EVALUATION OF POINTED GOURD CULTIVARS

(*Trichosanthes dioica* Roxb.)

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By

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CERTIFICATE-1

This is to certify that the thesis entitled "Evaluation of pointed gourd cultivars (Trichosanthes dioica Roxb.)" submitted in partial fulfilment of the requirements for the award of the degree of MASTER OF SCIENCE IN AGRICULTURE (HORTICULTURE) of Orissa University of Agriculture and Technology, Bhubaneswar is a faithful record of bona fied research work carried out by Smt. Babita Mishra under my supervision and guidance and no part of the thesis has been submitted for any other degree or diploma or published in any form.

It is further certified that the help and assistance received during the course of the investigation have been duely acknowledged by her.

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CERTIFICATE-2

This is to certify that the thesis entitled "EVALUATION OF POINTED GOURD CULTIVARS" (Trichosanthes dioica Roxb.) submitted by Smt. Babita Mishra to the Orissa University of Agriculture and Technology. Bhubaneswar in partial fulfilment of the requirements for the degree of Master of Science in Agriculture in the subject Horticulture has been approved by the Students' Advisory Committee after an oral examination on the same in coll aboration with the external examiner.

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ABSTRACT

Pointed gourd is a high priced vegetable and gains consumers preference in summer and rainy seasons. The visual assessment indicates availability of few distinct morphotypes being marketed. However, scientific informations on the genetics and breeding of crop are almost absent or not available in documented manuscript.

Therefore, in an attempt to generate informations on the crop, 11 promising accessions isolated from the genetic stock were evaluated to a replicated yield trial at the Horticulture Research Station, O.U.A.T, Bhubaneswar during 1995-96. The major objectives of the programme were:

* To study the floral biology of the dioecious nature of the crop.
* Assessment of Per se performances of the genotypes.
* Estimations of simple genetic parameters like variability and genetic advance.
* Correlation studies among characters.
* Path coefficient analysis to assess the direct and indirect effect of crop on yield.

and * Measurement of genetic distance among the cultivars by D^2 analysis.

Pointed gourd is a dioecious plant . The sex of the plant is identified by female and male flower bearing in separate plants. As observed, the bud formation appears after 40-45 days of plantation but is dependent on environmental factor like temperature, sunshine, humidity and moisture availability in the soil. Blooming in female flowers takes longer time than anthesis in male flower. The opening of the female flower remains longer favouring exposure of stigma for cross pollination. It is observed that the receptivity of stigma starts 3 hours earlier

and remained receptive for about 36 hours before and after the anthesis. The viability of the pollen remains for few hours and attains peak at the anthesis. It is observed that pollination in this case is often accomplished by the Red ant (Componatus compressus) and Red brown bettle (Carpophylus demidiatus).

The variability studies indicated low to moderate level of variation due to genotype (GCV=8.25 -71.91) and phenotype (PCV= 9.16-72.07). While the broad sense heritability indicated very high heritability (more than 90%) except diameter of fruit, possibly because of environment, favouring character expression. The advantage in selection (GA) indicated that selection for number of nodes per plant, number of fruits per plant, days taken for appearance of first female flower would be of advantage to the breeder.

The correlation studies on 14 characters indicated that the fruit yield per plant is significantly highly correlated with number of fruits per plant, percentage of fruitset and percentage of fruit retention. While the assessment of direct and indirect effect of various characters showed that number of nodes per plant, percentage of fruit set, number of fruits per plant, and weight of the fruit exhibited direct positive effect both at genotypic and phenotypic levels. The culminating stage of the programme was to assess the genetic distance among the 11 test genotypes . The D^2 analysis and the clustering pattern indicated that the five genotypes like BPS-1, BPS-3, BPS-8, BPS-9,BPS-10 fell into single cluster while BPS-2,BPS-6, BPS-7, fell into separate clusters.There were 3 monogenotypic clusters consisting of BPS-4, BPS-5, BPS-11 separately. The study indicated that a reciprocal recurrent selection by using best genotypes from each cluster would be of high value from the yield improvement point of view in the pointed gourd.

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CHAPTER I

INTRODUCTION

INTRODUCTION

Pointed gourd (Trichosanthes dioica Roxb.) is native of India. Probable centre of diversity is assumed to be somewhere in the eastern part of the country, most likely Bengal and Assam region. The crop is dioecious in nature having both male and female flower borne on separate plant. It is a vegetatively propagated rare vegetable, grown extensively in the states of Bihar, West-Bengal and East Uttar Pradesh. In recent years cultivation of pointed gourd has been tremendously picked up in the states like, Orissa, Assam, Madhya Pradesh, Maharastra and Gujurat for its high remunerative market price. The fruits of pointed gourd possesses therapeutic uses as well . It is easily digestible, diuretic and laxative. It also invigorates heart and has been found to be useful in correcting circulatory disorders.

Though pointed gourd is extensively grown in the states mentioned above, the exact acreage and production are not available. Somehow, not much work has been done on the improvement of this crop. Scientific informations are insignificant either not available and/ or inadequate for the purpose of launching a new research programme. For its high commercial value and consumer choice in the vegetable market, it has attracted the attention of scientists in quest of its genetic upgrading for high productivity, better quality and wider adoptability.

With the above background informations, the present study on 11 distinctly diverse genotypes, identified from the genetic stock collected from different parts of Orissa and also from neighbouring States, by the P.I., adhoc project on the "Improvement of pointed gourd", were taken up . The experiment was carried

out in the Horticulture Research Station, O.U.A.T., Bhubaneswar during November 1995 to July 1996, with the following objectives:

* Assessment of Per se performances of the test genotypes.
* Studies on floral biology and fruit development in both male and female flowers.
* Estimation of variability, genetic gain in selection, character association with direct and indirect effect of component characters on fruit yield.

and * Assessment of genetic distance among the genotypes following D^2- statistics.

CHAPTER II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

In this chapter an honest attempt has been made to sum up the available literature on the research work carried out in relation to evaluation of pointed gourd cultivars at different agro-ecological situations. However, the literature available on pointed gourd crop is scanty for which work on other related crops has also been reviewed.

FLORAL BIOLOGY

Development of floral bud :

Sing et. al. (1989) studied floral biology of pointed gourd and reported that male flower buds took 16-19 days while female flower buds took 10-14 days from initiation to anthesis (when anther and stigma become first visible).

Anthesis and dehiscence of anthers :

Singh et al. (1989) observed that anthesis in pointed gourd began at 19.00 to 19.30 hours in female and 19.30 to 20.00 hours in male flowers.

Receptivity of stigma :

Singh et al. (1989) studied the stigma receptivity in pointed gourd and reported that the stigma was highly receptive at the time of anthesis and remains viable for 14 and 24 hours after anthesis in open and tagged flowers respectively.

Pollen studies :

Singh et al. (1989) reported that pollen grains were 39.78μ in diameter and 97.77μ and 81.30% of them were viable

according to acetocarmine staining and artificial germination respectively.

Pollination :

Sachan et al. (1990) studies the pollination in pointed gourd and reported four insect species visiting the staminate and pistillate flowers. They were of the view that red brown beetle (Carpophylus demidiatus) contributed appreciably to pollination.

Fruit set and fruit development :

Sachan et al. (1990) opinioned that the fruits of pointed gourd took 27-29 days to reach full maturity and 10-11 days to edible marketable stage after pollination. Increase in length and diameter was more rapid during the first 10 days.

Other Cucurbits :

Flower bud development:

Brar et al. (1969) reported in Cucurbita pepo that the male and female flower buds took on an average 17.78 and 19.23 days respectively from initiation to full blooming.

Pal et al. (1972) observed that the male flower bud of bitter gourd took 17 to 19 days for complete development, whereas female flower took 21-22 days.

Vijay et al. (1977) noticed in Kakrol (M. cochinchinensis) that from initiation to full bloom, male and female buds took 20-24 days and 19-22 days, respectively.

Anthesis and anther dehiscence :

Agarwal et al. (1957) noticed that anthesis commenced between 4.00 A.M.to 7.30 A.M.and completed between 6.00 A.M. to 9.55 A.M. in bitter gourd.

Vijay et al. (1977) studied floral biology in Kakrol and reported that the stigma was receptive for 18 hrs before and after anthesis, but maximum receptivity was found between 12 hrs before and after anthesis.

Deshpande et al. (1979) observed in bitter gourd that stigma remained receptive for 24 hrs before and after anthesis.

Despande et al. (1980) studied stigma receptivity in ridge gourd by judging set method and concluded that fruit set reached the maximum (76%) at anthesis, but 19% fruit set was obtained 12 hrs after anthesis.

Deshpande et al. (1980) also studied the floral biology of snake gourd and as gourd and reported that in both cases the stigma remained receptive 12 hrs before anthesis & continued to do so to 12 hrs after anthesis of the peak stage of receptivity being at the time of anthesis.

Receptivity of stigma :

Pal et al. (1972) studied the receptivity of stigma in bitter gourd and reported that stigma was highly receptive at the time of anthesis, though it started 8 hrs before anthesis and continued to do so 12 hrs after anthesis.

Deshpande et al (1979) studied floral biology in four varieties of bitter gourd and reported that pollen viability ranged from 90% to 99% while pollen germination from 58% to 66%.

VARIABILITY COMPONENTS

Variability and heritability of quantitative traits :

Selection of superior genotypes at one stage or the other is the most important aspect in any plant breeding programme and the effectiveness of selection is dependant upon the existence of genetic variability within or among the population subject to selection (Dixit et al., 1971 ; Swamy Rao, 1972; Tika et al., 1974; Patnaik and Tak, 1974). Therefore, a quantitative measure of geneitic variability would be extremely beneficial in breeding for improvement of quantitative traits.

Coefficient of variation :

It is useful for comparision between different populations as it is the measure of variation and is independent of unit of measurement which is provided by the standard deviation as expressed as the percentage of mean (Panse and Sukhatme, 1967).

Genetic coefficient of variation is the genotypic standard deviation expressed as the percentage of mean and phenotypic coefficient of variation is expressed as the percentage of mean of phenotypic standard deviation. A negligible influence of environment on the character is indicated by a slight difference between phenotypic and genotypic standard deviation as suggested by Chaudhury, et al.

Heritability :

A useful measure of the relative importance of hereditary and environmental components of variation in the quantitative traits is the heritability. It is estimated as the ratio of genotypic variance to the total phenotypic variance that is due to genetic causes. The term heritability is also used in more

specific ways on consideration of response to selection, e.g., narrow sense heritability measured as the ratio of additive genetic variance to the total phenotypic variance (Wright, 1921) and a broad sense heritability is the ratio of total genotypic variance to the observed phenotypic variance (Lush, 1949) which are symbolically represented as follows:

$$h^2 \text{ (narrow sense)} = V_A/(V_G + V_E) = V_A/V_P$$

$$h^2 \text{ (broad sense)} = V_G/(V_G + V_E) = V_G/V_P$$

Mohanty and singh (1973) described heritability as relative importance of genetic and non-genetic factors on the expression of a quantitative character. But according to Liang and Walter (1968), heritability is defined as the transmission of characters from parent to the offspring.

Heritability is one of the major properties of a quantitative character. But it should be noted that heritability is a property not only of a character but also of a population and the environmental conditions to which the individuals are exposed.

Genetic advance :

Escuro et al (1963) reported that genetic advance indicates the potentiality of selection at a particular level of selection intensity. The expected genetic advance from selection is the product of (i) the selection differential based on the mean phenotypic value of the selected lines and of the base population, (ii) heritability of the character under selection, and (iii) phenotypic standard deviation.

Heritability in narrow sense is the most important tool to estimate expected improvement due to selection or response

to selection or genetic advance. Robinson (1963) and Johnson et al. (1955) are of the view that heritability estimates along with genetic advance are more valuable than the heritability value alone in predicting the response to selection. High heritability does not necessarily mean that a character with high heritability will show high genetic advance. But where the above association exists, additive gene comes into prominence. It is because no genetic advance was due to non-additive genes, where as additive genes are responsible for high genetic advance. Siva Subramaniam et al. (1973) stated that heritability and genetic coefficient of variation were not sufficient guide to show the expected progress that could be achieved through selection.

Variability and heritability in pointed gourd

Singh et al. (1985) studied variability in pointed gourd cultivars and found narrow range of variability in the characters like node bearing first flower, number of days to first flowering, internodal elongation,pulp content of fruit, skin thickness of fruit, and leaf area, where as fruit length, seed size, seed weight. Seed volume, seed weight, and fruit yield show higher coefficient of genetic variability. Fruit diameter and fruit length showed moderate coefficient of variation while other characters such as days to first flower and fruit weight showed low coefficient of variation indicating low genetic variability among the cultivars for these characters. The genetic advance expressed in percentage of mean was highest for seed number per fruit, Fruit length, diameter of fruit, yield per plant expressed high heritability and moderately high genetic advance. ingh and Krishna prasad (1989) found high variability among 5 cultivars of pointed gourd for characters like number of odes, shoots and fruits, fruit length and volume and yield

per plant. He also found maximum amount of genetic variation in number of shoots, yield per plant, fruit length and fruit weight.

Prasad and Singh (1990) conducted a study on morphological and agronomical components of pointed gourd. They observed higher yield was correlated with late flowering as demonstrated in CHESS-12. The fruit weight (34.6g.) and the seed number (19.9) were the highest in CHESS-14. The results indicated that the number of seeds per fruit had direct correlation with fruit weight.

Nandpuri et al. (1975) in a musk melon, scrutinised the germplasm for some economic characters. The number of fruits per plant and the yield per plant possessed high values for genotypic co-efficient of variability, also combined high values of heritability and consequently the high percentage of genetic advance.

Singh et al. (1977) in a study of bitter gourd (Momordica charantia) varieties, noticed high genetic co-efficient of variation, high estimates of heritability and genetic advance for the characters like yield, fruit number per plant and fruit length. Significant differences between varieties were found for all the characters studied.

Miller and Quisenberry (1976) studied about early and late flowering lines and their progenies of cucumber. They reported that genetic variance was primarily additive and observed partial dominance for early flower and low nodal position on the first flower. Moderately high heritability was noted for days to first flower appearance which was controlled by few genes.

Srivastava et al. (1976) working on 10 lines of bitter gourd, got high estimates of heritability and genetic advance for fruit number, fruit weight and yield per plant.

Panwar et al. (1977) studied the performance of 40 genotypes in spong gourd (Luffa cylindrica Roem.) and observed high heritability (broad sense) and genetic advance for fruit length and days to flower respectively.

Sidhu and Brar (1978) studied seven varieties of water melon and estimated genotypic and phenotypic variations and heritability for yield, yield components, maturity and quality traits. They concluded from their study that crop improvement could best be achieved by improvement in fruit number per plant and fruit weight.

Solanki and Seth (1980), found considerable phenotypic variability existing among 24 varieties for height, number of leaves per plant, number of male flowers per plant, number of days to maturity and number of female flowers per plant in cucumber. They reported high heritability and high genetic advance for the above characters and fruit yield and internode length which were found to be governed by additive genes. High heritability and low genetic advance for average fruit number per plant etc. were due to non-additive gene effects.

Indiresh (1982) assessed 24 lines of bitter gourd and reported high genetic co-efficients of variation for fruit fresh weight, yield per plant, fruit cavity length, leaf area and fruit length. High heritability was found for all characters except yield per plant and days for fruit development.

Rana (1982) reported significant difference among ten characters in 19 lines of pumpkin grown in two environments. High estimates of heritability and genetic advance for vine length and percentage of fruitset were also noticed by him.

Prasad et al. (1984) studied 40 Indian varieties of Luffa cylindrica and analysed data regarding yield per plant and 16 yield related traits. They found heritability estimates of 100% for yield per plant and otherr four traits. High values of both heritability and genetic advance were reported for 5 traits including fruit length and fruit diameter.

Rana et al. (1986) analysed the data on yield per plant and other eleven yield related qualities and developmental traits in 19 genotypes of pumpkin and found significant difference for all the traits except dry matter and carotene content. Phenotypic and genotypic co-efficients of variations were high for stem length, percentage of fruit set, branch number per plant and fruit weight. High heritability (55) and high expected genetic advance was exhibited by the characters like stem length, percentage of fruitset and fruit number per plant.

Prasad et al (1988) evaluated 9 germplasm lines of water melon for 14 characters and reported high genotypic and phenotypic co-efficient of variation for fruits per plant, average fruit weight, seeds per fruit, 100-seed weight, and fruit yield per plant. These characters also showed high values of heritability and genetic advance.

Selection for one character would result in the progress for all positively correlated characters. This relation suggests the advantage of a scheme for more than one characters at the same time (Baha Eldin et al. 1968). If negative correlation exists between components of yield, then selection is to be done for intermediate combinations for improvement of yield. According to Randhawa et al. (1975). It will be a great help for selection if a low heritable complex character exhibits high correlation with other simply inherited characters.

Character association in pointed gourd :

Singh and Krishnaprasad (1989) studied on 25 cultivars of pointed gourd and revealed that significant positive correlations exist between yield per plant and number of fruit, fruit volume and fruit weight and significant negative correlation in fruit diameter and number of nodes.

Characters association in other cucurbits :

Srivastava (1976) in a correlation study of 10 lines of bitter gourd, reported that yield was positively correlated with fruit number which was further positively correlated with number of lateral branches and number of female flowers per plant.

Ramachandran et al. (1979) worked on correlation studies with 25 diverse M. charantia forms indicated that yield per plant was positively i.e. both phenotypically and genotypicallly correlated with length of the main stem, fruit weight, fruit length and number of fruits per plant, number of female flowers per plant and number of primary branches per plant.

Rana (1982) in pumpkin, reported high significant positive association of yield per plant with number of flowers per plant, fruit number, fruit weight and flesh thickness. According to this finding, correlations between most of the yield components were postive and significant.

Rana et al. (1985) evaluated yield per plant and 9 related characters in 19 genotypes of pumpkin. They found significant and positive correlations of yield per plant with number of female flowers, number of fruits per plant, percent of fruit set, fruit weight and flesh thickness.

Singh and Singh (1988) in a study of 11 diverse genotypes of water melon, reported that yield per vine was positively correlated with number of fruits per vine (r = 0.95) and negatively correlated with rind thickness, fruit weight, number of days and nodes for the appearance of the first female flower.

U. Borthakur and A. Shadeque (1994) Twenty genotypes of pumpkin collected from diverse sources were evaluated for yield and various yield attributing characters. The data were utilised to work out the phenotypic, genotypic and environmental correlation between the traits. The characters viz ; length of main creeper, internodal length of main creeper, number of leaves per plant, number of female flowers per plant, number of fruits per plant, Fruit weight have direct influence on yield of pumpkin.

Janakiram and P.S. Sirohi (1994) . Variability and correlation studies were conducted in 12 genetypes of bottle gourd. Observations recorded on nine traits indicated highly significant genotypic differences in respect of all the characters. Fruit polar diameter followed by total yield per plant showed high genotypic coefficient of variation, genetic advance as percentage of mean, which may be attributed to additive gene effects. Total yield per plant was observed to have positive significant correlation with vine length, days to open first female flower, days to first harvest, number of fruits per plant and fruit weight.

PATH ANALYSIS :

Yield is a complex trait resulting from direct and indirect effects of several traits operating either in combination or individually. Selection for a trait in one direction may influence another trait by a direct of indirect effect via third variable. The study of correlation gives only the extent of association

but does not imply the cause and effect relationship. Therefore, the path coefficient analysis is used to determine the direct and indirect effects of various plant characters on crop yield.

According to Wright (1921) , path coefficient analysis provides a better knowledge of direct and indirect cause of association and it permits a critical examination of the specific forces acting to produce a given correlation and measures and relative importance of each causal factor.

This method was first used by Dewey and Lu (1959) in their analysis of seed yield in crested wheat grass. Since then several workers, have applied this method of analysis of character association in various crops.

Path analysis in cucurbits :

Thamburaj (1973) in ridge gourd (Luffa acutangula) reported that fruit weight and number of seeds were the important characters having a significant effect on yield. From a multiple regression analysis he concluded that seed weight per pod was highly predictable.

Tikka et al. (1974) conducted a study on path analysis in ten varieties of water melon and stated that number of days to first female flower and averge fruit weight had the highest direct effect on yield and were themselves influenced by main shoot length and number of primary laterals.

Srivastava et al. (1976) in a study of 10 lines of bitter gourd, reported that number of female flewers was having maximum positive direct effect on yield. They further reported the indirect contribution of other characters on yield namely through number of lateral branches per plant, number of female flowers per plant and number of fruits per plant.

Gopal Krishnan et al. (1980) studied 25 quantitative characters in 18 genetically distinct types of pumpkin and reported the greatest direct effects of main stem length and average fruit weight on yield.

Sidhu and Brar (1981) in a study of path coefficient analysis in water melon indicated that number of nodes to first female flower and flesh weight had high direct as well as indirect effects on yield.

Rana et al. (1985) while studying path analysis using 19 genotypes of pumpkin grown in summer and rainy season reported that fruit weight and flesh thickness had the greatest direct effect on yield in both environments and their indirect effects were responsible for the correlation of the characters viz;. number of fruits per plant, percentage of fruit set, fruit weight and flesh thickness with yield per plant.

Singh and Singh (1988) in water melon reported the highest direct effects of number of fruits per vine and total soluble solids on yield. From a correlation study they concluded that the characters like number of days and node number for the appearance of the first female flower could be recommended to improve earliness.

Abusalecha and Duta (1988) conducted path coefficient analysis on yield attributes in cucumber comprising 75 diverse genotypes. Their analysis revealed, that fruits per vine and fruit length had the greatest direct effect on yield.

Zhang and Wang (1989) while studying path coefficient analysis in 21 lines of water melon and their F_1 hybrids reported that fruit weight had a direct effect on fruit yield per plant

and indirect effect of shoot thickness on fruit yield per plant mainly via fruit weight were also observed by them.

Genetic divergence :

Parhi, et al. (1993) Genetic divergence using Mahalanobis' D^2 statistics was studied on 14 quantitative characters including yield per plant in a collection of 13 genotypes of bitter gourd (Momordica charantia L.). The genotypes differed significantly for all the characters studied and were grouped into six clusters based on the similarities of D^2 values. Considerable diversity within and between clusters were noted and it was observed that the characters like 100-seed weight, number of seeds per fruit and yield per plant contributed maximum to divergence. Hence, selection of divergent parents based on these characters may be useful for heterosis breeding in bittergourd.

M.Abdulwahab, P.K. Gopal Krishnan (1993) made a study on 50 genotypes in bitergourd revealed that the grouping pattern of genotypes was not always directly associated with the geographic diversity. The same group consisted of genotypes of different source/origin and the lines of same origin/source fell into different groups also. It is seen that the cluster I had lines of less economic importance. The high yielding types fell into cluster III, irrespective of geographic sources. From the study it is observed that choice of parents for any breeding programme need not necessarily be based on source, origin or genetic distance.

CHAPTER III

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation entitled "Evaluation of pointed gourd cultivars (Trichosanthes dioica Roxb.)" was carried out during 1995-1996 at the Horticulture Research Station, Orissa University of Agriculture amd Techonology, Bhubaneswar. The research work comprising of two parts viz :

Part-I Floral biology and fruit development of Cultivars.

Part-II Variability studies and character association.

Year	Kharif	Rabi	Summer
1993-94	Fallow	Fallow	Fallow
1994-95	Fallow	Pointed gourd	Fallow
1995-96	Fallow	Pointed gourd (Present experiment)	

SOIL :

An ideal soil sample was collected, analysed before commencement of the present experiment to determine the basic status of the soil. The Physico-chemical composition of soil of the experimental field as studied are presented below.

Sl.No.	Characteristics	Value	Method used.
1.	Mechanical composition :		
i)	Coarse sand	51.79%	Bouyoucos
ii)	Fine sand	29.51%	Hydrometer
iii)	Silt	7.12%	(Bouyoucos 1962)
iv)	Clay	11.58%	(Bouyoucos 1962)
2.	Total nitrogen	0.042%	Kjeldahl's method (Jackson, 1962)
3.	Available Phosphorus	6.5%	Brays strong reagent (Bray, 1948)
4.	Available Pottassium	13.0%	Morgan's reagent (Jackson, 1962)
5.	Organic Carbon	0.41	(Walkeley and Black, 1964)
6.	C:N, Ratio	9.76 :1	-
7.	pH	5.5	Beckman's pH (meter piper, 1966)

The soil of the experimental field was, thus, found to be sandyloam in texture containing less amount of nitrogen as well as phosphorous, but farely rich in potash. The soil pH was slightly acidic in nature.

CLIMATE :

Geographically, Bhubaneswar is loacted in the sub-tropics at the latitude of 25°15'.N and longitude of 80°22'E and on the altitude of 25.5 meters above the mean sea level. It is 62 kilometers away from the Bay of Bangal towards the west.

TABLE-1

Meterological information relating to research station from November 95 to July96.

Month	Temperature °c			Relative humidity(%)			Rainfall (mm)	No.of rainy days	Wind Velocity (Km/ha.)	Sunshine hours
	Max.	Min.	Mean	F.N.	A.N.	Mean				
Nov.95	29.2	19.0	24.1	90	58	74.0	183.5	7	5.3	7.8
Dec.95	28.9	14.7	21.8	92	44	68.0	NIL	NIL	1.5	9.0
Jan.96	29.1	16.9	23.0	93	51	72.0	83.5	2	-	8.1
Feb.96	30.9	18.3	24.6	95	46	70.5	4.6	2	-	9.4
Mar.96	35.0	22.6	28.8	92	47	69.5	Trace	1	-	8.1
Apr.96	36.9	24.5	30.7	89	45	67.0	17.2	4	-	8.6
May.96	37.5	26.8	32.1	87	55	71.0	41.1	5	-	8.4
Jun.96	34.1	25.4	29.7	90	68	79.0	134.5	14	-	8.2
July.96	32.8	25.3	29.0	92	72	82.0	141.5	16	-	5.4

METROLOGICAL INFORMATION RELATING TO RESEARCH FROM 1995 to 1996

The average annual preceptation is about 1526.75 mm. which was received from Nov.95 month to July 96 month. The average maximum temperature received during the experimental period varies between 36.9°C to 37.5°C during April to May month and the average minimum temperature during the months of December to January varies between 14.7°C to 16.9°C. The meterological data of the station pertaining to the period has been presented in Table No. 1.

PART-I

FLORAL BIOLOGY AND FRUIT DEVELOPMENT

Experimental details :

The planting materials of (both male and female) eleven identified cultivars were collected from the research plots maintained by the P.I., Adhoc Project on "Improvement of Pointed gourd". Planting was done in the well prepared and manured plots during 27.11.95 with a spacing of 2m.X1m. . In each plot 10 plants were planted in the ratio of 9:1 (female : male). The plots were fertilised with N,P,K,@ 90:60:40 Kg/ha, respectively. At the time of planting full dose of phosphorus, potash and 1/3rd of nitrogen were applied. Rest 2/3rd nitrogen was subsequently top dressed in three equal splits. Regular plant protection measures were taken as and when required. For the convinience of recording observations, individual plants were provided supports.

Characters studied :

Observations were recorded from five sampled plants of

each plot and the mean figures were taken for the study. The characters pertaining to the study of floral biology are as follows :

1. Flower Morphology
2. Days taken for the appearance of first flower bud
3. Time taken for opening of flower
4. Time of anthesis
5. Pollen viability (%)
6. Pollen dimension
7. Pollen germination
8. Receptivity of stigma
9. Pollination
10. Fruit Set
11. Fruit development

1.Flower Morphology :

For morphological study, ten numbers of flowers of male aand female were observed under desecting microscope. The number of sepals, petals, stamens, carpels per flower were counted. The position of the ovary and anthers were also recorded.

2.Days taken for the appearance of first flower bud :

The period between the visible flower bud and opening of the flower was recorded in days for male and female flowers, separately. For this study five flowers from each male and female plants were selected randomly from the population.

3.Time taken for the opening of the flowers :

The period between the starting of small rupture at the tip of the petal to complete opening of flower was observed in both male as well female flowers.

4.Time of anthesis :

For recording the time of complete opening of flower, ten flower buds including male and female which were likely to open the day after, were tagged between 6.00 - 9.00 P.M. Anthesis studies were taken up at half an hour intervals starting from 6.00 P.M. Observations were recorded for five days and the average values were taken into considerations.

5.Pollen viability (%):

For this pollen grains were extracted from freshly dehisced anthers of each cultivar on the slide. They were stained in 1% acetocarmine solution and observed under the microscope. The percentage of viable (stained) and nonviable (non stained) pollen grains were calculated from the total number of pollens observed in the microscopic field.

6.Pollen dimensions :

The diameter of fifteen pollen grains of the male flower was measured by stage and occular micrometers using 10x eyepiece and the diameter was calculated in microns.

7.Germination of pollen :

Various concentrations of sucrose solutions (0%,5%,10%,15%,20%) were taken in five cavity slides and pollengrains from freshly deshisced anther were dusted in these solutions. Then the slides were covered with wet blotting paper and kept in the petridishes. The whole system was maintained in a cool place by frequently sprinkling water. After twelve hours, the pollen germination was recorded and expressed in percentage.

. Receptivity of stigma :

As soon as the lusturous fluid with shining colour was bserved at the stigmatic surface, it was understood to be the nception of receptivity of stigma. The time taken to the withering f stigmatic surface which was considered to be the duration f receptivity.

. Pollination :

Specific flowers were kept under watch through out the ay to notice the interference of pollinating agents and bservations were recorded accordingly.

). Fruit Set :

The fertilised flowers which exhibited the sign of swelling f ovaries was presumed to be the stage of completion of ertilisation leading to formation of fruits. Then the number f fruit set were converted into percentage with respect to ne number of female flowers.

1. Fruit development :

The days taken from fruit set to the stage of harvest f marketable fruits were recorded. The length and diameter of en fruits were also measured and the average values were taken or the purpose.

P A R T- II

VARIABILITY STUDIES AND CHARACTER ASSOCIATION

xperimental details :

sign of layout	:	Randomised Block Design(Fig.1)
mber of treatments	:	11 (Cultivars of pointed gourd)
mber of Replications	:	3
tal number of plots	:	33

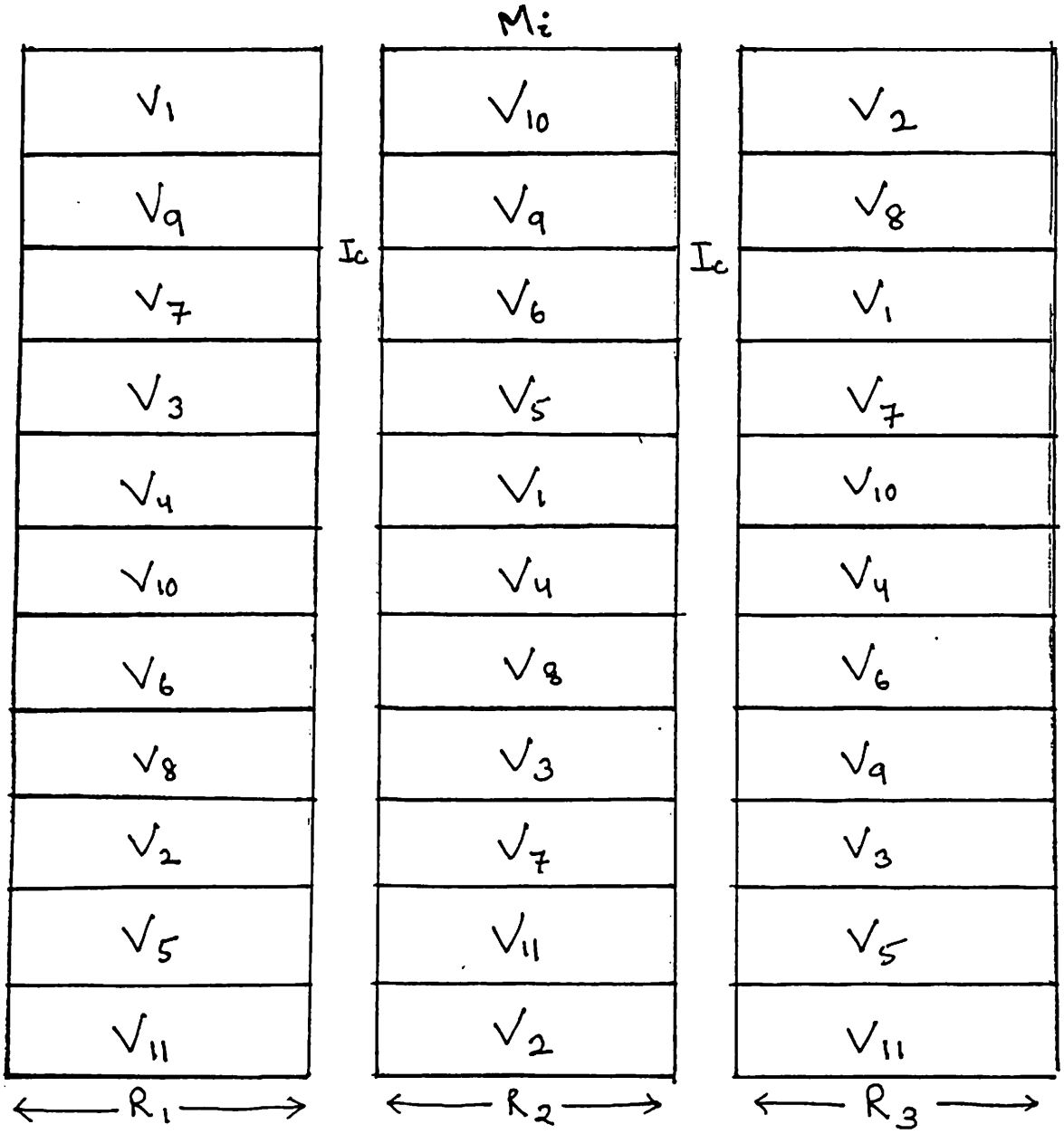

Fig-1

PLAN OF LAYOUT OF THE EXPERIMENTAL PLOT

DESIGN - RANDOMISED BLOCK

PLOT SIZE - 5 mt. X 2 mt.

M_i - MAIN IRRIGATION CHANNEL

Ic - IRRIGATION CHANNEL

Plot size : 5mX2m

Spacing : 2mX1m

Row to Row : 2m

Plant to Plant : 1m

Number of Plants/Plot : 10 (nine females and one male)

Source of Planting materials :

For variability study, eleven cultivars were selected from among 69 cultivars obtained from different parts of Orissa as well as neighbouring states.

Land Preparation :

The general preplanting operation carried out in the field were as follows:

Date	**Operations**	**Remarks**
2.11.95	Ploughing	By tractor
5.11.95	Ploughing and cross Ploughing	By tractor
10.11.95	Weeding	By manual labour
12.11.95	Weeding and layout	By manual labour
14.11.95	Layout, digging of pits of size 1'x1'x1' each and application of well rotter poultry manure @1/2 basket and Aldrin 5%, Dose @ 20g/Pit respectively.	By manual labour

Technique of study :

For collecting data on various biometrical observation,

TABLE-2

SOURCE OF PLANTING MATERIALS

Sl.No.	Code	Genotypes	Place	District
01.	BPS-1	AC-21	jenapur	Jajpur
02.	BPS-2	AC-22	Jenapur	Jajpur
03.	BPS-3	AC-25	Panikoili	Jajpur
04.	BPS-4	AC-28	Bolangir	Bolangir
05.	BPS-5	AC-35	Bolangir	Bolangir
06.	BPS-6	AC-57	Bhanjanagar	Ganjam
07.	BPS-7	AC-58	Bhanjanagar	Ganjam
08.	BPS-8	AC-61	Polasara	Ganjam
09.	BPS-9	AC-64	Maner(Bihar)	----
10.	BPS-10	AC-66	North Bihar	----
11.	BPS-11	AC-69	North Bihar	----

five plants of each cultivar in a replication were selected randomly from each plant. The selected plants were tagged and labelled properly. The average of five plants per replication for each character studied was subjected to statistical analysis. All the characters were studied at later part of peak harvesting stage except the days taken for appearance of first female flower and node at which first female flower appeared.

The observations were recorded on the following growth, yield and yield attributing characters for the variability study. Some observations were also recorded on the qualitative parameters of the fruits and also documented.

(A) 1. Number of branches per plant

The total number of branches emerging from the main vine was counted and the mean values were recorded.

2. Fruit diameter :

The diameter of five fruits at each harvest was measured at the equatorial region and the mean values were recorded. The mean fruit diameter was calculated after final harvest.

3. Days taken for the appearance of first female flower:

Days required for the appearance of the first female flower was recorded from five randomly selected plants and the mean was found out for the purpose.

4. Fruit length :

The length of three fruits at each harvest was measured and the mean values were recorded. The mean length of the fruits was calculated after final harvest.

5. Fruit number per Plant:

A record on number of fruits from each sample plant at each harvest was maintained and finally the total number of fruits per plant was determined.

6. Fruit weight :

The fruits selected earlier for measuring fruit size were also utilised for recording the fruit weight at each harvest. The fruits were weighted and the mean weight was calculated in grams after the final harvest.

7. Number of nodes per plant :

The total number of nodes per plant were counted and the mean number of nodes were estimated in each case.

3. Length of the vine (m):

The vine length of five randomly chosen tagged plants measured from the base of the plant to the top of the vine and the average values were recorded.

. Node at which first female flower appeared:

Node number at which the first female flower appeared as counted from the base and the mean of five selected plants ere evaluated.

0. Length of internode:

Length of 5^{th} internode from the tip of the main branch as measured and the mean was recorded.

1. Fruits set (%):

The total number of fruit set per plant was counted nd converted into percentage with respect to the total number f female flowers per plant and the mean values were recorded.

12. Final fruit retention (%):

The total number of fruits retained till the final harvest was recorded and converted into percentage with respect to total fruit set and the mean values were recorded.

13. Days taken from fruit set to marketable maturity:

Days required for attending marketable maturity from the day of fruit set was documented from the five sample plants of each plot and the mean value was found out.

14. Fruit yield per plant :

Fresh weight of marketable fruits per plant at different harvests were added up for calculating the sum total fruit yield per plant.

Qualitative characters:

.. Pulp content :

The pulp content of fruits were recorded taking five fruits from each sample plants. Pulp was removed by cutting the fruits into two longitudinal halves and scrapping the pulp along with the seed leaving back only the rind. The pulp thus, obtained from twentyfive fruits of each plot were weighed and the mean content of pulp per fruit was recorded.

. (Rind : Pulp) ratio:

After the extraction of the pulp from each fruit the rind weight of the same number of fruits as mentioned above as recorded and the weight of rind per fruit was documented. Finally taking both the mean values the rind: pulp ratio was calculated.

3. Rind thickness:

The rind thickness of twenty five sample fruits from each plot was recorded and the mean value was documented.

4. Seed number :

The seeds separated from the pulp of twenty five fruits of each plot were counted and the mean number of seeds per fruit was documented.

5. Total soluble solids (T.S.S.) :

Fruits were shreded, maserated and the juice collected from the materials after squeezing, was used to record the total soluble solids of fruits by refractometer and expressed in Brix.

Statistical analysis :

The data recorded were subjected to statistical analysis, based on sample means of the various characters under observation.

Analysis of Variance :

The analysis of variance was carried out separately for each trait following the procedures of randomised block design analysis (Panse and Sukhatme, 1954). Analysis of variance was done on the basis of the following model :

$$Y_{ij} = m + g_i + r_j + e_{ij}$$

Where,

Y_{ij} = Phenotypic observation in the i^{th} genotype and j^{th} replication.

m = General mean.

g_i = Effect of the i^{th} genotype.

r_j = Effect of the j^{th} replication.

e_{ij} = Random error associated with i^{th} genotype and j^{th} replication.

Form of the analysis of variance and expected mean square :

Source	df	MS	Expected mean sum of square
Replication	(r-1)	M_R	$6^2_e + g6^2_r$
Genotype	(g-1)	M_G	$6^2_e + r6^2_g$
Error	(r-1)(g-1)	M_E	6^2_e

Mean, range, standard error and critical difference:

Mean values of each character was worked out by dividing the total with corresponding number of observations, while the lowest and highest values for each character were taken as the range.

The S.E. and C.D were calculated by using the following formula:

Standard error of difference (SED) $= \sqrt{\frac{2EMS}{r}}$

Critical difference $= \sqrt{\frac{2EMS}{r}}$ x t value at error degrees of freedom at 5% and 1% levels of significance

where,

r = Number of replications

EMS = Error mean sum of square

Coefficient of variation:

From the structure of the analysis of variance

$$\text{Error variance} = \sigma^2_e = ME$$

$$\text{Genotypic variance} = \sigma^2_g = (M_G - M_E)/r$$

$$\text{Phenotypic variance} = \sigma^2_p = M_G/r = \sigma^2_g + \sigma^2_e/r$$

The genotypic coefficient of variation (GCV) and the phenotypic coefficient of variation (PCV) were calculated by the formula given by Burton (1952).

$$GCV = \frac{\text{Genotypic standard deviation}}{\text{Grand mean}} \times 100$$

$$PCV = \frac{\text{Phenotypic standard deviation}}{\text{Grand mean}} \times 100$$

Heritability (Broad Sense):

Degree of correspondence between phenotypic value and breeding value is measured by the heritability estimate. Heritability (h^2) estimate was worked out by using the formula suggested by Lush (1949) and Burton and Devance (1953). This was expressed in percentage according to Weber and Moorty(1952).

$$h^2 \text{ (broad sense)} = \frac{\text{Genotypic variance}}{\text{Phenotypic variance}} \times 100$$

Expected genetic advance:

Genetic advance was estimated as per the formula suggested by Johnson, Rabinson and Comstock (1955).

$$GA = k.h^2 .6_p$$

Where,

k = Selection differential in standard units,which is 2.06 for5% selection intensity.

h^2 = Heritability in broad sense

6_p = Phenotypic standard deviation

GA expressed as percentage of mean = (GA/Mean) x 100

Analysis of covariance:

The analysis of covariance between all possible pairs of characters was done on plot mean value followng the procedures of Randomised Block Design Analysis (Panse and Sukhatme, 1954).

Form of covariance and expected mean sum of products

Source	df	MP	Expected mean sum of products.
Replication	(r-1)	$M_{R(xy)}$	$6_{e(xy)} + g\ 6_{r(xy)}$
Genotype	(g-1)	$M_{G(xy)}$	$6_{e(xy)} + r\ 6_{g(xy)}$
Error	(r-1) (g-1)	$M_{E(xy)}$	$6_{e(xy)}$

$M_{R(xy)}$, $M_{G(xy)}$ and $M_{E(xy)}$ stand for mean sum of products between pairs of characters due to replication genotypes and error respctively. From the structure of analysis of covariance the following estimates were computed.

Error convariance $= 6_{e(xy)} = M_{E(xy)}$

Genotyppic covariance $= 6_{g(xy)} = (M_{G(xy)} - M_{E(xy)}) / r$

Phenotypic covariance $= 6_{P(xy)} = M_{G(xy)} / r = 6_{g(xy)} + (6_{e(xy)}) / r$

Estimation of Correlation coefficients :

Simple correlation coefficients wre computed at genotypic and phenotypic levels between pairs of characters adopting the following formula :

Genotypic correlation $(r_g) = 6_{g(xy)} / (6_{g(x)} \times 6_{g(y)})$

Phenotypic correlation $(r_p) = 6_{p(xy)} / (6_{p(x)} \times 6_{p(y)})$

Where,

$6_{g(xy)}$ = Genotypic covariance between the two traits x and y

$6_{p(xy)}$ = Phenotypic covariance between the two traits x and y.

$6_{g(x)}$ and $6_{g(y)}$ stand for genotypic standard deviations for x and y respectively.

$6_{p(x)}$ and $6_{p(y)}$ stand for phenotypic standard deviations for x and y respectively.

To test the significance of correlation coefficients at phenotypic level, the estimated values owere compared with the table value (Fisher and Yates, 1967) at (n-2) degrees of freedom at the 5 per cent and 1 per cent levels of significance.

Path coefficient analysis :

The path coefficient analysis is a type of cause and effect relationship among the various correlated characters. Path coefficients were standardised partial regression coefficients which individually provide a measure of direct effect of the causal fctors on the effect variable. These permit partitioning of the correlations between causal factor and the effect of variables into components of direct and indirect effects and thus, give a better picture of the associations of the causal factors with the effect variable.

In the present investigation, yield per plant was taken as the 'effect' with other characters like,number of branches per plant , diameter of fruit, days taken for the appearance of first female flower, fruit length, number of fruits per plant, weight of the fruit, number of nodes per plant, vine length,node at which first female flower appeared, internode length, percentage of fruit set, percentage of fruit retention , days taken from fruit set to marketable maturity and the qualitative characters like pulp content , rind: pulp ratio, rind thickness, seed number, T.S.S to yield as the causal factors. The path coefficients were obtained by solving the following simultaneous equations which give the basic relationship between correlations and path coefficients in a system of correlated causes (Wright, 1971; Dewey and Lu, 1959).

$$r_{1.14} = p_{1.14} + r_{1.2}\,p_{2.14} + r_{1.3}\,p_{3.14} + \ldots\ldots\ldots\ldots + r_{1.13}\,p_{13.14}$$

$$r_{2.14} = r_{2.1}\,p_{1.14} + p_{2.14} + r_{2.3}\,p_{3.14} + \ldots\ldots\ldots\ldots + r_{2.13}\,p_{13.14}$$

$$r_{3.14} = r_{3.1}\,p_{1.14} + r_{3.2}\,p_{2.14} + p_{3.14} + \ldots\ldots\ldots + r_{3.13}\,p_{13.14}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$r_{13.14} = r_{13.1}\,p_{1.14} + r_{13.2}\,p_{2.14} + r_{13.3}\,p_{3.14} + \ldots\ldots + p_{13.14}$$

Where, r_{ij} is the coefficient of correlation between i^{th} and j^{th} characters and p_{qi} is the path coefficient (direct effect of i^{th} character on yield (character-14).

The solutions for path coefficients, direct and indirect effects of the causal factors were estimated as the values of the individual terms of the above equations in R.H.S.

The coefficient of determination (R^2) and the residual effect ($P_{14.R}$) were calculated as follows :

$$1 = p^2_{14.R} + \Sigma P_{iy} r_{iy}$$

$$R^2 = \Sigma P_{iy} r_{iy}$$

$$= P_{1.14}\, r_{1.14} + P_{2.14}\, r_{2.14} + P_{3.14}\, r_{3.14} + \ldots + P_{13.14}\, r_{13.14}$$

Hence, $P_{14.R} = \sqrt{1 - R^2}$

The path analysis at the phenotypic level with the same cause and effect relationship was computed using the phenotypic correlations as stated earlier.

Genetic divergence :

After testing for difference between varieties for each of the 13 characters except plot yield a simultaneous test of significance of difference in mean values of the 13 correlated variables for the eleven cultivars was carried out using Wilk's

Lambda (Λ) criterion (Wilks, 1932) and V-statistic (Rao, 1952).

Genetic divergence was computed by using Mahalanobis' generalized distance, D^2 - statistic, as described by Rao (1952). The original measurements were transformed to standardised uncorrelated variables by pivotal condensation (Rao, 1952). The divergence between any two varieties was obtained as the sum of squares of the differences in the values of the corresponding transformed values (Y_{ij}).

$D^2_{ij} = \sum_{i=1}^{k} (Y_{i1} - Yj1)$ gives the D^2 between i^{th} and j^{th} cultivars for K characters. The all possible 55 pairs of D^2 were calculated from the eleven cultivars. Following Tocher's method as described by Rao (1952), the genotypes were grouped into clusters. Inter-and intra-cluster distances were determined and their relationship was diagramatically represented. Canonical analysis was done according to Anderson (1958). The divergence of 11 genotypes of pointed gourd was represented in a two dimensional graph using the first two canonical vectors(Z_1 and Z_2) as co-ordinates.

CHAPTER IV

EXPERIMENTAL RESULTS

EXPERIMENTAL FINDINGS

The present investigation on pointed gourd constituted two different aspects namely :

(i) Floral biology and Fruit development.

(ii) Variability and character association.

The results obtained there of, have been presented below in the same order.

P A R T - I

FLORAL BILOGY AND FRUIT DEVELOPMENT.

Flowering habit :

The pointed gourd plant is dioecious in nature oand both male as well as female sexes exist on separate plants. The type of inflorescence in both the cases is racemose where flowers are borne laterally on the nodes in an acropetal succession. In general, the flowers are regular, epigynous, unisexual, differentiated into staminate and pistillate ones on separate plants planted apart in a definite male : female ratio.

Calyx : Sepals six in number, green in colour, gamosepalous, valavate and fused forming a calyx tube.

Corolla : Petals five in number, white in colour, polypetalous, imbricate, inserted at the base into the calyx tube, petals are pubescent with typical hairy outgrowth along the lobes encircling the entire surface, the whole make up being called corona which is a natural design for promoting entomophilous pollination.

Staminate flowers:

Regular, androecious, stamens three, filaments attached to the calyx tube, anthers three, single lobed, basi-fixed and free.

Pistillate flowers :

Regular, gynoecious, ovary syncarpous, tricarpellary, inferior typical to cucurbitaceae family to which the crop belongs, parietal placentation, ovules many, style one terminating to a trifid stigma.

Development of flower :

The male flowers were found to take 14 to 16 days from the appearance of floral bud to complete opening whereas, the female one took 9 to 11 days (Table-3).

Opening of flowers :

The male flower took 35-45 minutes for complete opening starting from bud break stage whereas the female flower took 50-60 minutes (Table-4).

Time of anthesis :

The anthesis of male flower was found to occur at 6.00 to 6.30 P.M. and continue up to 8.30 P.M. More than 75% of the male flowers opened between 7.00 to 8.00 P.M. The peak period being 7.30 to 8.00 P.M. Anthesis in female flower commenced at 7.00 P.M. and continued upto 9 P.M. The maximum percentage of female flowers opened between 7.30 to 8.30 P.M.(Table-5)

Viability of pollen grains :

The average percentage of pollen viability was found to be high at the time of anthesis (96.7%). The same exhibited to a decreasing trend after 24 hours of anthesis (88.8%) which

TABLE-3

DAYS TAKEN TO DEVELOPMENT OF FLOWER

Sl. No.	Sex M/F	Date of visible flower bud	Date of opening of Flower	No.of days taken.	Range days.
01.	M	14.6.96	29.6.96	15	
02.	M	15.6.96	01.07.96	16	
03.	M	17.6.96	01.07.96	14	14-16
04.	M	19.6.96	04.07.96	15	
05.	M	20.6.96	06.07.96	16	
06.	F	14.6.96	24.6.96	10	
07.	F	15.6.96	25.6.96	10	
08.	F	17.6.96	26.6.96	09	09-11
09.	F	19.6.96	28.6.96	09	
10.	F	20.6.96	01.07.96	01	

M = Male F = Female.

Table-4

TIME TAKEN FOR FULL OPENING OF FLOWER

Sl.No	Sex	Time of flower bud break	Time of which corolla starts unfolding	Time at which corolla completly opens	Time taken min.	Range min.
01.	M	6.55pm	7.10pm	7.35pm	40	
02.	M	7.05pm	7.20pm	7.50pm	45	35-45
03.	M	7.15pm	7.35pm	7.50pm	35	
04.	M	7.15pm	7.30pm	7.55pm	40	
05.	M	7.20pm	7.40pm	8.oopm	40	
06.	F	7.00pm	7.15pm	7.50pm	50	
07.	F	7.00pm	7.20pm	7.55pm	55	50-60
08.	F	7.10pm	7.30pm	8.10pm	60	
09.	F	7.15pm	7.30pm	8.05pm	50	
10.	F	7.25pm	7.40pm	8.15pm	50	

M = Male, F = Female

Table-5

TIME OF ANTHESIS IN *Trichosanthes dioica* Roxb.

Sl. No.	Sex	Date	Percentage of flowers opened at different hours					
			6.00-6.30pm	6.30-7.00pm	7.00-7.30pm	7.30-8.00pm	8.00-8.30pm	8.30-9.00pm
01	Male	8.6.96	4.0	10.0	20.0	66.0	-	-
02	Male	9.6.96	3.0	12.0	35.0	56.0	-	-
03	Male	11.6.96	7.5	12.5	22.5	57.5	-	-
04	Male	12.6.96	4.5	15.5	15.0	62.5	02.5	-
05	Male	14.6.96	7.5	11.5	23.5	52.5	00.5	—
06	Female	8.6.96	-	2.0	06.0	20.0	70.0	2
07	Female	9.6.96	-	-	05.0	22.5	67.5	5
08	Female	11.6.96	-	2.5	05.0	15.5	75.5	1.5
09	Female	12.6.96	-	-	04.0	15.0	78.0	3.0
10	Female	14.6.96	-	-	05.5	17.5	77.0	-

Table - 6

Percentage of viable pollen grains after anthesis

Sl. No	Pollen viability % at the time of anthesis	24 hours after anthesis	36 hours after anthesis
1.	96.5	88.0	66.0
2.	98.0	95.5	60.5
3.	97.5	93.5	62.0
4.	96.0	87.0	62.0
5.	95.5	85.0	60.5
Mean	96.7	88.8	62.0

further came down to (62.2%) after 36 hours. (Table -6).

Pollen dimension :

The average diameter of the pollen grain was measured to be 28.76 microns.

Pollen germination :

The pollen grain germination was found to be the maximum in the medium of 5% sucrose solution than the other treatments.

Receptivity of stigma :

The stigma started becoming receptive 2-3 hours before anthesis and continued upto 30 hours after the commencement of anthesis.

Pollination :

Since pointed gourd is dioecious in nature the plants obligatorily seek the help of various pollinating insects for pollination. The observations, thus obtained led to the identification of the best pollinators mentioned below.

1) Red brown beetle-Carpophyllus demidiatus

2) Small ants-Componatus Compressus

Pollen grains were found sticking to the ventral side of the body and mouth of the above Pollinators and the transfer of Pollen grains was observed to occur by contact to other flowers with the movements of the insects.

Fruit set :

Two days after pollination stigma and style turned deep brown in colour and the petals started withering ultimately

turning to brown colour. Subsequently the ovary appeared enlarged. In the non-pollinated flowers or the flowers which were free from the contact of pollinators the ovary changed to pale yellow in colour and dried at length.

Fruit development :

The fruits were found to have required 20-25 days for full maturity (ripening of fruit). The fruits attained the edible maturity stage after 10-14 days of fruit set. The average length and diameter of the fruits were found to be 8.19 cm. and 4.10 cm. respectively at the time of edible maturity.

P A R T - II

VARIABILITY STUDIES AND CHARACTER ASSOCIATION

The study on genetic variability and character association in pointed gourd cultivars was carried out and the results obtained to the study are presented below :

Analysis of variance :

The analysis of variance revealed that all the traits exhibited significant differences among the cultivars(Table-7) indicating the presence of sufficient genetic variability in the material. The mean values of the cultivars for 14 characters were statistically analysed and are presented in Table-8(a) .

Number of branches Per Plant :

The number of branches varied from 8.07 to 2.73. Significant difference was also observed among all the cultivars. Maximum number of branches was recorded in BPS-10 (8.07), which remained at par with BPS-1 (7.6) and the minimum in BPS-7 (2.73) with a mean of 4.87.

TABLE-7

Analysis of variance for 14 characters in Pointed gourd.

Characters	Mean sum of squares (d.f) Replications (2)@	Cultivars (10)	Error (20)
No. of branches per plant	0.95	11.8**	0.17
Diameter of fruit	0.01	0.4**	0.04
Days taken for the apperance of 1st female flower	25.53	225.0**	1.25
Fruit length	0.10	7.9**	0.09
No. of fruits per plant	7.56	1455.4**	4.54
Weight of the fruit	4.02	143.3**	1.49
No. of nodes per plant	11.81	3153.1**	5.88
Length of the vine	0.18	69.5**	0.1
Node at which 1st female flower appeared	0.33	121.6**	0.18
Internode length	0.14	14.3**	0.31
Fruit set(%)	0.99	95.0**	0.29
Fruit retention(%)	0.45	139.4**	0.21
Days taken from fruit set to marketable maturity	0.20	10.8**	0.09
yeild per plant(Kg)	0.00003	0.5**	0.0005

* and ** significant at 5% and 1% level of probability respectively @ Figures in the parenthesis indicate degrees of freedom of respective sources of variation

TABLE - 8(a)

Mean Performance of Cultivars

	NB	DF	DFF	FL	FN	WF	NN	LV	NFFF	IL	FS	FR	DFMM	Yield/Pl. (kg)
BPS-1	7.60	4.73	69.87	8.07	48.00	29.50	89.53	11.43	4.20	12.93	43.43	38.45	10.87	1.64
BPS-2	6.67	4.03	76.67	6.63	51.67	23.47	53 33	4.57	15.67	8.80	35.88	27.70	10.47	1.18
BPS-3	3.47	4.53	70.40	7.97	39.60	34.13	111.47	14.87	3.47	13.73	43.39	38.10	10.13	1.44
BPS-4	6.93	4.07	72.77	11.57	32.80	40.93	89.47	13.33	11.07	15.00	36.43	30.04	14.67	1.28
BPS-5	3.87	4.53	82.60	6.80	48.40	23.47	50.93	5.50	24.33	10.93	34.77	26.68	13.60	1.12
BPS-6	3.27	3.50	73.47	6.77	32.00	32.17	33.00	3.47	3.40	10.33	33.09	25.43	12.13	1.12
BPS-7	2.73	4.01	83.00	7.20	42.87	22.13	42.13	4.77	8.47	11.67	32.92	24.24	10.07	0.94
BPS-8	3.33	3.80	50.60	7.63	65.93	23.00	41.07	7.30	5.53	8.20	44.48	39.41	10.33	1.59
BPS-9	3 60	4.03	77.33	7.80	67.20	25.33	47.43	5.03	4.67	10.60	45.19	39.99	9.73	1.63
BPS-10	8.07	3.87	72.20	10.77	34.47	39.20	130.40	15.20	9.80	11.87	37.20	29.73	10.07	1.26
BPS-11	4.53	4.23	70.20	8.93	107.53	22.93	51.53	4.40	6.73	8.53	49.22	42.88	14.53	2.43
Mean	4.87	4.10	72.64	8.19	51.86	28.77	67.32	7.80	8.86	11.14	40.82	30.20	11.46	1.39
CDat5%	0.698	0.346	1.902	0.531	3.629	2.079	4.130	0.542	0.717	0.955	0.915	0.723	0.517	0.04

NB: No. of branches per plant
DF: Diameter of fruit
DFF: Days taken for appearance of first female flower
WF: Weight of the fruit
NN: No. of nodes per plant
LV : Length of the vine
NFFF: Node at which first female flower appeared
IL: Internode Length
FS : Fruitset(%)
FR: Fruit retention(%)
FL : Fruit length
FN : Number of fruits Per Plant
DFMM: Days taken from fruitset to marketable maturity

Diameter of Fruit :

The Fruit diameter was significantly higher in BPS-1 (4.73 cm.) which also remained at par with BPS-3 (4.53) and BPS-5 (4.53). However, BPS-6 produced fruits having lesser diameter (3.50 cm.).

Days taken for the appearance of first female flower :

Maximim and minimum number of days taken for the appearance of first female flower were observed in case of BPS-7 (83.00) and BPS-8 (50.60) respectively. However, BPS-5 (82.60) remained at par with BPS-7 which took maximum days for the appearance of first female flower.

Fruit length :

Maximum fruit length was recorded in BPS-4 (11.57cm.) and the minimum length was in BPS-2 (6.56 cm) which also remained at par with BPS-6 (6.77cm) and BPS-5 (6.80cm.).

Number of fruits per plant :

The maximum number of fruits per plant was recorded in BPS-11 (107.53) and was significantly superior than rest of the cultivars but the minimum was found in BPS-6 (32.00) which remained at Par with BPS-4 (32.80).(Fig-2)

Fruit weight :

The highest individual fruit weight was recorded under BPS-4 (40.93 gms) which remained at par with BPS-10 (39.20 gms). However, the lowest fruit weight was marked under BPS-7 (22.13 gms), which remained at par with BPS-11 (22.93 gms), BPS-8 (23.00 gms.), BPS-5 (23.47 gms), BPS-2 (23.47 gms.).

THREE DIMENSIONAL GRAPH SHOWING NUMBER OF NODES AND NUMBER OF FRUITS PER PLANT IN 11 POINTED GOURD CULTIVARS

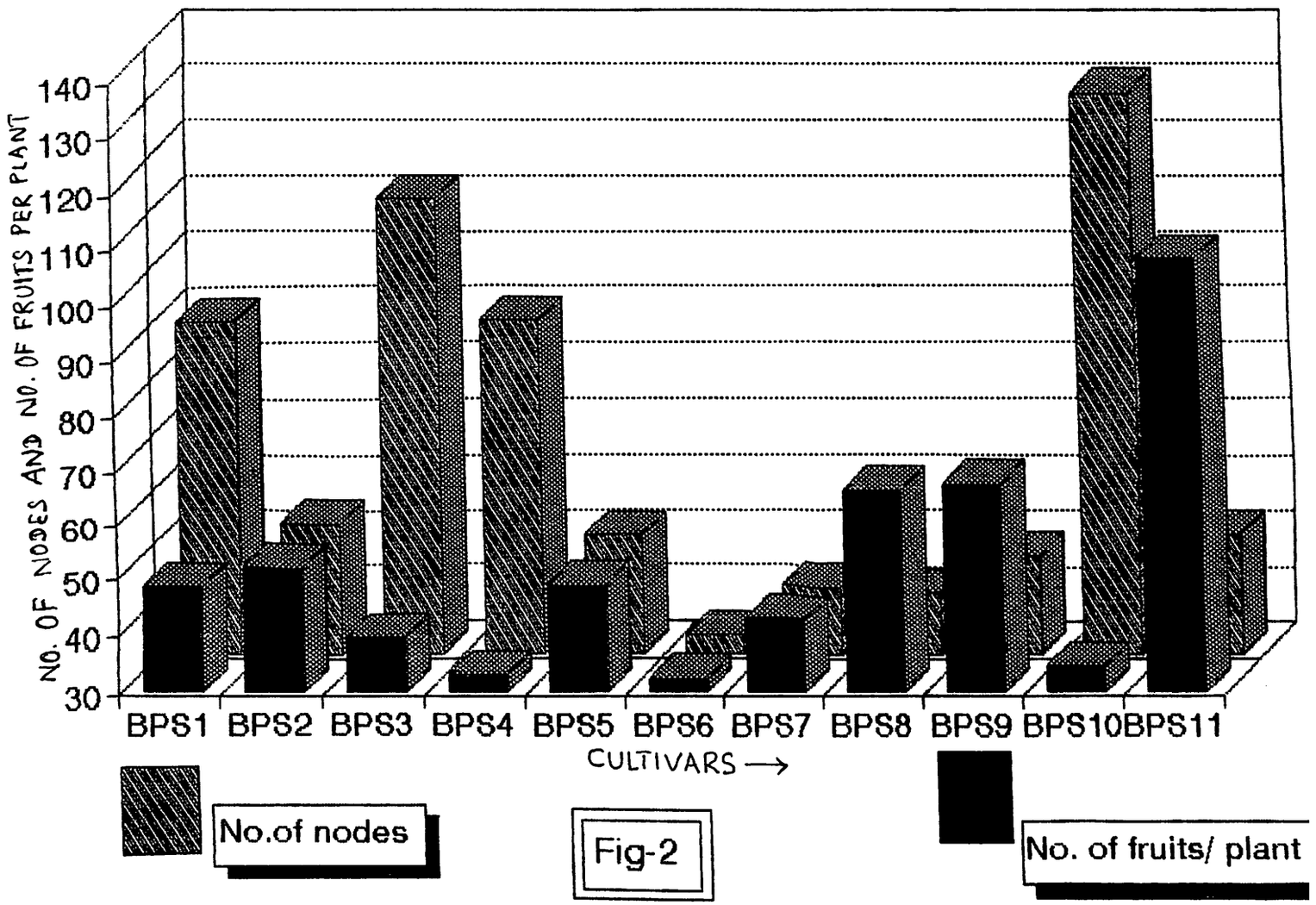

Fig-2

Number of nodes Per plant :

The number of nodes per plant was the highest in BPS-10(130.40) and the lowest numbr of nodes were observed in BPS-6 (33.00). (Fig-2)

Length of the vine :

Vine length showed a significant variation among the cultivars. The maximum vine length of 15.20 m. was recorded in BPS-10 followed by BPS-3 (14.87m.) which also remained at par. However, the shortest vine length was noticed in BPS-8 (3.30m.).

Node at which first female flower appeared:

The number of the lowest possible node at which the first female flower appeared was found in BPS-6 (3.40) which also remained at Par with BPS-3 (3.47) and the highest node at which the female flower appeared was recorded in BPS-5 (24.33). These values exhibited significant difference in respect of the trait.

Internode length :

The internode length was significantly more in BPS-4 (15.00cm.) and the minimum internode length as it was recorded in BPS-8 (8.20 cm.).However, the minimum internode length recorded under BPS-8 also remained at Par with BPS-11 (8.53 cm.) and BPS-2 (8.80cm.).

Fruit set (%) :

The Fruit set (%) was significantly more in BPS-11 (49.22%) and the minimum fruit set was recorded in BPS-7 (32.92%) performing at Par with BPS-6 (33.09). (Fig-3)

THREE DIMENSIONAL GRAPH SHOWING FRUITSET (%) AND FRUIT RETAINTION (%) IN 11 POINTED GOURD CULTIVARS

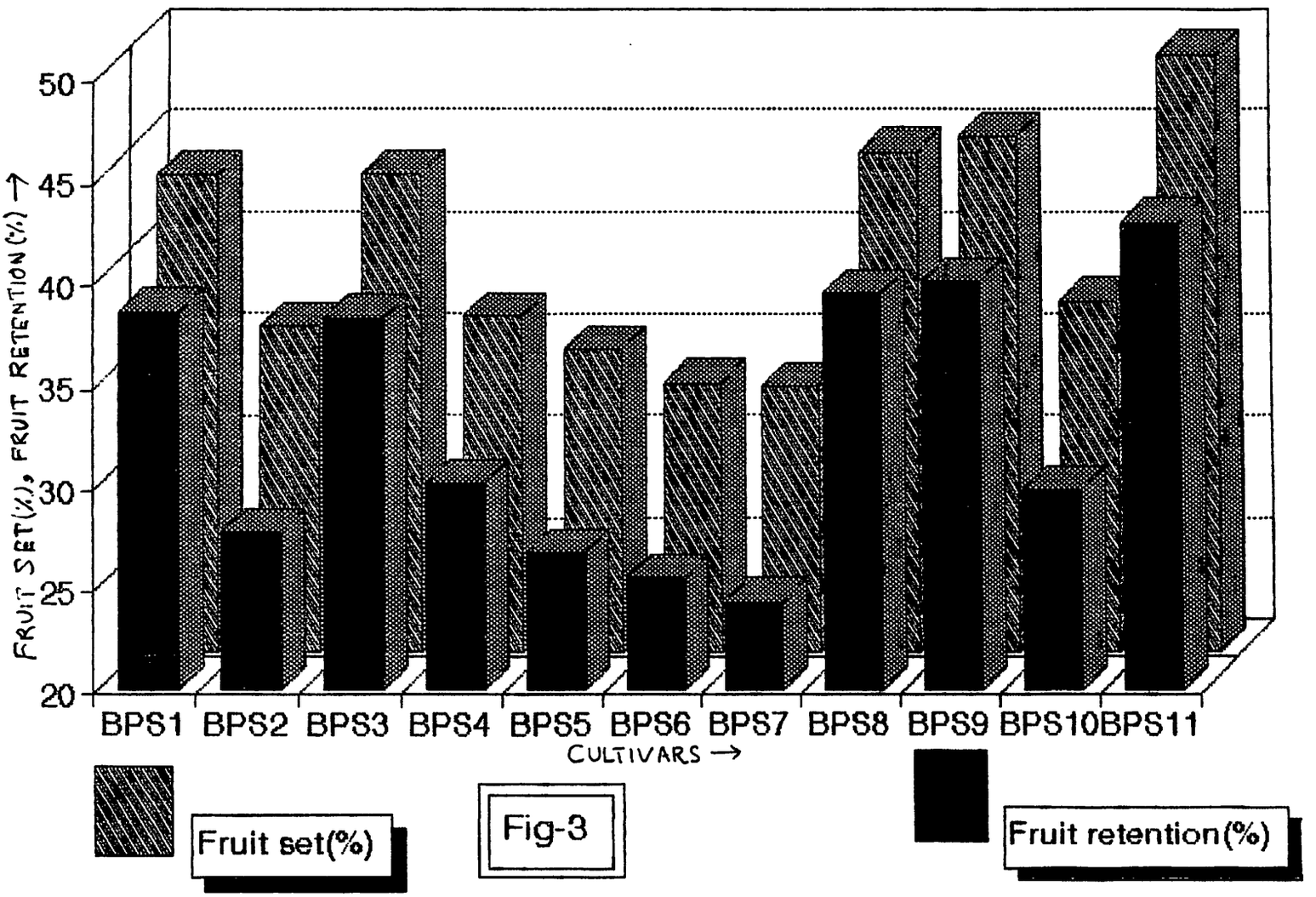

Fig-3

THREE DIMENSIONAL GRAPH SHOWING YIELD PER PLANT IN 11 POINTED GOURD CULTIVARS

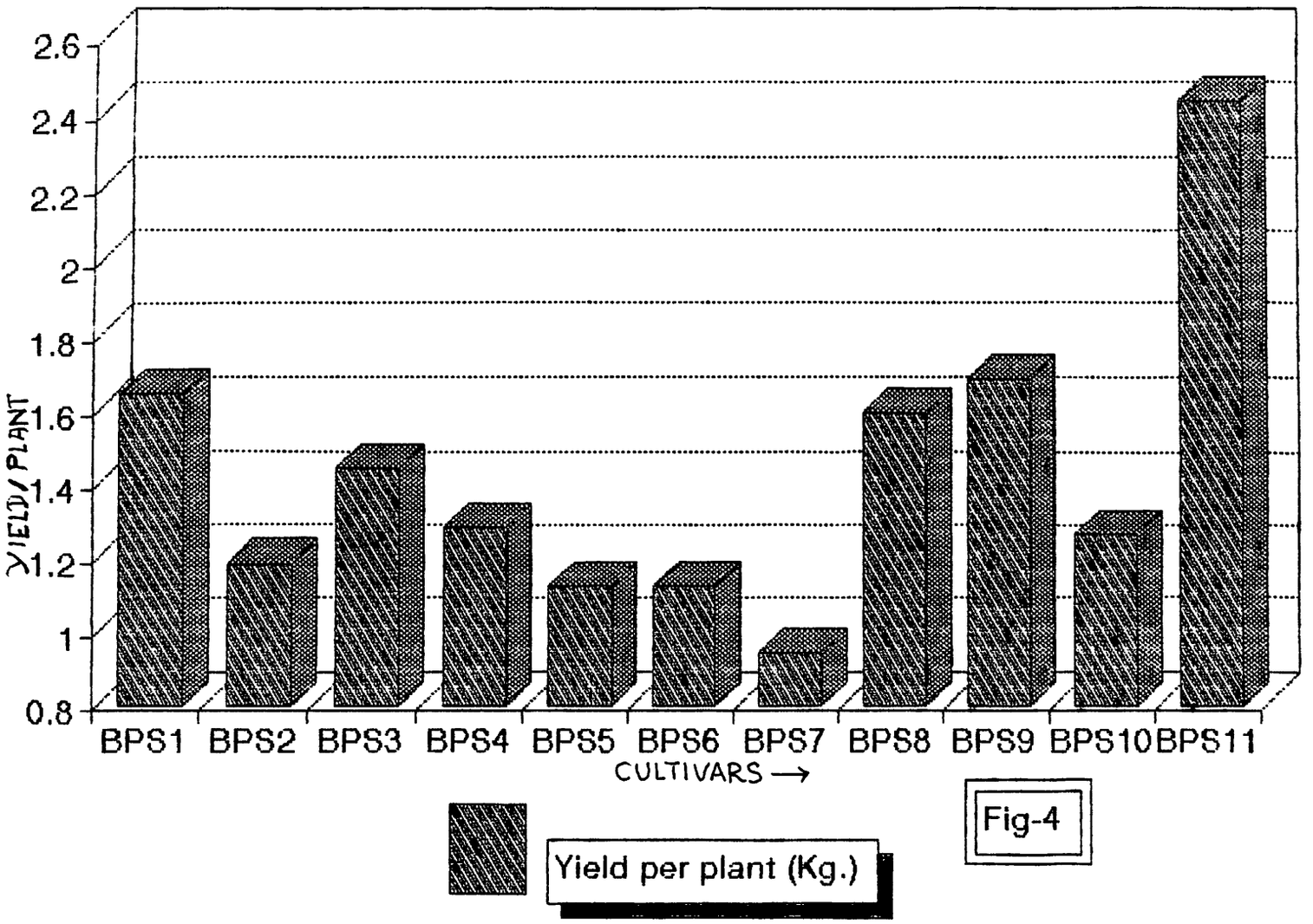

Fig-4

Final Fruit retention (%) :

The highest final fruit retention with significant difference was observed in BPS-11 (42.88%) and the lowest fruit retention was marked in BPS-7 (24.24%). (Fig-3)

Days taken for fruit set to marketable maturity :

The minimum days taken from fruit set to maturity was observed in BPS-9 (9.73 days) followed by BPS-10 (10.07), BPS-7 (10.07), BPS-3 (10.13). However, maximum days taken from fruitset to marketable maturity was recorded in BPS-4 (14.67).

Fruit yield per plant :

Among all the cultivars evaluated BPS-11 was judged as the best in respect of yield of Fruits Per Plant. (2.4 Kg/ Plant). All the other cultivars registered significantly lower yield in comparision to BPS-11. However, the lowest yield of fruits per plant was recorded under the cultivars BPS-7 (0.94Kg.) (Fig-4)

Qualitative Characters: **(TABLE-8 (b))**

Pulp content was found to be maximum in BPS-3(24.2gms) and Minimum BPS-9(10.06gms).The fruits of BPS-4 possessed highest rind : pulp ratio (1.08) and the minimum rind : pulp ratio was found in BBS-3(0.54). The rind thickness was maximum in BPS-9(0.5cm). Seed number was maximum in BPS-1 and was minium in BPS-9(8.6).The maximum T.S.S.was found in BPS-8(5.7).

Coefficient of Variation :

The table-9 depicting range, the estimates of simple genetic parameters like Co-efficient of variation GCV, PCV, heritability and GA. It is apparently bear on the estimate of CV that the experimental precision was high. In non of the characters the CV was beyond 10% .

TABLE-8 (b)

Mean Performances

	Pulp content	Rind: pulp	Rind thickness	Seadnumber	Tss
BPS-1	22.23	0.85	0.3	28.6	5.3
BPS-2	18.7	0.71	0.2	20.0	4.3
BPS-3	24.2	0.54	0.1	19.3	4.1
BPS-4	18.1	1.08	0.3	23.0	4.6
BPS-5	15.6	0.91	0.1	19.3	4.3
BPS-6	14.93	0.93	0.1	16.6	4.1
BPS-7	18.97	0.94	0.1	18.6	4.1
BPS-8	16.4	0.87	0.1	21.0	5.7
BPS-9	10.06	0.63	0.5	8.6	5.2
BPS-10	20.4	0.94	0.2	19.6	4.8
BPS-11	12.83	0.78	0.3	11.6	4.7
Maen	17.4	0.83	0.20	18.7	4.65
cd at 5%	0.445	0.074	0.811	1.575	0.168

TABLE-9

Grand mean, range, genotypic and phenotypic coefficients of variation, heritability and genetic advance estimatev of 14 characters

	Mean	Range	GCV	PCV	CV	h2	GA
No.of branches/pl.	4.87	2.70-8.00	40.06	40.92	8.35	0.958	3.97
Dia. of fruit	4.10	3.50-4.70	8.25	9.61	4.91	0.737	0.60
Days taken for the apperance of 1st female flower	72.64	50.6-83.0	11.89	11.99	1.53	0.984	17.64
Fruit length	8.19	6.63-11.56	19.74	20.10	3.82	0.964	3.27
No. of fruits per plant	51.86	32.0-107.5	42.40	42.60	4.11	0.991	45.09
Weight of the fruit	28.77	22.13-40.93	23.89	24.26	4.24	0.969	13.94
No. of nodes/plant	67.32	33.0-130.40	48.11	48.24	3.60	0.994	66.54
Length of the vine	7.80	3.30-15.20	61.62	61.75	4.09	0.996	9.89
Node at which 1st female flower appeared	8.86	3.40-24.30	71.91	72.07	4.76	0.996	13.08
Inter node length	11.14	8.20-15.0	19.35	19.99	5.03	0.937	4.30
Fruit set (%)	40.82	32.92-49.22	14.18	14.24	1.35	0.991	11.52
Fruit retention(%)	30.20	24.24-422.88	20.66	20.71	1.38	0.996	14.00
Days taken from fruit set to marketable maturity.	11.46	9.70-14.67	16.41	16.62	2.64	0.975	3.84
Yield /plant(Kg.)	1.39	0.94 - 2.43	28.74	28.78	1.56	0.997	0.84

The estimates of GCV and PCV are found to maintain correspondence in all characters. However, the PCV estimate were slightly above, the estimates for GCV. The characters like vine length and node at which female flower appeared have given GCV and PCV estimate above 60%. In vine length, it is above 60% while node at which first female flower appeared was above 70%. Thus, indicating that these two characters are least influenced by the environment characters like number of branches per plant, number of fruits per plant,number of nodes per plant produced GCV and PCV estimates above 40% .In number of fruits per plant, it was above 42% while in number of nodes per plant, the estimates was above 42%, thus, indicating 50% influence of enviromental effect in modifying expression of these characters. In rest of character, the GCV & PCV estimates were less than 30% indicating high influence of environment in the expression of the characters. The broad sense heritability estimates (h^2) showed that the most of these characters studied are highly heritable in nature indicating 73.7% to 99.7% .

The estimate of genetic gain per generation expressed as percentage of mean showed that the selection for number of nodes per plant, could be as high as 66.5% advantage while genetic gain per selection for character like fruit didmeter and per plant yield might fetch, selection advantage of 0.6% and 0.8% respectively. It is interesting to point out that the genetic gain per selection in respect of selection for number of fruits per plant likely to fetch 45% advantage. Thus, selection, for number of fruits per plant, number of nodes per plant would be of advantage.

Character Association :

Table-10 depicts the genotypic and phenotypic correlation coefficients involving 14 characters. These were estimated from

Table-10

Estimates of Genotypic and Phenotypic correlation coefficients among various characters

		NB	DF	DFF	FL	FN	WF	NN	LV	NFFF	IL	FS	FR	DFMM	Yield/Pl.
	r_g		0.191	-0.016	0.603	-0.219	0.546	0.655*	0.597	0.158	0.317	-0.037	-0.025	0.087	0.029
NB	r_p		0.129	-0.021	0.586	-0.208	0.516	0.635*	0.585	0.156	0.322	-0.035	-0.022	0.084	0.027
DF	r_g			0.229	-0.040	0.131	-0.099	0.356	0.385	0.226	0.405	0.332	0.324	0.119	0.226
	r_p			0.208	-0.045	0.102	-0.122	0.304	0.336	0.119	0.372	0.268	0.288	0.076	0.198
DFF	r_g				-0.164	-0.248	-0.056	-0.061	-0.012	0.468	0.278	-0.537	-0.577	0.109	-0.417
	r_p				-0.157	-0.251	-0.053	-0.059	-0.012	0.461	0.259	-0.532	-0.569	0.116	-0.423
FL	r_g					-0.104	0.757*	0.674*	0.696*	-0.099	0.534	0.134	0.159	0.333	0.203
	r_p					-0.095	0.733*	0.662*	0.684*	-0.103	0.504	0.139	0.150	0.324	0.195
FN	r_g						0.616*	-0.383	-0.480	-0.105	-0.648*	0.758**	0.688*	0.248	0.870**
	r_p						-0.601*	-0.379	-0.477	-0.104	-0.624*	0.754**	0.681*	0.240	0.865**
WF	r_g							0.766**	0.836**	-0.194	0.762**	-0.195	-0.130	0.130	-0.204
	r_p							0.758**	0.820**	-0.192	0.700*	-0.190	-0.132	0.122	-0.201
NN	r_g								0.973**	-0.088	0.670*	0.091	0.123	-0.135	-0.016
	r_p								0.969**	-0.088	0.635*	0.089	0.122	-0.135	-0.017
LV	r_g									-0.114	0.817**	0.025	0.075	-0.056	-0.087
	r_p									-0.113	0.799**	0.026	0.074	-0.056	-0.088
NFFF	r_g										-0.077	-0.474	-0.515	0.361	-0.376
	r_p										-0.072	-0.472	-0.513	0.355	-0.373
IL	r_g											-0.235	-0.164	0.092	-0.327
	r_p											-0.222	-0.156	0.085	-0.316
FS	r_g												0.996**	-0.015	0.922**
	r_p												0.987**	-0.010	0.917**
FR	r_g													-0.039	0.886**
	r_p													-0.038	0.884**
DFMM	r_g														0.279
	r_p														0.274
Yield/PL.															—

NB: No. of branches per plant DF: Diameter of fruit DFF: Days taken for appearance of first female flower

WF: Weight of the fruit NN: No. of nodes per plant LV : Length of the vine

NFFF: Node at which first female flower appeared IL: Internode Length FS : Fruitset(%) FR: Fruit retention(%)

DFMM: Days taken from fruitset to marketable maturity

FL : Fruit length

FN : Number of fruits per Plant

the pooled analysis of variances and covariances. There were altogether 91 sets of estimates and in almost all the sets, the genotypic coefficients (r_g) were of higher magnitude than phenotypic correlation coefficients ($r_{p.}$) This showed that association between characters were greatly influenced by environmental changes.

In as many as 19 sets, genotypic coefficients were significant and in 18 of 19 sets, phenotypic coefficients were also significant and showed near equal value and these mostly involved yield and its components. Thus, association of yield with its components was stronger when the sample estimates in yield were dependable. The estimates for yield showed significant (r_g) and (rp) with each of the three component traits such as percentage of fruitset, percentage of fruit retention and number of fruits per plant.

That means yield per plant showed highly significantly genotypic and phenotypic correlation with each of three component traits like percentage of fruit set, percentage of fruit retention and number of fruits per plant. All are significant at 1% level. Yield per plant did not show any significant correlation either at genotypic or phenotypic level with any other characters. On the other hand percentage of fruit set showed highly significant correlation at the 1% level for (r_g) and at 5% level for (rp) with number of fruits per plant. It does not show any significant correlation with percentage of fruit retention both at (r_g) and (r_p) level . The number of fruits per plant showed significant correlation with fruit length at 5% level, internode length, days taken from fruit set to marketable maturity and percentage

of fruit set at 1% level for r_g and at 5% level for rp. Thus, association of yield with its component traits was stronger when number of fruit was taken into account. This was not unexpected as estimates in traits other than yield which were computed on the basis of data of the sample plants. Thus, in correlation study involving yield, sample yield should be preferred when samples are used in recording observations on the other characters.

Among other characters node at which 1st female flower appeared to be significantly correlated with number of nodes per plant, vine length, weight of fruit.

There was a significant correlation exists between number of nodes per plant and weight of fruit also between number of nodes per plant and fruit length both at r_g and rp level. Weight of the fruit significantly correlated with fruit length. Days taken for appearance of first female flower was significantly correlated with number of branches per plant at genotypic level. Node at which first female flower appeared showed association of moderate magnitude both at the genotypic and phenotypic level with number of branches per plant, diameter of fruit, days taken for appearance of first female flower, fruit length but the correlation coefficients were not significant. Node at which first female flower appeared is an important character in pointed gourd. Present study showed that expression of the traits was greatly affected by several other traits.

Path analysis of yield components:

In order to findout the cause and effect relationship on fruit yield per plant, it was further analysed using path coefficient analysis. The correlations of yield with other characters were partitioned into components of direct and indirect

Path Diagram Of Factors Influencing Yield In Pointed gourd

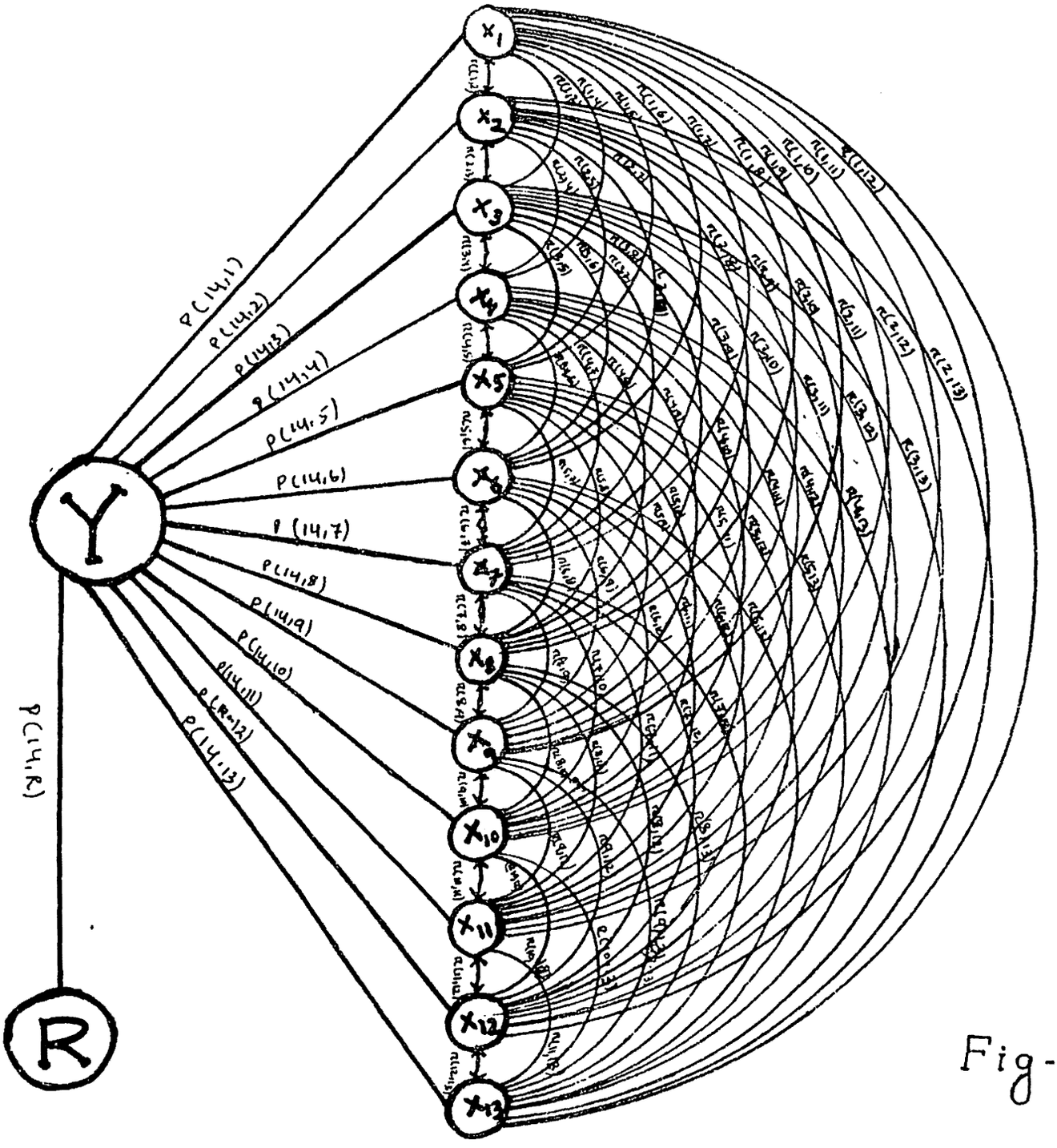

Fig-5

1. Number of branches per plant. 2. Diameter of the fruit.
3. Days taken for the appearance of first female flower.
4. Fruit length. 5. Number of fruits per plant.
6. Weight of the fruit. 7. Number of nodes per plant.
8. Vine length 9. Node at which first female flower appeared.
10. Internode length. 11. Fruit Set (%) 12 Fruit retention (%).
13. Days taken from fruit set to marketable maturity.
14. Yield per plant (Kg.)

effect that coud reflect on the nature of these associations and the relative importance of the components in determining yield. The phenotypic correlation coefficients and genotypic corelation coefficients were used in path analysis and presented in Table 11 and 12 respectively.

Under genotypic level, positive and direct effects of number of nodes per plant, percentage of fruit set , number of fruits per plant, weight of the fruit, number of branches per plant numbe, diameter of fruit, day taken for appearance of first female flower on total yield was observed in that order and was partially nullified by the negetive direct effects of fruit length, vine length, node at which first female flower appeared, internode length, percentage of fruit retaintion and days taken from fruitset to marketable maturity.

The direct effect of number of fruits per plant on yield was of higher magnitude. The indirect effects via vine length, followed by percentage of fruit set , internode length, percentage of fruit retention , days taken from fruit set to marketable maturity, diameter of the fruit and fruit length were in positive direction but rest of the characters were found to exert negetive indirect effect.

The indirect effects of fruit set percentage via number of fruits per plant followed by number of nodes per plant, internode length, days taken from fruit set to marketable maturity, diameter of fruit were found positive where as the indirect effect via number of branches per plant , day taken for appearance of first female flower, fruit length, weight of the fruit, vine length, node at which first female flower appeared, percentage of fruit retention was negetive.

TABLE-11

Direct and indirect effects of component traits on yield in pointed gourd at the phenotypic level

	NB	DF	DFF	FL	FN	WF	NN	LV	NFFF	IL	FS	FR	DFMM	CWY.
NB	0.099	0.007	-0.001	-0.054	-0.124	0.104	0.459	-0.484	0.041	0.001	-0.009	0.022	-0.035	0.027
DF	0.013	0.054	0.007	0.004	0.061	-0.025	0.220	-0.278	0.047	-0.005	0.124	0.019	-0.044	0.198
DFF	-0.002	0.011	0.032	0.014	-0.149	-0.011	-0.043	0.010	0.033	0.009	-0.246	0.030	-0.102	-0.413
FL	0.058	-0.002	-0.005	-0.092	-0.057	0.148	0.479	-0.566	0.064	-0.002	0.065	0.083	0.023	0.195
FN	-0.021	0.006	-0.008	0.009	0.594	-0.121	-0.274	0.394	-0.079	-0.013	0.294	0.061	0.023	0.865
WF	0.051	-0.007	-0.002	-0.067	-0.357	0.202	0.548	-0.678	0.088	0.003	-0.057	0.031	0.043	-0.201
NN	0.063	0.016	-0.002	-0.061	-0.225	0.153	0.724	-0.801	0.080	-0.002	0.053	-0.035	0.020	-0.017
LV	0.058	0.018	0.000	-0.063	-0.283	0.165	0.701	-0.827	0.101	0.000	0.032	-0.014	0.025	-0.088
NFFF	0.015	0.011	0.015	0.009	-0.062	-0.039	-0.064	0.094	-0.009	0.008	0.221	0.091	-0.222	-0.373
IL	0.032	0.020	0.008	-0.046	-0.371	0.141	0.460	-0.661	0.126	0.004	-0.068	0.022	0.016	-0.316
FS	-0.003	0.015	-0.017	-0.013	0.448	-0.038	0.065	-0.022	-0.028	-0.017	0.426	-0.003	0.105	0.970
FR	-0.002	0.016	-0.018	-0.014	0.404	-0.027	0.088	-0.061	-0.020	-0.017	0.432	-0.010	0.114	0.884
DFMM	0.008	0.004	0.004	-0.030	0.143	0.025	-0.098	0.046	0.011	0.00	-0.016	0.256	-0.079	0.274

Residual = 0.0056

NB: No. of branches per plant
DF: Diameter of fruit
DFF: Days taken for appearance of first female flower
WF: Weight of the fruit
NN: No. of nodes per plant
LV : Length of the vine
NFFF: Node at which first female flower appeared
IL: Internode Length
FS : Fruitset(%)
FR: Fruit retention(%)
FL : Fruit length
FN: Number of fruits per plant
DFMM: Days taken from fruitset to marketable maturity
CWY: Correlation with yield

Table-12

Direct and indirect effects of component traits on yield in pointed gourd at the Genotypic level

	NB	DF	DFF	FL	FN	WF	NN	LV	NFFF	IL	FS	FR	DFMM	CWY.
NB	0.055	0.010	0.000	-0.038	-0.077	0.115	1.620	-18424	0.206	-0.005	-0.011	0.034	-0.040	0.029
DF	0.011	0.054	0.001	0.002	0.046	-0.021	0.880	-1.190	0.263	-0.045	0.146	0.046	-0.057	0.226
DFF	-0.001	0.012	0.003	0.010	-0.087	-0.012	-0.151	0.036	0.181	-0.074	-0.259	0.042	-0.118	-0.417
FL	0.033	-0.002	-0.000	0.063	-0.036	0.160	1.668	-2.148	0.347	0.018	0.072	0.129	0.025	0.203
FN	-0.012	0.007	-0.001	0.006	0.352	-0.130	-0.948	1.483	-0.422	0.104	0.309	0.096	0.026	0.870
WF	0.030	-0.005	0.000	-0.047	-0.217	0.211	1.894	-2.580	0.496	-0.027	-0.059	0.050	0.049	-0.204
NN	0.036	0.019	0.000	-0.042	-0.135	0.162	2.474	-3.004	0.436	-0.012	0.055	-0.052	0.022	-0.016
LV	0.033	0.021	0.000	-0.044	-0.169	0.177	2.406	-3.087	0.532	0.003	0.034	-0.002	0.029	-0.087
NFFF	0.009	0.012	0.001	0.006	-0.037	-0.041	-0.218	0.351	-0.050	-0.065	-0.231	0.139	-0.252	-0.376
IL	0.018	0.022	0.001	-0.033	-0.228	0.161	1.657	-2.523	0.651	-0.032	-0.074	0.035	0.020	-0.327
FS	-0.002	0.018	-0.002	-0.008	0.267	-0.041	0.225	-0.078	-0.153	-0.137	0.447	-0.006	0.119	0.922
FR	-0.001	0.017	-0.002	-0.010	0.242	-0.028	0.305	-0.232	-0.107	0.136	0.449	-0.015	0.130	0.886
DFMM	0.005	0.006	0.000	-0.021	0.087	0.027	-0.333	0.172	0.060	-0.02	-0.017	0.386	-0.091	0.279

Residual = -0.0045

NB: No. of branches per plant DF: Diameter of fruit DFF: Days taken for appearance of first female flower

WF: Weight of the fruit NN: No. of nodes per plant LV : Length of the vine

NFFF: Node at which first female flower appeared IL: Internode Length FS : Fruitset(%) FR: Fruit retention(%)

FL : Fruit length

DFMM: Days taken from fruitset to marketable maturity CWY: Correlation with yield FN : Number of fruits per Plant

The direct effect of weight of the fruit was positive. But the indirect effect via number of nodes per plant ,node at which first female flower appeared, percentage of fruit retention, days taken from fruit set to marketable maturity, number of branches per plant were found positive but the rest of the characters were found to exert negetive indirect effect.

The direct effect of number of nodesper plant on yield was positive and higher in magnitude. The indirect effect via node at which first female flower appeared,percentage of fruit set, internode length, weight of fruit, number of branches per plant, diameter of fruit, days taken from fruit set to marketable maturity were in positive direction and the other characters showing negetive trend.

The direct effect of vine length on total yield was negetive and higher in magnitude but the indirect effect via all characters except fruit length, number of fruits per plant and percentage of fruit retention were in positive direction.

The direct effect of number of branches per plant on yield was positive and smaller in magnitude. The highest indirect effect via node at which first female flower appeared was observed in positive direction.

Diameter of fruit has a positive direct effect on yield but the effect was less.The indirect effect via all character, except weight of fruit, vine length and days taken from fruit set to marketable maturity were in positive direction.

The direct effect of day taken for appearance of first female flower on yield was positive and very small in magnitude. The indirect effect via node at which first female flower appeared was highest in positive direction.

The effect of fruit length on yield was direct but in negetive direction.The indirect effect via all characters except diameter fruit, number of fruits per plant and vine length were in positive direction.

The direct effect of node at which first female flower appeared was in lower magnitude and show negetive trend. But the indirect effect via number of branches per plant , diameter of fruit, days taken for appearance of first female flower, fruit length, vine length and percentage of fruit retention were in positive direction.

The internode length has a negetive direct effect on yield. The indirect effect via number of nodes per plant was positive and higher in magnitude.

The direct effect of percentage of fruit retention on yield is negetive and smaller in magnitude. The indirect effect via percentage of fruit set, number of nodes per plant, number of fruits per plant was higher in magnitude and in positive direction.

The effect of days taken from fruit set to marketable maturity on yield was direct and showed a negetive trend. The indirect effect through percentage of fruit retention was in positive direction and higher in magnitude.

Genetic divergence :

D^2 analysis:

The aggregate effect of all the 14 characters tested by wilk's criterion indicated significant differences among the varieties . Thus, it would be worthwhile to classify the population

into different genetic groups on the basis of the characters chosen. In the present study divergence was assessed by Mahalanobis' D^2 statistics and canonical analysis. The D^2 estimates corresponding to 55 possible paired values were compared for 11 varieties .

The D^2 values ranged from 1240:29 between BPS-2 and BPS-7 to 15766.84 between BPS-1 and BPS-5 . The genetic closeness between BPS-2 and BPS-7 was apparently due to their similarity in possessing vine length, yield, days taken from fruit set to marketable maturity, fruit weight, fruit length, diameter of fruit and days taken for appearance of first female flower.

On the other hand the farest distance of 15766.84 between BPS-1 and BPS-5 could be attributed to greater difference in number of branches per plant, days taken for appearance of first female Flower, fruit length, number of nodes per plant, vine length, node at which first female flower appeared, percentage of fruit set . Other highly divergent combinations were BPS-4 and BPS-11 (D^2 = 14543.30) and BPS-3 and BPS-5 (D^2 = 12727.47).

Table-13 depicts over all D^2 estimates computed as Average D^2 values for 10 paired wise combinations involving each of the 11 genotypes along with percentage to total D2 estimates. The high average D^2 values were observed for characters like node at which first female flower appeared, days taken from fruit set to marketable maturity and yield per plant respectively.

So these characters were apparently the decisive characters for genetic divergence among the genotypes.

Cluster Pattern :

Following Tocher's method 11 cultivars were grouped into 5 clusters and these are given along with the average inter- and intra- cluster D^2 values in Table-14. (Fig-6)

TABLE - 13

AVERAGE D^2 VALUES AND PERCENTAGE TO D^2 IN THE EXPERIMENT

Sl.No.	Character	Average D^2 values	Percentage to total D^2
1.	No. of branches/ plant	46.65	0.710
2.	Dia. of fruit	13.33	0.204
3.	Days taken for the apperance of 1st female flower	126.34	1.94
4.	Fruit length	54.99	0.84
5.	No. of fruits per plant	368.55	5.66
6.	Weight of the fruit	321.33	4.93
7.	No. of nodes/plant	521.65	8.01
8.	Length of the vine	185.80	2.85
9.	Node at which 1st female flower appeared	1746.13	26.84
10.	Internode length	236.14	3.63
11.	Fruit set (%)	338.57	5.20
12.	Fruit retention(%)	567.42	8.72
13.	Days taken from fruit set to marketablematurity.	1016.47	15.62
14.	Yield /plant(Kg.)	961.60	14.78

Table-14

Average intra-(diagonal) and inter-cluster distance(D^2) among 11 cultivars

Cluster	I	II	III	IV	V	
I	2433.6 (49.3)	5809.1 (76.2)	7043.7 (83.9	11124.3 (105.5)	5223.1 (72.3)	1,3,8,9,10
II	—- (45.05)	2030.2 (101.62)	10328.6 (8.26)	6441.7 (96.14)	9243.3	2,6,7,
III	—	—-	——	7915.3 (88.96)	11467.9 (107.08)	4
IV	—	—-	—-	——	14543.3 (120.59)	5
V	—	——	—-	—-	—	11

Figures in the parenthesis indicate the D value 1.BPS-1, 2. BPS-2, 3. BPS-3, 4. BPS-4, 5. BPS-5, 6. BPS-6, 7. BPS-7, 8. BPS-8, 9. BPS-9, 10. BPS-10, 11. BPS-11.

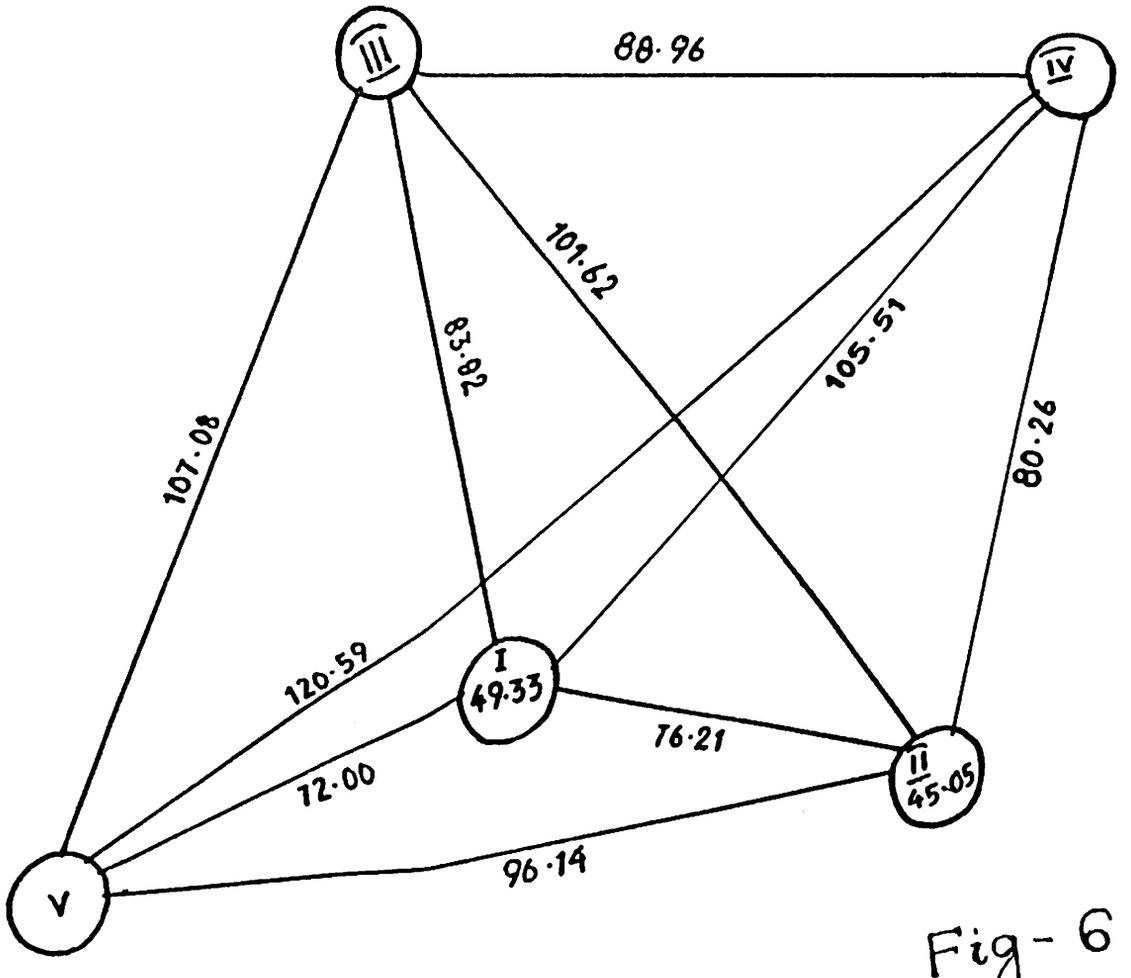

Fig- 6

Relative Disposition Of Clusters Showing Average Genetic Distance

Cluster-I constituted of 5 cultivars such as BPS-1, BPS-3 , BPS-8, BPS-9 and BPS-10. In all the cultivars fruits takes about 10 days to attain marketable maturity, percentage of fruit set is also high, node at which first female flower appeared is less than 9 .

Cluster II constituting 3 cultivars BPS-2, BPS-6 and BPS-7. These 3 cultivars had vine length ranges between 3.47-4.77, percentage of fruit set varies from 32.92-35.88. Number of branches per plant is low.

Cluster III clusture IV and V were monogenotypic clusters containing BPS-4, BPS-5 and BPS-11 respectively and showed high inter- cluster distance BPS-4 and BPS-5 (D^2 = 7915.28) BPS-4, BPS-11 (D^2= 11467.87) BPS-5 and BPS-11 (D^2 = 14543.30.)

Intra- and inter-cluster distance :

From the average intra- and inter-cluster distances presented in Table-14, it is evident that the lowest intra-cluster distance was associated with cluster II . The average inter-cluster distance revealed that the most divergent clusters were IV and V (D^2 = 14543.30) followed by III and V (D^2= 11467.87) I and IV (D^2 = 11124.34) and II and III (D^2 = 10328.62) . On the other hand the minimum inter-cluster divergence was found between I and V (D^2 = 5223.11) followed by I and II (5809.05) and II and IV (7441.74).

Characteristic features of the Clusters :

Table-15 Show cluster means of characters. It is evident from Table-15 that cluster I was characterised by minium days required for appearance of first female flower, node at which first female flower appeared and days taken from fruit set to marketable maturity.

TABLE-15

Cluster means of 14 characters in pointed gourd experiment Clusters

Characters	I	II	III	IV	V
No. of branches/plant	5.21	4.22	6.93	3.87	4.53
Dia. of fruit	4.19	3.87	4.07	4.53	4.23
Days taken for the apperance of 1st female flower	68.08	77.71	72.77	82.60	70.20
Fruit length	8.44	6.86	11.57	6.80	8.93
No. of fruits per plant	51.04	42.18	32.80	48.40	107.53
Weight of the fruit	30.29	25.92	40.93	23.47	22.93
No. of nodes/plant	84.04	42.82	89.47	50.93	51.53
Length of the vine	9.96	4.27	13.33	5.50	4.40
Node at which 1st female flower appeared	5.53	9.18	11.07	24.33	6.73
Inter node length	11.46	10.2	15.00	10.93	8.53
Fruit set (%)	42.73	33.96	36.43	34.77	49.22
Fruit retention(%)	37.13	25.79	30.04	26.68	42.88
Days taken from fruit set to marketable maturity.	10.22	10.89	14.67	13.60	14.53
Yield /plant(Kg.)	1.52	1.08	1.28	1.12	2.43

Cluster II consisting of 3 cultivars was characterised by lowest diameter of fruit and lowest yield per plant, vine length.

Cluster III was a monogenotypic cluster and was identified by highest number of branches per plant, more fruit length, highest fruit weight, number of nodes per plant, vine length, Internode length and maximum days taken from fruit set to marketable maturity. However , it showed lowest fruit number per plant.

Cluster IV was also a monogenotypic cluster was characterised, by highest diameter of fruit, maximum days required for appearance of first female flower , highest node at which 1st female flower appeared, and it however, showed lowest number of branches per plant, shortest fruit length.

cluster V was also a monogenotypic cluster was identified by highest number of fruits per Plant, highest percentage of fruit retention , highest percentage of fruit set and highest yield per plant. However, the cluster could be identified by lowest Internode length and lowest fruit weight.

Cluster patterns and geographic origin :

There did not appear to be any correspondence between pattern of clustering and geographic origin of the genotypes.

BPS-1 (AC-21), BPS-3 (AC-25), BPS-8 (AC-61), from Orissa and BPS-9 (CHESS-22) ,BPS-10 (Selection-1) from Bihar were found to cluster together.

Canonical analysis:

The contribution of the two canonical roots were 40.55 and 27.12 percent of the variability and thus, together accounted

for 67.67 percent of the total variability. The graphic presentation of the population along the two axes Z_1 and Z_2 shown in (Table-16) Fig.-7 . The groupings obtained through D^2 analysis were superimposed on the grouping by canonical analysis. The scattered points in Z_1 - Z2 graph were in good agreement with clustering by D^2 values following Tocher 's method.

Contribution of characters to genetic divergence:

The relative importance of the characters contributing towards the divergence is reflected in the coefficients of the first two canonical vectors given in Table-17 . Considering the Z_1 values , it was observed that the important characters responsible for genetic divergence in the major axis of differentiation were node at which first female flower appeared (-0.5868), yield per plant (Kg.) (0.5214), days taken from fruit set to marketable maturity (0.3289), percentage of fruit set (002.834), percentage of fruit retention (0.2758), number of nodes per plant (0.2252), vine length, (0.1230) and days taken for appearance of first female flower (-0.1222).

Also role of internode length, fruit length, number of branches per plant, diameter of fruit, number of fruits per plant, fruit weight was low, but complementing.

There was no consistency in relative contribution of characters to genetic divergence. However, the importance of node at which first female flower appeared to the genetic divergence is further evident from the results presented in Table-13.

TABLE-16

Mean valuees of the first two canonical varieties cultivers

Cultivars	Z_1	Z2
BPS-1	61.03	110.78
BPS-2	-16.35	100.32
BPS-3	52.53	129.05
BPS-4	20.10	187.29
BPS-5	-51.88	145.70
BPS-6	4.76	104.79
BPS-7	-29.75	97.91
BPS-8	26.13	113.52
BPS-9	13.67	94.33
BPS-10	39.00	150.73
BPS-11	52.11	93.16

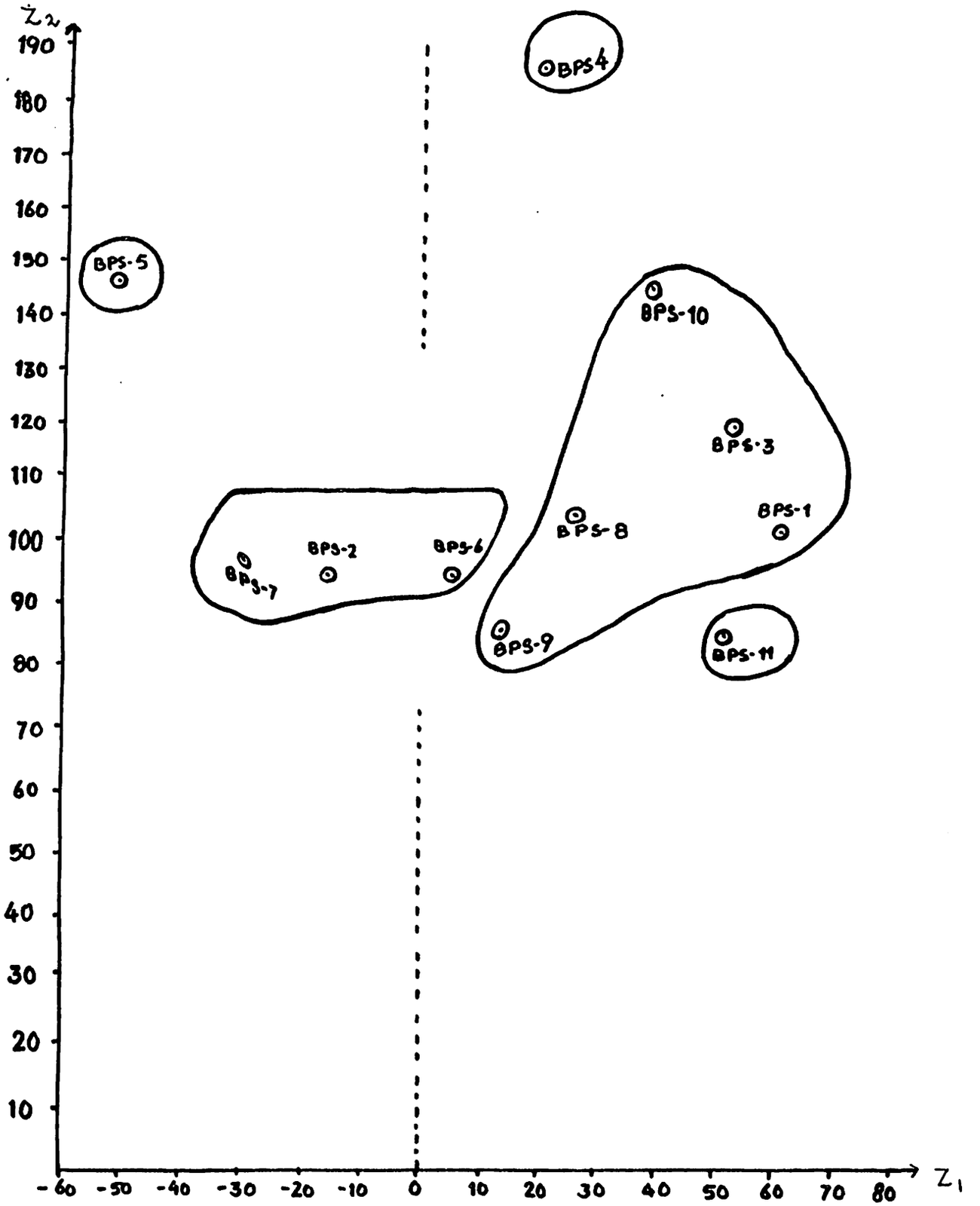

Fig-7

Group Constellations In The Z_1-Z_2 Graph

TABLE-17

Canonical Vectors (Z_1 and Z_2) for the experiment

Sl.No.	Characters	Z_1	Z_2
1.	No. of branches/plant	0.0471	0.0720
2.	Dia. of fruit	0.0227	0.0284
3.	Days taken for the apperance of 1st female flower	-0.1222	0.0122
4.	Fruit length	0.0843	0.1141
5.	No. of fruits per plant	-0.0284	-0.2944
6.	Weight of the fruit	0.437	0.3203
7.	No. of nodes/plant	0.2252	0.3209
8.	Length of the vine	0.1230	0.1818
9.	Node at which 1st female flower appeared	-0.5868	0.5327
10.	Inter node length	-0.0852	0.2145
11.	Fruit set (%)	0.2834	-0.0559
12.	Fruit retention(%)	0.2758	-0.0551
13.	Days taken from fruit set to marketable maturity.	0.3289	0.5646
14.	Yield /plant(Kg.)	0.5214	0.0289

Consistency in clustering pattern :

Inconsistency in the results of the D^2 analysis was very much reflected in the clustering pattern.

There were five clusters in the experiment. The orissa varieties BPS-1, BPS-3, BPS-8, and Bihar varieties BPS-9 and BPS-10 remained together in cluster I, thus indicating similer character expression under changed environmental conditions, but the varieties of Orissa like BPS-2, BPS-6 and BPS-7 were seen to have dissociated in to separate cluster (cluster -II). The verieties BPS-4, BPS-5 and BPS-11 have maintained their genotypic identity by forming monogenotypic clusters separately irrespective of the growing conditions.

CHAPTER V

DISCUSSION

It may be recalled that entomophilous type of pollination is in vogue in a dioecious crop like pointedgourd. The observations recorded on the efficacy of pollinator have laid to the identification of red brown beetle(Carpophyllus demidiatus) and red ant(Componatus compresseus) as specific major pollinators for pointedgourd. The pollen grains sticking to the ventral surface of their body and oral parts during the course of their movement on flowers were found to have been transferred mechanically to the stigmatic surface of the female flower for the accomplishment of pollination. Similar views in confirmative to this have also been expressed by Sachan et al. 1990. After pollination, non-polliated female flowers quickly withered turning the petal colour to brown and their ovaries were shrivelled. On the otherhand, in the pollinated ones, the size of the ovaries appearded magnified in their dimensions oviously because of the post fertilisation development.

Crop improvement is a process of genetic upgradation for enhancement of economic products or byproducts of a crops.The process involves coherent scientific planning based on sound knowledge of genetics and plant breeding. As a first step, the understanding of the component traits of the base materials pertaining to their genetic worth and breeding value is of paramount importance since, from the date of Mendelian science, the understanding has been clear and scientists in the field of crop imporvement have delivered wonders, the glorious example being the green revolultion in cereals. Similar achievements would have been accomplished in vegetable crops. Could the scientists put their efforts in the manner expected ? Now, the target crop other than cereals, oilseeds, pulses and sugar crops have been the vegetables, we have heard significant achivements in autogamous vegetable crops like potato, brinjal and Okra. However, perhaps because of complexity in reproductive

DISCUSSION

The floral biology of one of the genotypes (BPS-3) was thoroughly studied starting from the flower morphology till the initiation of the fruits, observing the days taken for development of flowers to stages of flower opening.It was found that the male flower took more days (14-16days) than the female flowers (9-11days). Thus ,it indicated that the physiology of male flower development took a longer time than the female counter parts. This result coroborated with that of (Sing et al. 1989, Vijay et al. 1977). On the other hand the male flowers took less time (35-45 minutes) than the female flowers (50-60 minutes) for complete blooming . However, this difference was not so conspicuous.

Observations recorded on anthesis in both the sexes was the evening hours. Critical studies further revealed that the male flower bloomed slightly earlier (7.30 - 8.00 P.M.) than the female counterpart (7.30 - 8.00 P.M.) but the diffferences were not very much spectacular. Similar findings have been reported by Singh et al. (1989). The coincidence in the blooming peroid for both the sexes is perhaps a natural device for promoting effective pollination followed by fertilisation especially in a dioecious crop like pointed gourd.

The stigma was found to have in receptive condition for 2-3 hours before anthesis and continued to remain so for a period of 30 hrs after. Singh et al. (1989) have also given similar views in this aspects. On the otherhand, the pollens were found to be viable for a period of 36 hours after anthesis. The degree of viability was the maximum (96.7%) at the peak of anthesis which gradually reduced.

It may be recalled that entomophilous type of pollination is in vogue in a dioecious crop like pointedgourd. The observations recorded on the efficacy of pollinator have laid to the identification of red brown beetle(Carpophylus demidiatus) and red ant(Componatus compresseus) as specific major pollinators for pointedgourd. The pollen grains sticking to the ventral surface of their body and oral parts during the course of their movement on flowers were found to have been transferred mechanically to the stigmatic surface of the female flower for the accomplishment of pollination. Similar views in confirmative to this have also been expressed by Sachan et al. 1990. After pollination, non-polliated female flowers quickly withered turning the petal colour to brown and their ovaries were shrivelled. On the otherhand, in the pollinated ones, the size of the ovaries appearded magnified in their dimensions oviously because of the post fertilisation development.

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'system, most of the monoecious vegetables have been by-passed or not attempt in the manner the demand and the necessities deserved it. Of recent years due attention have been paid for the improvement of dioecious vegetables of the market. It is worthwhile, to mention that these crops have tremendous yield potentialities and scope for launching an action plan for quantum jump in yield. The feasible approach might be mutation breeding than conventional breeding. Worth fully, these are the asexually propagated crops and thus, once a superior genotype is isolated, perpetuation is no problem. Under the aegies of an ICAR adhoc project on pointed gourd, 11 genotypes have been identified for having high yield potential and superior growth parameter, Therefore, the present study entitled "Evaluation of pointed gourd cultivers" (Trichosanthes dioica Roxb.) was carried out for basic study that could be a necessary prelude for future planning.

Variability studies : **(PLATE-1)**

Selection of superior genotypes at one stage or the other is the most important aspect in any Plant breeding programme and the effectiveness of selection is dependent upon the existance of genetic variability within or among the population subjected to selection. (Dixit et al. 1971) Swamy Rao, 1972 : Tika et al. 1974 ; Patnaik and Tak, 1974) . Therefore, a quantitative measure of genetic variability would be extremely beneficial in breeding for improvement of quantitative traits.

The estimates of GCV, PCV indicates the proportion of geneitc and environmental causes responsible for the expression of a particular character while genetic advance (GA) indicates the extent of genetic gain a breeder is expected to obtain through selection generation. In the present study the analysis computed for each character indicated existance of significant

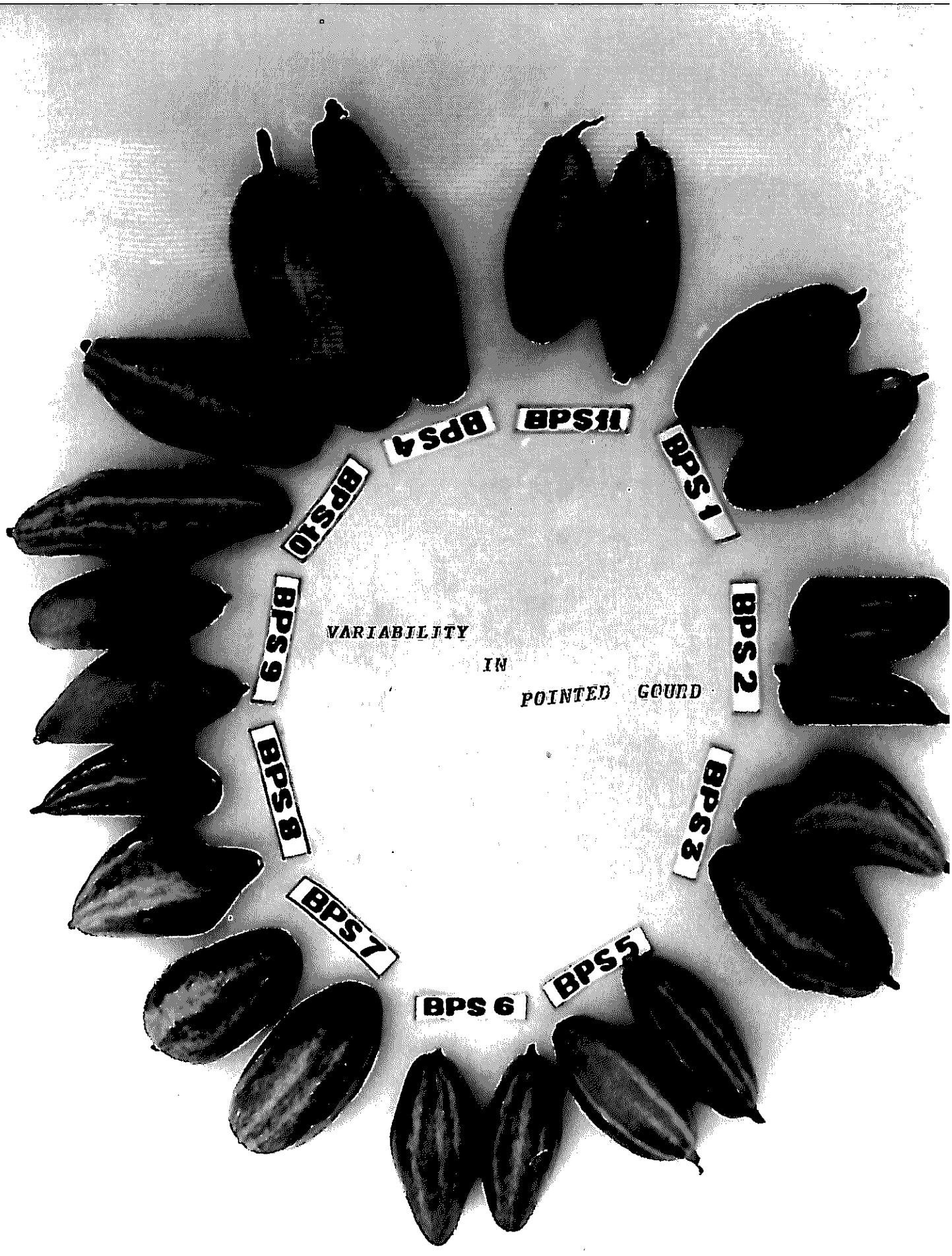
BPS11
BPS 1
BPS 2
BPS 3
BPS 5
BPS 6
BPS 7
BPS 8
BPS 9
BPS10
BPS 4
VARIABILITY
IN
POINTED GOURD

PLATE - 1

difference among the cultivars for all characters. The estimates of mean, range, GCV, PCV, and CV, heritability and GA (Table No.-9) Point out the wide range of phenotypic as well as genotypic variations contained in the population for all the characters. Both the estimates maintained correspondence, though the PCV was slightly higher than GCV, however, much variation was not marked between GCV and PCV (Choudhury et al 1973). The characters showing more than 30% GCV are likely to be less influenced by the environment and thus , might be considered stable over varying environment.

Yield is an interaction byproduct of genotype (G) + environment (E) + interaction of genotype (G) X Environment (E)

$$Y = G + E + (GXE)$$

In pointed gourd the economic yield is measured through the green matured fruits vis-a-vis existance of variability in respect of shape, size, pulp content and seed number per fruit. It is the number of fruits per plant and individual fruit weight that determines high productivity . In the present study of 11 promising lines Table-8(a) BPS-11 and BPS-9 gave the highest yield due to higher number of fruits per plant, percentage of fruit set, percentage of fruit retention and days taken from fruit set to marketable maturity. In respect of other characters like days taken for the appearance of first female flower, it was marked that BPS-8 flowered earlier but could not produce highest yield as compared to other cultivars. On the otherhand BPS-9 took slightly more number of days for appearance of first female flower but could produce significantly higher yield than rest of the cultivars. However, BPS-7 was the late most ocultivars as the primordia appeared later than other.

These traits can be considered as indices for selection of promising genotypes. The characters like node at which first female flower appeared, vine length, number of nodes per plant, number of fruits per plant and number of branches per plant exhibited more than 40% GCV indicating stable nature of the characters. Similar results have also beeen reported by (Rana et. al. 1986 ; singh and Krishna Prasad, 1989). Burton (1952) has suggested that an expected amount of GA can be estimated by GCV along with heritability. In the present study except diameter of the individual fruit, high estimate of heritability was obtained in all the characters studied. It can also be seen from Table No. - 9 . GA as percentage of mean was high (more than 40%) in number of nodes per plant and number of fruits per plant. Thus, emphasising the additive effect (Panse, 1957) and such characters can effectively be taken for selection of the promising line. Since, higher heritability coupled with GA indicates significance additive gene action of the charactrer, Hence, the improvement can be hoped by recurrent selection of these characters. This is in confirmation with (Randhwa et. al. 1975, Robinson 1963, Johnson et. al. 1955 and Singh and Prasad 1989).

Character association :

There can not be any gene system for yield as yield is the end product of multiplicative interaction between the yield components (whitehouse et al.1958). Genetical studies on association of yield components throw definite light on the evolutionary trend and the direction of divergence in association among a group of charactrers and enable the breeder to plan for manupulating or accentuating the expression of characters chanelliging towards higher yield. The present study of correlation coefficient at genotypic and phenotypic levels were analysed and presented in Table - 10 for 14 characters. Considering their

association with yield per plant in 11 genotypes it would be worth while to mention that yield per plant has uniformly exhibited positive significant association with characters like number of fruits per plant, percentage of fruit set and percentage of fruit retention and thus, selection on the basis of these characters would be reliable. It may be pointed out that the number of fruits per plant is positively significantly correlated with weight of the fruit, percentage of fruit set and percentage of fruit retention. Besides having direct effect of number of fruits per plant on yield other characters like internode length, which exhibited indirect negetive significant effect on yield. Thus probably, implies that internode length may not be given weightage as a criteria for selecting promising lines in subsequent generations. Weightage to other characters showing positive correlation might fetch selection advantage. This is in confirmative with Baha Eldin et al. (1968).

Vine length of the cultivars bears significant positive association with fruit length, weight of the fruit and number of nodes per plant at both phenotypic and genotypic level. This clearly implies that when the vine trails longer produces more number of nodes, leaves and more of female flowers. The photosynthates produced in the leaves encourages increased fruit length and higher fruit weight. It is also interesting to note that number of nodes per plant exhibited direct positive significant effect association with numnber of branches per plant, fruit length and individual fruit weight. The weight of the individual fruit also expressed positive significant effect with fruit length as well as number of fruits per plant. Rest of the characters did not show any significant correlation with yield per plant. Thus, confirming characters for selection should be chosen on the basis of number of fruits per plant, percentage of fruitset and percentage of fruit retention . This confirms the findings of (Rana et. al. 1985, Singh and Prasad 1989).

Path analysis :

Yield is a complex trait resulting from direct and indirect effects of several traits operating either in combination or individually. Selection for trait in one direction may influence another trait by a direct or indirect effect via a third variable. The study of correlation gives only the extent of association but does not imply the cause and effect relationship. Therefore, the path coefficient analysis is used to determine the direct and indirect effects of various plant characters on crop yield.

The direct positive effect of number of fruits per plant (0.352) could be reduced due to the negetive direct effects of vine length, node at which first female flower appeared, days from fruitset to marketable maturity, internode length and fruit length. Whereas, their mutual indirect effect was positive as expressed via vine length, percentage of fruit set , percentage of fruit retention, days taken from fruit set to marketable maturity, diameter of the fruit, fruit length, internode length. The results of the present investigation was in confirmative with Srivastava et al. (1967). Rana et al. (1985), Singh and Singh (1988).

However, compairing the direct positive effects of various characters like number of nodes per plant, percentage of fruit set , number of fruits per plant and fruit weight found to exert positive effect on yield. Hence, clearly indicating as desirable characters of selection for high yielding cultivars.

Genetic divergence :

The multivariate analysis has been used as a common tool in discriminating cultivars on the basis of their genetic distance. Published reports of Murty and Arunachalam (1966), Anand and Murty (1968), Ramanujan et al. (1974) have emphasized the merit of D^2 statistic and canonical analysis for genetic

grouping of germplasm. In the present study, the grouping by two multivariate techniques have shown good aggrement. In the clustering pattern, it can be seen from Fig -7 that BPS-4, BPS-5 and BPS-11 which are placed wide apart genetically formed monogenotypic clusters whereas, BPS-1, BPS-3, BPS-8, BPS-9, BPS-10 and BPS-2, BPS-6, BPS-7, produce two different clusters. This clustering patter, clearly indicates the superiority of the genotype in monogenotypic clusters than genotype in other clusters. Moreover, the comparision among the cultivars in the present set of environment indicates that the affinity of the genotypes to cluster together is the cause and effect of their common ancestry. Correspondence between genetic diversity and geographic origin did not appear to be existing among the cultivars included in the prestnt study. Similar results have been reported by M. Abdulwahab, P.K. Gopalkrishnan (1993) and G.Parhi, N.H. Mishra and P. Tripathy (1993) .

Breeding Emplications :

Changing attitude of the farmers for adoption of hybrid vegetables have been the present trend in any where and every where. Propagules are the microtive derivatives and thus, maintain hybrid vigour, once the superior hybrid is identified. The crop like pointed gourd where asexual propagation is the means of perpetuation, development of a high yielding hybrid could be of thunderous acceptance to the farmers. To the present study it has been possible not only indentify superior promising line but also the promising characters and interrelationship among characters. The superior genotypes being, BPS-11, BPS-4, and BPS-5 and the dependable characters being number of fruits per plant, percentage of fruit set and percentage of fruit retention.

A reciprocal recurrent selection programme could be planned to tailor a high yielding line. However, besides the present informations studies on quality aspects, biochamical aspects and nutritional aspects warrants further investigations.

CHAPTER VI

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

Unlike genetic informations available in major field crops, such findings are mostly silent or absent or inadequate in rare vegetable crops like pointed gourd (Trichosanthes dioica Roxb). Though a rare seasonal vegetable pointed gourd is one among the costliest vegetable and thus, has attracted attention of scientists in quest of its genetic upgrading for higher productivity. It is dioecious, normally vegetatively propagated. Therefore, a basic genetic study was undertaken in an adhoc project on "Evaluation of pointed gourd cultivars "(Trichosanthes dioica Roxb.)"being carried out under the aegies of ICAR in the Department of Horticulture, College of Agriculture, O.U.A.T., Bhubaneswar during the year 1995-96.

The basic objectives in experimentation were:

* Assessment of per se performance of 11 promising lines.
* Basic studies on floral biology and fruit development.
* Studies on character association of 14 characters.
* Estimation of direct and indirect influence of component characters on a complex characters, fruit yield per plant (Path analysis).

and * Assessment of genetic divergence among the 11 test entries following Mahalanobis' D^2 statistics.

The experiment was carried out in Horticulture Research Station, O.U.A.T., Bhubaneswar during the year 1995-96. The test materials constituted of 11 promosing lines isolated from among 69 land races collected from different parts of Orissa and else where. The experiment was laid out in RBD with 3 replications

having net sub plot size of 10 m^2. There were 2 rows of 5 plants/ row. The proportion of male and female plants was 1:9. The fertility levels in the experiment was 90:60:40 kg/ha.N,P,K respectively and was administered as per the package of practice. Adequate need best plant protection measures were ensured through out the crop season. Five randomly selected competative plants were tag-marked for recording observations on 14 quantitative characters like number of branches per plant, diameter of the fruit, days taken for the appearance of first female flower, fruit length, number of fruits per plant, weight of the fruit, number of nodes per plant, vine length, node at which first female flower appeared, internode length, percentage of fruit set, percentage of fruit retention, days taken from fruit set to marketable maturity, yield per plant. Observations were also recorded on qualitative characters like pulp content, rind: pulp ratio, rind thickness, seed number and T.S.S. content.

The floral biology was studied in one genotype (BPS-3) . While studying the floral development it was found that the male buds took more time than the female counterpart, whereas, the period taken for complete blooming was slightly more in case of female flowers. Although, the time of anthesis is in both the cases was evening hours, the peak period for female flowers was slightly later amounting to a state of coincidence. The matter of coincidence in the blooming was attributed to a device of nature for promoting easy pollinations in a dioecious crop like pointed gourd.

The receptivity of stigma appeared to be in readyness 2-3 hours before anthesis and continued more than a day after anthesis. On the other hand, the pollen grains were found to be viable for a period of 36 hours after anthesis. The investigations leading to the identification of suitable pollinators revealed that red brown beetle (Carpophyllus demidiatus) and

small red ant (Componatus Compressus) were the major pollinators for promoting effective pollination. For variability studies of 11 different cultivars,the mean data were put to statistical analysis to derive informations on the experimental objectives spelt out previously. The per se performances was assessed on mean values recorded on various characters. It was observed that the cultivar BPS-11 found to be the best for producing more number of fruits per palnt, more percentage of fruit set and more percentage of fruit retention followed by BPS-4 having longer fruit, more fruit weight followed by BPS- 9 having moderately high yield.

It was observed that all the traits exhibited significant differences among themselves meaning that a great deal of genetic variability existed among the cultivars under study. It was further reflected that the characters like node at which first female flower appeared, vine length, number of nodes per plant, number of fruits per plant exhibited more than 40% GCV and also high heritability indicating the importance of these characters to be included in the scale of selection criterion for better yield in pointed gourd.

Reviewing the results on the characters association it was observed that number of fruits per plant, percentage of fruit set and percentage of fruit retention exhibited high significant positive correlation with fruit yield both at genotypic and phenotypic levels.

The association of fruit yield with other component traits were further subjected for path analysis studies to obtain the direct and indirect effects of the correlated traits in determining the final fruit yield. It was thus, indicated that the characters like, number of nodes per plant, percentage of fruit set, number of fruits per plant, weight of the fruit exhibited direct positive effect both at genotypic and phenotypic levels.

The indirect effect of number of fruits per plant at genotypic level via vine length, percentage of fruit set and internode length were found to be in positive direction.

By using D^2 statistics and Tocher's method the 11 cultivars were grouped into five genotypic clusters (Table -14). Cluster I was the largest cluster constellating 5 cultivars, cluster II comprising 3 cultivars, rest three were monogenotypic cluster indicating their distinctly diversed nature.

. The characters contributing more towards genetic divergence were node at whcih first female flower appeared, days taken from fruit set to marketable maturity,percentage of fruit retention and number of nodes per plant. The grouping by Tocher's method showed close correspondence with the dimensional dispersion of the genotypes by the two canonical vectors. The genetic divergent among the genotypes did not commensurate with their place of origin or maintained any correspondence.

CONCLUSION :

It is apparently clear and consiviable that the basic genetic information emanated from the present study are highly valuable and informative. Any future research programme aimed at augmenting fruit yield in pointed gourd would be used effectively. Development of a superior variety not withstanding the individual merits on individual character,superiority must ranked upon the *per se* performance. Utilising the divergence analysis a reciprocal recurrent selection scheme can be meaningfully launched for general combining ability of the parent and specific combining ability of the character. This is in turn whould be useful for developing a highly heterotic hybrid for higher productivity of pointed gourd.

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