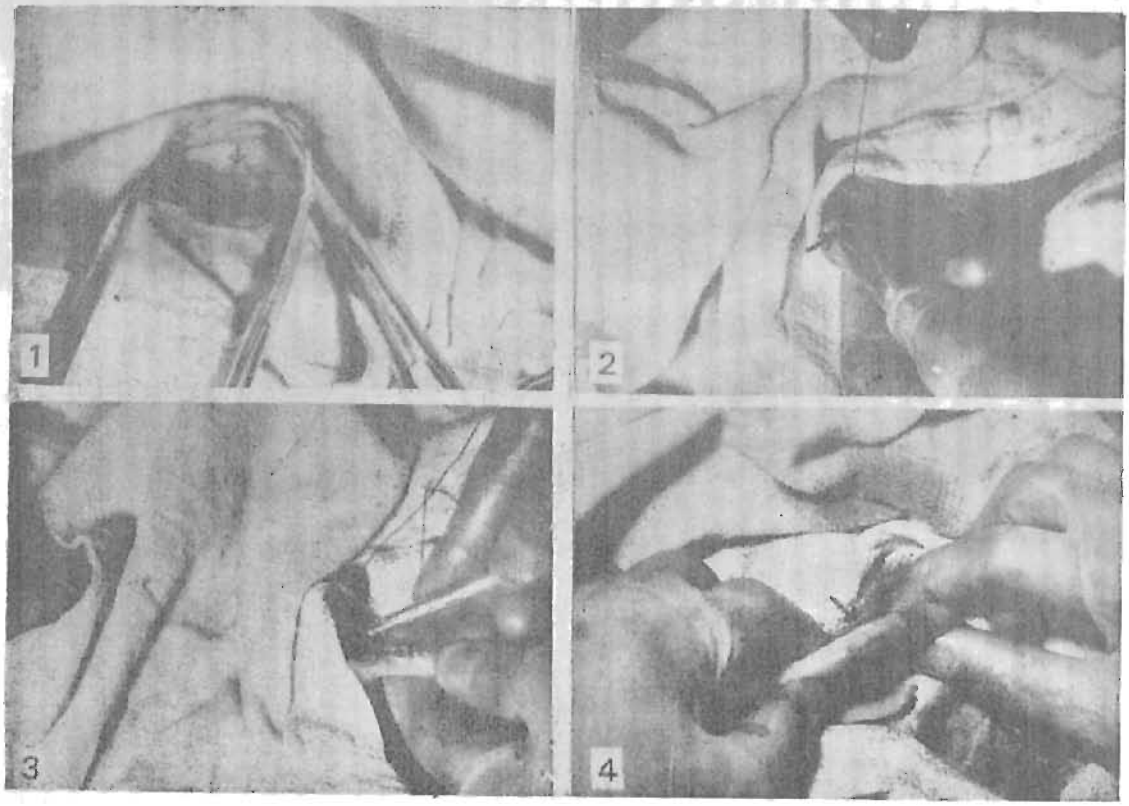


Fig. 1. Exposure of saphenous vein (arrow) without any branches.
Fig. 2. Anastomosis of venous grafts (arrow) with lumen of urethra.
Fig. 3. Closing of the urethra after grafting.
Fig. 4. Complete repair of urethral wound after transplantation.

continuous lock stitch pattern and a second layer of suturing was done by simple continuous sutures with 3/0 black braided silk (Fig. 2). The lower end of the polythene tube was inserted in the urethra and taken out through the external urethral meatus and prepucial orifice. The lower end of the vein was sutured with distal part of the incised urethra. The grafted vein was covered by suturing the incised urethral flap (Fig. 3) and finally penile fascia was also sutured by simple continuous sutures (Fig. 4). After local application of tetracycline powder at the operative site, the cutaneous wound was closed with interrupted mattress sutures. The polythene catheter was transfixed with the prepucial skin (Fig 5). Skin sutures were removed between 8-10 days after surgery.



Fig. 5. Indwelling catheter in situ (arrow) after surgery.

Group II. Untreated homogenous saphenous vein grafts were collected from healthy calf aseptically and kept in sterile normal saline solution. Surgical procedure for the transplantation of graft was identical as in group I.

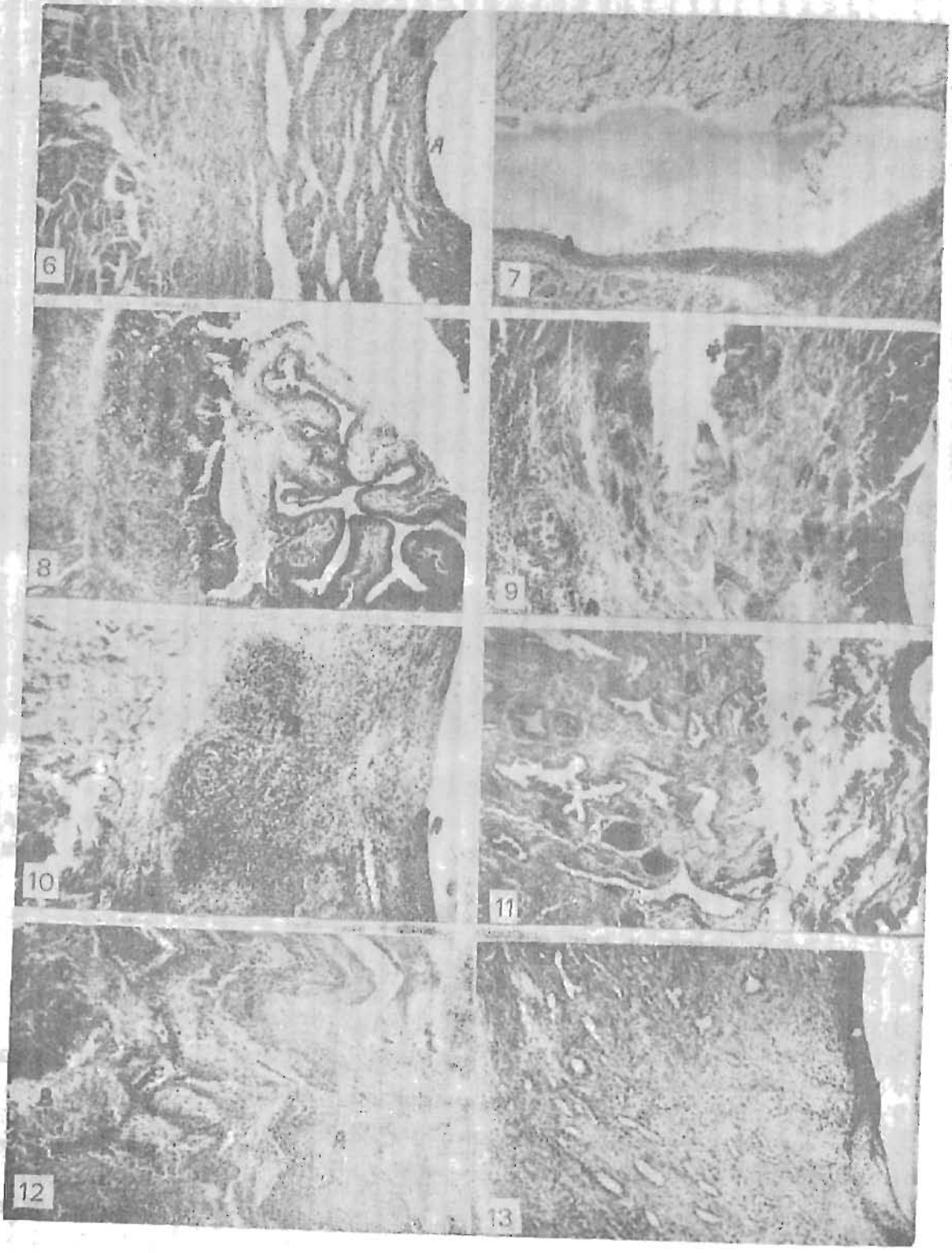
Group III. The saphenous vein from healthy calf was collected aseptically and after washing with sterile normal saline solution, the vein was transferred to one per cent aqueous solution of ficin*. prepared in a standard phosphate citrate buffer pH 5.5. Traces of L-cystine were added in ficin solution. The vein was kept in this solution for $2\frac{1}{2}$ h at 37°C. Then the vein was transferred to one per cent solution of sodium chloride for 24 h. The tanning was carried out with several changes within 18 h in 1.3% dialdehyde starch buffered solution with a pH of 8.8. After tanning, the vein was, thoroughly washed with distilled water and was preserved in a solution of 50% ethanol containing one per cent propylene oxide till used. Before grafting, the vein was washed with sterile normal saline solution. A 4 to 5 cm long piece of treated vein was grafted with the same procedure as described in Group I.

The animals were observed for a period of 45 days and the grafted part of the urethra along with the penis were collected from animal which died or in which case there was leakage of the urine at the site of graft. The tissues were fixed in 10% formal saline solution for the histopathological studies. After processing and embedding in paraffin wax, 5 μ thick sections were cut and stained with heamatoxylin and eosin stain.

RESULTS

Group I. After surgery, all the calves passed the urine through the catheter with normal micturation and frequency. In two calves, the catheter was dropped out of the urethra on 4th and 6th post-operative day and infiltration of urine in the subcutaneous tissues of lower

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abdomen was seen on 11th and 12th postoperative day. In third animal, the infiltration of urine from the graft site was seen on 14th post-operative day. The remaining animals of this group recovered completely and survived till the end of the experiment.

Pathological Studies

Macroscopic. In calves where infiltration of urine was observed, the healing was not complete. However, there was complete healing from 25th post-operative day onward in rest of the animals. Grafts could not distinguished from urethra in such animals.

Microscopic. Histopathological studies of 11 days old grafts (Fig. 6) revealed regeneration and hyperplasia of the transitional epithelium of the urethra which was focal in nature. The blood vessels of the mucosa were congested and infiltration of few lymphocytes was also seen. A blood vessel of the serosa was thrombosed. Microscopic examination of 25 days old graft (Fig. 7) revealed the adhesions of the grafted vein with the underlying urethral surface. The blood vessels were showing some congestion and there was also infiltration of few lymphocytes.

Group II. All the animals of this group normally passed the urine through the catheter. There was infiltration of urine in all the calves between 14 to 26 post-operative days. The animal, in which the leakage of urine started on 14th post-operative day, was also showing presence of suppurative foci at the site of graft. In two of the animals, retention of urine resulted due to urethral obstruction.

Pathological Studies

Macroscopic. The grafted parts of the penis showed slight to severe adhesions. The lumen of the urethra above the graft was haemorrhagic and congested. Junction of the graft and urethra was also prominent, where the infiltration of urine was seen.

Fig. 6. Microphotograph of the urethra showing regeneration and hyperplasia of transitional epithelium (A) and infiltration of few lymphocytes (B) 7 × 10.

Fig. 7. Microphotograph of the urethra showing the graft (A) and normal transitional epithelium (B) H × E, 7 × 10.

Fig. 8. Microphotograph of the urethra showing necrotic changes of the graft and underlying urethral mucosa (A) and heavy infiltration of lymphocytes and polymorphonuclear cells (B) H × E, 7 × 4.

Fig. 9. Microphotograph of the urethra showing necrotic changes of the graft (A), heavy cellular infiltration (B) and severe congestion of the urethral mucosa (C) H × E, 7 × 10.

Fig. 10. Microphotograph of the urethra showing focal regeneration of transitional epithelium (A) and polymorphonuclear cells (B) H × E, 7 × 10.

Fig. 11. Microphotograph of the urethra showing degenerative changes of the graft (A) and infiltration of lymphocytes and polymorphonuclear cells (B) H × E, 7 × 10.

Fig. 12. Microphotograph of the urethra showing necrotic changes of the graft (A), extensive haemorrhage (B) and infiltration of polymorphonuclear cells (C) H × E, 7 × 10.

Fig. 13. Microphotograph of the urethra showing oedematous urethral mucosa lined with transitional epithelium H × E, 7 × 10.

Microscopic. Histopathological studies of 14 days old untreated homogenous vein graft (Fig. 8) revealed that the graft as well as the underlying mucosa of the urethra were showing necrotic changes and some bacterial colonies were also present in the necrosed areas. No adhesions were seen between the graft and underlying urethral surface. The connective tissue of the mucosa and the muscularis layer was congested and haemorrhagic. Infiltration of polymorphonuclear cells and lymphocytes was also seen. On 18th day (Fig. 9), the reaction was same as in 14 days old graft except that there was infiltration of more polymorphonuclear cells and absence of any bacterial colony. The connective tissue of mucosa and the muscularis layer was highly congested and haemorrhagic. On 26th day (Fig. 10), necrosis of the graft was noticed and piece of the graft was present in the lumen of the urethra. The urethral mucosa was oedematous and highly congested. The cellular infiltration was prominent.

Group III. Ficin treated homogenous vein grafts were effective upto 20 to 43 days. Except in one animal where obstruction of urethra occurred, the infiltration of urine was noticed in other animals. The animal which showed infiltration of urine on 20th post-operative day, was also having some infection at the graft site.

Pathological Studies

Macroscopic. Except in one animal where there was severe adhesions and pus formation, the other animals showed no adhesions or very slight adhesions with the penis. The suture material was also present in all the cases.

Microscopic. Histopathological studies of 20 days old graft (Fig. 11) revealed some necrotic changes of the graft and the underlying urethral mucosa. The graft was showing no adhesions with the urethral mucosa. Slight infection characterised by cellular infiltration was also noticed. There was infiltration of lymphocytes and polymorphonuclear cells. On 39th day (Fig. 12), the graft was in the form of necrosed tissue attached to the urethral surface. The urethral tissue attached to the graft showed extensive haemorrhage and infiltration of polymorphonuclear cells along with some necrotic changes. On 43rd day (Fig. 13), microscopic examination revealed the absence of the graft. The urethral mucosa was lined with transitional epithelium and was slightly oedematous and showing areas of old haemorrhage. The infiltrating cells were almost absent or occasionally present in the muscularis.

DISCUSSION

Group I. From studies conducted so far it seems that autologous grafting of veins are well tolerated and accepted at new locations; eliciting a transient minimal tissue response followed by normal fibrous repair. Attempts have been made to use autogenous vein as a substitute for the ureter (Melchior, 1908; Tietze, 1909) and as well as for the common duct, fallopian tube and tendon sheath but its use as a substitute for the urethra has not been reported so far.

In two animals of this group, the polythene, catheter dropped out which could be because of accidental stampede and pulling of the protruding part of catheter by other animals or self. The retention of catheter for a period of three

weeks was found essential for protection against physiological stress of urination. Hardin *et al.* (1954) reported complete failure with free autografts of vein supported by an indwelling polythene tube in ureteral transplantation as leakage or stenosis occurred in all cases. Rosenberg and Dahlon (1953) also reported slough and leakage in 48 h after the vein was used as a substitute for the ureter. Morrick *et al.* (1951) and Robinette (1973) tried ileum and silicone rubber prosthesis as a substitute for the urethra in dogs and cats with variable success and satisfactory to excellent results, respectively.

Microscopic examination upto 25th post-operative day did not show gross sign of graft rejection except the infiltration of few lymphocytes.

Group II. Homogenous vein grafts have been widely used to correct the defects in vascular system and as a substitute for other tubular parts of the body but no such report is available regarding urethral substitution.

In the present study, the substitution of urethra using homogenous vein grafts failed completely. The infiltration of urine at the graft site started between 14 to 26 post-operative days which showed signs of graft rejection. Penis also showed adhesions with the adjoining tissues.

Microscopic examination further revealed the rejection of the graft. There was infiltration of a large number of lymphocytes and polymorphonuclear cells in addition to severe congestion and haemorrhage. The graft as well as the underlying ureteral mucosa were going under necrotic changes. There were very slight or no adhesions between the graft and the underlying mucosa and later on the sloughing of the graft was evident. Loeb (1945) reported that the destruction of a homotransplant was accompanied by an inflammatory reaction, often of a violent character. Degenerative changes in vascular grafts were also observed in experimental studies by many observers (Coleman *et al.*, 1951; Everson and Southwick, 1951; Johnson *et al.*, 1952; Gentsch *et al.*, 1954).

Sewell (1955) tried freeze-dried jugular vein and carotid artery as ureteral replacement but obtained poor results. In most of the cases, hydroureter and hydronephrosis ensured along with necrosis of the graft. It was presumed that host's reaction to homogenous vein grafts might had been aggrevated by the irritating chemicals and bacteria existing in the urine.

Group III. The ficin treated homogenous vein grafts were strong enough to withhold the suturing, however, the treated veins became thinner than the untreated. Glutaraldehyde used as tanning agent in the present experiment was also used by Rosenberg *et al.* (1964) and Dardik *et al.* (1976). Tanning strengthened the graft to improve the suture holding power.

The survival of the treated homogenous vein graft was found more than the untreated grafts. This might be due to removal of antigenic soluble proteins and mucopolysaccharides which parallels the findings of Rosenberg *et al.* (1964) and Rubin *et al.* (1965).

The treated grafts were effective upto 43 days and there were only slight or

no adhesions of the penis with the adjoining tissues. Microscopic examination revealed the rejection of the graft having no adhesions with the underlying mucosa. There were infiltration of lymphocytes and polymorphonuclear cells though less in quantity than in Group II.

The rejection of the treated homogenous vein grafts might be due to the fact that there was no complete removal of the graft antigenicity and might also be due to the irritation of the chemical agents and bacteria present in the urine.

REFERENCES

Coleman, C. C., Deterling, R. A. and Parshley, M. S. 1951. Experimental studies of preserved aortic homografts. *Ann. Surg.* 134 : 868-77.

Dardik, H., Ibrahim, I. M. and Dardik, I. 1976. Arteriovenous fistulae constructed with modified human umbilical cord vein graft. *Arch. Surg.* 111 : 60-62.

Everson, T. C. and Southwick, H. W. 1951. Growth of vascular grafts in growing experimental animals. *Arch. Surg.* 63 : 576-78.

Gentsch, T. O., Waters, L. L. and Glenn, W. W. L. 1954. The influence of acute hypervolemia on the freeze dry homologous aortic grafts. *Surg.* 35 : 30-39.

Hardin, C. A., Reismann, K. R. and Dimond, E. G. 1954. The use of hypothermia in the section and homologous graft replacement of the Thoracic aorta. *Ann. Surg.* 140 : 720-25.

Johnson, J., Kirby, C. K. and Horn, R. C. 1952. The growth of preserved aorta homografts. *Surg.* 31 : 141-46.

Loeb, L. 1945. *The biological basis of Individuality.* Thomas, Springfield.

Melchior, 1908. Erastz des ureters durch cin Blutgefase. *Klin. Wochenschr.* 45 : 1470.

Morrick, J. W., Gilchrist, R. K., Homin, H. and Rieger, I. T. 1951. A substitute bladder and urethra using caecum as bladder and ileum as urethra. *J. Urol.* 65 : 561-66.

Robinette, J. D. 1973. Silicone rubber prosthesis for replacement of urethra in male cats. *J. Anim. Vet. Med. Assoc.* 164 : 285-89.

Rosenberg, M. L. and Dahlon, G. A. 1963. Autogenous vein grafts and venous valves in ureteral surgery. An experimental study. *J. Urol.* 70 : 434.

Rosenberg, N., Henderson, J., Lord, G. H. and Bothwell, J. W. 1964. An arterial prosthesis of heterologous vascular origin. *J. Anim. Med Assoc.* 187 : 741-43.

Rubin, A. L., Drake, M. P., Davison, P. E., Pfahl, D., Speakman, P. T. and Schmitt, F. O. 1965. Effect of pepsin treatment on interaction properties of trophocollagen macromolecules. *Biochem.* 4 : 181-86.

Sewell, W. H. 1955. Failure of freeze dried homologous arteries used as ureteral grafts. *J. Urol.* 74 : 603.

Tietze, 1909. Versuche zur transplantation lebendev Gefasstucke auf andere Hohlorgane des korpers. *klin. Wochenschr* 46-83.

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ANATOMICAL STUDIES ON THE CELIAC ARTERY OF BUFFALO

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ABSTRACT

The major branches ensuing from the celiac artery in buffalo resembled in general with those of other ruminants. The accessory splenic and accessory reticular arteries which have been reported in smaller ruminants only were recorded in buffalo.

Except for a solitary account of Sengar and Singh (1971) the literature on the arteries of the postdiaphragmatic segment of the digestive tract of buffalo is incomplete and sparse. The present paper, therefore, aims at describing the detailed anatomy of the celiac artery and its branches in this animal.

MATERIAL AND METHODS

The investigations were carried on 5 adult females of 8-12 years of age and 8 male murrah buffalo calves of about two years of age. The animals were embalmed by routine intravascular perfusion of 10% formalin solution. The celiac trunk and its branches were dissected in all the carcasses. The young specimens were used after filling the celiac trunk with the coloured latex (Turtox : Chicago). The adult specimens, however, were not injected.

RESULTS AND DISCUSSION

The celiac artery (*A. Celiaca*) arose from the ventral face of abdominal aorta (*Aorta abdominalis*) under the body of the last thoracic or first lumbar vertebra, either separately (in 10 specimens) or in common (in 3 cases) with the cranial mesenteric artery (*A. mesenterica cranialis*). The celiac artery pursued a cranioventral course directed slightly to the right and placing itself between right crus of the diaphragm on right side and pancreas and rumen on the left. It gave off 1-3 phrenic branches (*Aa. phrenicae caudales*) and then finally divided into hepatic artery (*A. hepatica*), splenic artery (*A. lienialis*) and ruminogastric artery.

The caudal phrenic arteries were 2-3 small branches which sometimes arose singly from the cranial surface of the celiac artery, shortly after the latter's exit from the aorta. They ramified in the crurae of the diaphragm. Their detail course and distribution has been described elsewhere (Sharma *et al.*, 1980).

The hepatic artery (Figs. 1-3) arose from the right face of the celiac artery after the exit of the caudal phrenic

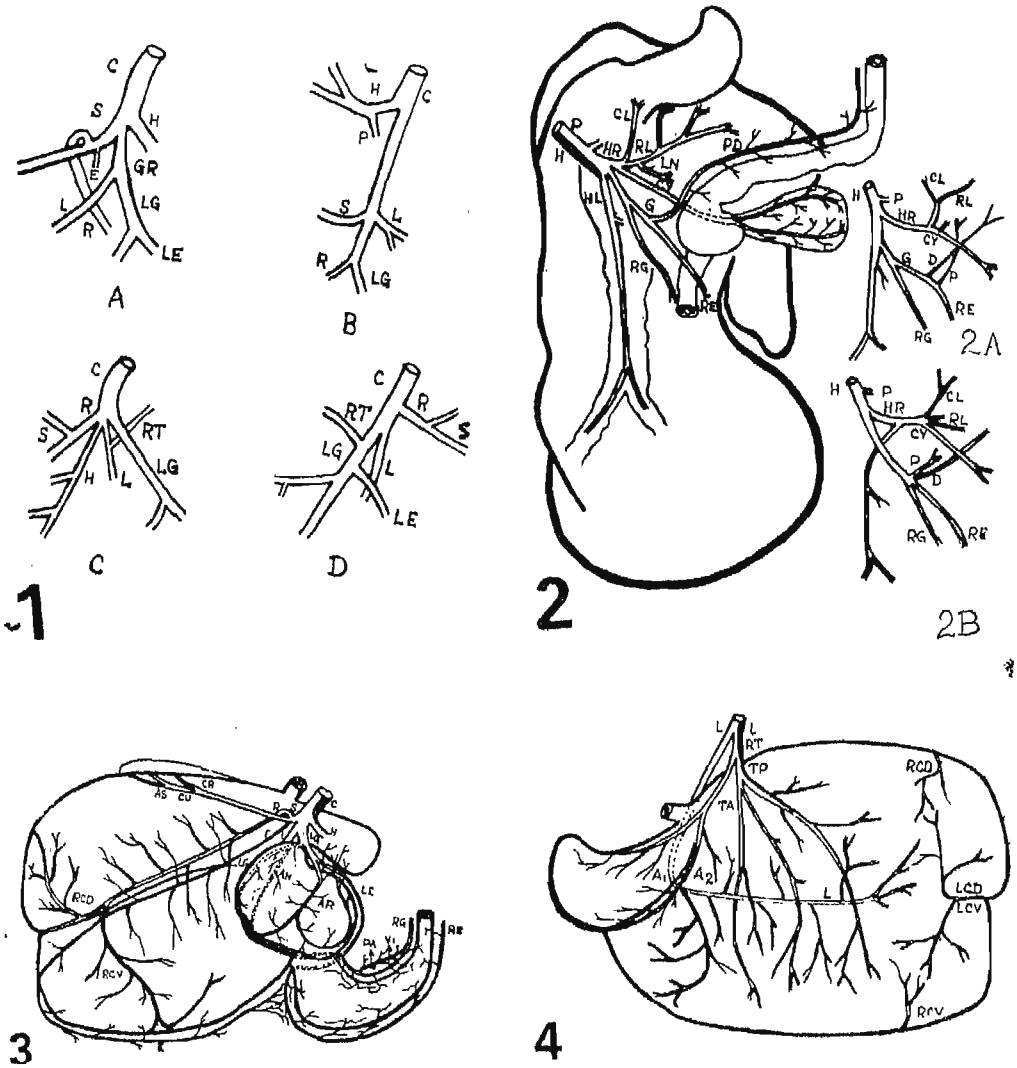


Fig. 1. Schematic diagram to show the branching pattern of celiac artery in buffalo as observed in the present study (A) and by Sengar and Singh, 1971 (B); comparative branching pattern of celiac artery in ox as observed by McLeod, 1958 (C), and Habel, 1975 (D).

Fig. 2. Schematic diagram to show the branches of hepatic artery in buffalo. Figs. 2 A and 2 B illustrate the variations in their branching pattern.

Fig. 3. Schematic diagram showing the branches of celiac artery as observed from the right side. The main celiac trunk has been stretched craniad to show the splenic artery and its branches (and hence the splenic artery appears coursing caudally). The abomasum has also been reflected.

Fig. 4. Schematic diagram to show the branches of the left ruminal and right ruminal arteries as observed from the left side.

artery. In 10 of the cadavers, it sprang dorsal to the origin of the splenic artery. In the remaining three specimens, the two arteries originated from the celiac artery at the same level (Fig. 1). The artery traversed laterally and cranioventrally towards the portal fissure and gave off a small pancreatic ramus (*Ramus pancreatici*). As it passed below the portal vein, it gave off the right ramus (*Ramus dexter*), left ramus (*Ramus sinister*) and a common trunk of right gastric (*A. gastrica dextra*) and gastroduodenal (*A. gastroduodenalis*) arteries. In one animal, this common trunk was found arising from the left ramus (Fig. 2A). In ox, the hepatic artery gives off the pancreatic, dorsal and ventral branches, cystic and gastroduodenal arteries and the right gastric artery is a branch of ventral ramus (Sisson and Grossman, 1953; McLeod, 1958; Raghavan, 1964; Habel, 1975) or the hepatic artery as such.

The right ramus (Fig. 2) of hepatic artery gave off a cystic artery (*A. cystica*) as it crossed over the right face of the portal vein. The origin of the cystic artery, in goat (Harowitz and Venzky, 1966) is similar; however, in sheep it arises directly from the hepatic artery (Anderson and Weber, 1969). The right ramus then gave off branches to the hepatic lymph node, right and caudate lobes of liver and finally continued along the cystic duct as the cystic artery.

The cystic artery passed on to the neck of the gall bladder and divided into two terminal branches. The latter ran on either side of the gall bladder and ramified in a pinnate manner (Fig. 2). Their finer collaterals anastomosed freely with each other. Anderson and Weber (1969) have reported a palmate type of branching pattern of the cystic artery in cow and a pinnate type in sheep.

- Celiac Artery (C)
  - Hepatic artery (H)
    - Pancreatic ramus (P)
    - Right branch (HR)
      - Branch to caudate lobe (CL)
      - Branch to right lobe (RL)
      - Branch to hepatic lymph node (LN)
      - Cystic artery (CY)
    - Left branch (HL)
    - Gastroduodenal (G)
      - Cranial pancreaticoduodenal (PD)
        - Pancreatic (P)
        - Duodenal (D)
      - Right gastroepiploic (RE)
    - Right gastric (RG)
      - Parietal branch (PA)
      - Viceral branch (VI)
  - Splenic (s)
    - Cranial branch (CR)
    - Caudal branch (CU)
    - Accessory splenic (AS)
    - Right ruminal (R)
      - Right dorsal coronary (RCD)
      - Right ventral coronary (RCV)
      - Left dorsal coronary (LCD)
    - Epiploic branch (E)
  - Ruminogastric artery (GR)
    - Left ruminal (L)
      - Reticular (RT)
        - Cranial branch (TA)
          - Dorsal branch (A1)
          - Ventral branch (A2)
        - Caudal branch (TP)
    - Left gastric (LG)
      - Left gastroepiploic (LE)
        - Accessory reticular (AR)
      - Anastomotic branch (AN)

The left ramus commonly originated from the hepatic artery; however, in one calf it arose from the right ramus (Fig. 2B). This vessel traversed cranioventrally deep into the portal fissure and after furnishing arterial twigs to the hepatic lymph nodes, ramified extensively into the left lobe of the liver.

The right **gastric artery** (Figs. 2, 3) commonly arose from the hepatic artery by a common trunk with the gastroduodenal artery. In one case, it arose from the left ramus (Fig. 2A). It coursed ventrally in the lesser omentum. On reaching the ascending part of duodenum it gave off a number of duodenal branches which anastomosed with the branches of right gastroepiploic artery. Then the artery turned along the lesser curvature of abomasum and divided into parietal and visceral branches. They joined the similar branches of the left gastric artery (*A. gastrica sinistra*) and furnished collateral branches for the lesser curvature of abomasum and lesser omentum.

The gastroduodenal artery (Fig. 2) passed cranioventrally in the lesser omentum for a short distance and divided into cranial pancreaticoduodenal (*A. pancreaticoduodenalis cranialis*) and right gastroepiploic arteries (*A. gastroepiploica dextra*). In some cases the right gastroepiploic artery, appeared to be the direct continuation of the gastroduodenal artery, and the pancreatic and duodenal branches sprang separately from it near the second loop of the sigmoid flexor of duodenum.

The cranial pancreaticoduodenal artery after reaching the sigmoid flexor of the duodenum traversed under the common bile duct. It proceeded caudally along the descending part of duodenum and anastomosed with the pancreatic ramus (*Ramus pancreatici*) of the cranial mesenteric artery (*A. mesenterica cranialis*) near the caudal flexor of the duodenum. The collateral branches from this vessel were distributed in the pancreas, duodenum and mesoduodenum.

The right gastroepiploic artery (Figs. 2, 3), immediately after its origin from the gastroduodenal artery, turned caudally, crossed the medial face of sigmoid flexor of duodenum and reached the pylorus via the greater omentum. The artery then passing along the greater curvature of abomasum joined the left gastroepiploic artery (*A. gastroepiploica sinistra*). Collateral branches were given off this vessel to supply the duodenum, the abomasum and the greater omentum. The duodenal branches anastomosed with the branches of the right gastric artery.

The **splenic artery** (Figs 1, 3) arose from the left face of celiac artery slightly distal to or at the level of hepatic artery. It passed along the splenic vein and reached the dorsal curvature of the rumen. It divided into cranial and caudal splenic branches. The two branches of the splenic artery sandwitched the splenic vein and entered the splenic hilus. The caudal splenic branch usually gave off a small accessory splenic artery which also entered the hilus caudal to the entry of the parent artery. In one animal, the accessory splenic artery arose from the epiploic artery (*Ramus epiploicus*). Harowitz and Venzky (1966) have reported the origin of accessory splenic artery from a proximal branch of ruminal artery in two goats. However, it has not been described in cattle.

The collateral branches of the splenic artery were the epiploic artery and the right ruminal artery (*A. ruminalis dextra*). Similar collaterals have been described in ox (Habel, 1975) and goat (Harowitz and Venzky, 1966). The epiploic artery sprang from the caudal face of splenic artery just proximal to the origin of right ruminal artery. It proceeded caudally between the left lobe of pancreas and the splenic vein. Here it gave off a pancreatic ramus which supplied the adjacent lobe of pancreas. The epiploic artery entered the greater omentum as the latter reflected over the right ruminal wall and traversed to the ventral sac. From the right ventral coronary groove of rumen it turned caudoventrally and passed on to the ventral curvature of rumen. Thence it arrived at the fundus of the abomasum and anastomosed with the branches of right gastroepiploic artery.

The right ruminal artery (Figs 3, 4) arose from the cranial face of the splenic artery. In ox, the right ruminal artery may arise from the celiac trunk directly (McLeod, 1958) or in common with the splenic artery (Sisson and Grossman, 1953; Raghavan, 1964) or as a branch of the splenic artery (Habel, 1975). In sheep and goat, it arises as a common trunk with the splenic (Anderson and Weber, 1969; Ghoshal, 1975) or may be a branch of it (Harowitz and Venzky, 1966). The artery wound around the splenic vein and passed caudally over the rumen, ventral to the left lobe of pancreas. There it gained company of the satellite vein and traversing through the right longitudinal and caudal grooves it arrived on the left side of the rumen. Here it gave off the left dorsal and ventral coronary arteries into these ruminal grooves of the corresponding names and anastomosed with the several terminal branches of the left ruminal artery. The right ruminal artery furnished the right dorsal and ventral coronary arteries in the respective grooves before its course into the caudal groove. Branches from these vessels ramified on to the caudal blind sacs of the rumen and anastomosed with the contralateral coronary arteries along the dorsal and ventral sacs of the rumen. Other collateral branches from the dorsal and ventral surfaces of the artery supplied the right wall and the left caudal wall of the rumen.

The **ruminogastric artery** (Figs. 1, 3) appeared to be the continuation of celiac artery. After its origin it coursed between the hepatic and the splenic arteries for a short distance and then gave rise to the left ruminal artery (*A. ruminalis sinistra*) and left gastric artery (*A. gastrica sinistra*). The left ruminal artery arises directly from the celiac artery in ox (Sisson and Grossman, 1953; McLeod, 1958; Raghavan, 1964). However, Habel (1975) described its origin from the splenic or the left gastric artery. It has been reported to originate from the gastric or right ruminal in sheep (May, 1970) and from left gastric or splenic in goat (Harowitz and Venzky, 1966). Soon after its origin the left ruminal artery issued a reticular artery (*A. reticularis*). It then passed cranioventrally between the omasum and the right wall of the rumen, entered the cranial groove and then into the left longitudinal groove of the rumen to gain the company of the satellite vein. As it entered the left groove it gave off a large branch from its ventral side which ramified into the cranial part of the ventral sac and adjacent area of the

rumen. The artery terminated in the caudal part of the left longitudinal groove by giving several branches which anastomosed with left coronary branches of right ruminal artery. The collateral branches from this artery ramified into the cranial part of the right ruminal wall, the cranial ruminal lymph node and left ruminal wall. A few of its branches anastomosed with the branches of the reticular artery on the ruminal wall as has been reported in ox (Sisson and Grossman, 1953; Raghavan, 1964).

The reticular artery (Fig. 4) arose from the left ruminal artery as in ox (Sisson and Grossman, 1953; Raghavan, 1964; McLeod, 1958; Habel, 1975), and sheep (Anderson and Weber, 1969; Habel, 1975). In goat, it may be a branch of left gastric or splenic or left ruminal artery (Harowitz and Venzky, 1966). The artery proceeded ventrolaterally to the left dorsal wall of the rumen and divided into cranial and caudal branches. The cranial branch passed on the atrium ventriculi and divided into dorsal and ventral branches at the cardia. Raghavan (1964) described the division of the reticular artery into superior and inferior branches in ox. The dorsal branch traversed the lesser curvature of the reticulum, turned medially and ramified at the reticulo-omasal junction. Its collateral branches were spread over the right and left dorsal wall of the reticulum and the lesser curvature of omasum. This territorial ramification of the dorsal and ventral branches more or less agrees with the descriptions of superior and inferior reticular arteries of ox (Raghavan, 1964). An anastomotic branch from the dorsal reticular artery joined the accessory reticular artery *(A. reticularis accessoria)*, a branch of the left gastric artery, at the lesser curvature of the reticulum. The ventral branch coursed through the ruminoreticular groove. It furnished several rami for the greater curvature of the reticulum and finally reached the right cranial wall of the rumen. Here it terminated by giving several branches on the cranial part of the rumen. These collaterals anastomosed with the collateral branches of the left ruminal artery as in ox (Sisson and Grossman, 1953; Raghavan, 1964). The caudal branch of the reticular artery passed ventrally and ramified extensively over the left ruminal wall, gave branches to the dorsal and ventral sacs and left cranial part of the rumen. They joined the collaterals of the left ruminal artery. McLeod (1958) reported a rich arterial supply of the left ruminal wall through the reticular artery in ox.

The left gastric artery (Figs. 1, 3) stemmed from the ruminogastric artery. It is considered to be the continuation of celiac artery in ox (Sisson and Grossman, 1953; McLeod, 1958; Raghavan, 1964; Habel, 1975), sheep (Ghoshal, 1975) and goat (Harowitz and Venzky, 1966). It traversed cranioventrally, and issued left gastroepiploic artery and anastomotic ramus dorsal to the omasum. It then passed over the greater curvature of omasum, reached the lesser curvature of the abomasum and divided into parietal and visceral branches which joined with the similar branches of right gastric artery. Collateral branches, given off this artery, supplied the omasum, abomasum and lesser omentum.

The left gastroepiploic artery *(A. gastroepiploica sinistra)* (Fig. 3) traversed between the omasum and reticulum and gave off the accessory reticular artery. After the exit of the latter it reached the reticulo-omasal junction. Following the

lesser curvature of omasum and crossing the omaso-abomasal junction it arrived at the greater curvature of the abomasum and finally anastomosed with the right gastroepiploic artery. The collateral branches of this artery were distributed over the reticulum, reticulo-omasal junction, abomasum and greater omentum.

The accessory reticular artery (Fig. 3) arose from the left gastroepiploic artery as it coursed through the reticulo-omasal junction. It occurs as the branch of left gastric artery in sheep (May, 1970) and goat (Scupin, 1960; Harowitz and Venzky 1966). It passed ventrocaudally along the right surface of omasum and then turned dorsocaudally towards the greater curvature of omasum and anastomosed with the anastomotic ramus of the left gastric artery. It gave off a number of reticular and omasal branches and several anastomotic radicles which joined the collaterals from the reticular artery.

An anastomotic ramus (Fig. 3) was always found to sprout out from the left gastric artery after the origin of the left gastroepiploic artery. It passed along the greater curvature of the omasum and came on its right surface. There it anastomosed with the accessory reticular artery. This branch probably has not been reported earlier in the ruminants.

From the foregoing it appears that the spleen and the reticulum of buffalo are supplied with more number of blood vessels than any other ruminant.

REFERENCES

Anderson, W. D. and Weber, A. F. 1969. Normal arterial supply to the ruminant (ovine) stomach. *J. Anim. Sci.* 28 : 379-82.

Ghoshal, N. G. 1975. abdominal Aorta : In Sisson and Grossman's *"The Anatomy of the Domestic Animals"*, ed. R. Getty. 5th edn. pp. 1016-17. W. B. Saunders Company, Philadelphia, London.

Habel, R. E. 1975. Abdominal aorta : In Sisson and Grossman's *"The Anatomy of the Domestic Animals"*, ed. R. Getty. 5th edn. pp. 912-83. W. B. Saunders Company. Philadelphia, London.

Harowitz, A. and Venzky, W. B. 1966. Distribution of blood vessels to the postdiaphragmatic digestive tract of the goat : Celiac trunk-Gastroduodenal and splenic tributaries of the portal vein. *Am. J. Vet. Res.* **27**: 1293-1315.

May, N. D. S. 1970. *The Anatomy of the Sheep*. 3rd edn. University of Queensland Press, Brisbane, Australia.

McLeod, W. M. 1958. *Bovine Anatomy*. 2nd edn. Revised by Trotter D. M. and Lumb, J. W. pp. 145-46. Burgess Publishing Co., Minneapolis, Minn.

Raghavan, D. (ed.). 1964. *Anatomy of the Ox*. 1st edn. pp 471-73. Indian Council of Agricultural Research, New Delhi.

Sengar, O. P. S. and Singh, S. N. 1971. Studies on the digestive system of ruminants. VIII. Innervation and blood supply of the digestive system in buffalo. *Agra Univ. J. Res. Sci.* 20 : 35-46.

Sisson, S. and Grossman, J. D. 1953. *The Anatomy of the Domestic Animals*. 4th edn. pp 726-27. W. B. Saunders Company, Philadelphia, London.

Sharma, D. N., Barnwal, A. K. and Dhingra, L. D. 1980. Studies on the arterial supply to the diaphragm in relation to diaphragmatic hernia in buffalo, *Haryana agric. Univ. J. Res.* (in press).

Scupin, E. 1960. *Blutgefassversorgung der Verdauungsorgane in Bauch-und Beckenhohle einschliesslich Leber, Milz und Bauchspeicheldruse bei der Ziege*. Diss. med. vet., Hannover. Germany. (fide Harowitz and Venzky, 1966).

RESEARCH NOTE

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ZINC, COPPER AND IRON CONTENTS IN THE BUFFALO BLOOD OF DISTRICTS ROHTAK, SONEPAT AND MOHINDERGARH

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The essentiality of micro-minerals for the growth and production as well as normal functioning of several body systems of the animals is well recognised. The information on the status of micro minerals in the buffalo blood particularly of Haryana region is scanty. This communication reports the zinc, copper and iron contents in the blood of buffaloes of districts Rohtak, Sonepat and Mohindergarh of Haryana State.

Sixty seven samples of buffalo blood from 24 villages belonging to districts Rohtak, Sonepat and Mohindergarh were collected in heparinized glass tubes during November, 1976 to January, 1977. The blood samples were digested in diacid mixture of distilled nitric acid and perchloric acid (AR grade) in the ratio of 5:1 following the method of Lindsay and Norvell (1969). The zinc, copper and iron contents were determined by using the Southern Analytical Atomic Absorption Spectrophotometer (Model A 3000, Shandon, England).

The average values for zinc, copper and iron contents in the blood of buffaloes of different villages of Haryana are presented in Table 1. The average values for zinc content (mg/l) in buffalo blood of districts Rohtak, Sonepat and Mohindergarh were 5.06±0.33, 5.29±0.30 and 4.61±0.12, respectively. The values for blood zinc obtained in this study were higher than the values (0.84 to 3.50 µg/ml) reported by Arneja *et al.* (1977) and were within the range (3.5 to 16.6 µg/ml) reported by Glick (1971) for mammalian blood. Other results for zinc in the blood of different species were 2.5 to 3.5 µg/ml in cattle and sheep (Underwood, 1971)

The average copper content in the blood of buffaloes from districts Rohtak, Sonepat and Mohindergarh were 0.94±0.33, 0.98±0.38 and 0.54±0.05 mg/l respectively. The concentration of total copper content in the blood of buffaloes recorded during the present study appeared to be quite comparable with the range cited by Arneja *et al.* (1977) in buffaloes from 0 to 35 post-partum days.

The average values for iron content in the blood of buffaloes of districts

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TABLE 1

Average zinc, copper and iron contents in the buffalo blood of different localities of Haryana

Village	No. of samples	Trace minerals (mg/l)		
		Zn	Cu	Fe
District Rohtak				
Sahlawas	5	5.21	2.25	211.64
Chhawa	2	6.60	1.14	394.65
Chiri	6	4.35	0.54	276.47
Chandi	1	4.95	0.46	185.90
Nidana	7	4 62	0.36	320.73
Fermana	1	4.62	0.91	343 20
Average		5.06±0.33	0.94±0.33	288.77±32.64
District Sonepat				
Gohana	7	5.52	2.12	165.33
Kathura	5	4.49	0.60	224.10
Sisana	5	6.27	0.46	179.34
Baroda	2	4.29	0.23	329.75
Kansala	2	5.28	0.35	206.25
Khandria	1	6.27	2.74	343.20
Silana	1	4.95	0.46	285.00
Average		5.29±0.30	0.98±0.38	247.57±27.16
District Mohindergarh				
Bawal	7	5.42	0.75	249.93
Perkhotampur	6	5.06	0.41	193.75
Botwas	1	4 62	0.46	285.00
Lakhnol	1	4.29	0.46	212.50
Kakoria	1	4.95	0.46	225.00
Sharanwas	1	4.62	0.91	175.00
Konsiwas	1	4.29	0.68	262.50
Salawas	1	4.29	0.46	200.00
Rewari	1	4.29	0.46	162.50
Bitwana	1	4.62	0.46	250.00
Mundalia	1	4.29	0.46	200.00
Average		4.61±0 12	0.54±0.05	219.65±11.57
Overall average		4.95±0.14	0.78±0.14	245.07±13.20

Rohtak, Sonepat and Mohindergarh were 288.77±32.64, 247.57±27.16 and 219.65±11.57 mg/l, respectively. The average iron content in buffalo blood has been reported to be 53.4 mg % by the scientists from Anand (Anonymous, 1953-70) and 225 to 533.0 µg/ml by Arneja *et al.* (1977). The values for iron content reported in this study were within the range (212.39 to 332.19 µg/ml) reported by Prasad *et al.* (1979) in the buffalo blood in different physiological conditions.

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REFERENCES

Anonymous. 1953-70. A review of the research work on animal nutrition in Western India. Institute of Agriculture, Anand.

Arneja J. S., Hothi, D. S., Singh, Balwant and Varman, P. N. 1977. Status of some macro and micro minerals in neonatal buffalo calves and their mothers. *Indian J. Dairy Sci.* 30 (3) : 255-57.

Glick, David. 1971. *Methods of biochemical Analysis.* Vol. 19, John Wiley and Sons, Inc., New York.

Lindsay, W. L. and Norvell, W. A. 1969. A new DTPA-TEA soil test for zinc and iron. *Agron. Abstr.* 61 : 84.

Prasad, Omkar, Arneja, J. S. and Varman, P. N. 1979. Survey of some mineral elements in the blood of buffaloes in different physiological conditions. *Indian J. Anim. Sci.* 49 (5) : 337-42.

Underwood, E. J. 1971. *Trace elements in human and health.* Academic Press, Inc, New York.

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