LINE X TESTER ANALYSIS FOR COMBINING ABILITY IN EGG PLANT (*Solanum melongena* L.)

THESIS

SUBMITTED IN
PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

GENETICS AND PLANT BREEDING

2005

By

Kailash Ram

Id. No. CA - 5026/01

DEPARTMENT OF GENETICS AND PLANT BREEDING

CHANDRA SHEKHAR AZAD UNIVERSITY OF AGRICULTURE & TECHNOLOGY, KANPUR - 208 002 (U. P.) INDIA

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KANPUR - 208 002 (U. P.) INDIA

Dedicated

to

My Venerably

Mother

Smt. Gulaechi Devi

And

Father

Shri Phoolchand Ram

Whose blessings brought me here up to............

Kailash

Dr. Prahlad Singh
M.Sc. (Ag.), Ph.D.
Professor & Former Head

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Kanpur-208 002 (India)*

CERTIFICATE

This is to certify that the thesis entitled, "**Line x tester analysis for combining ability in egg plant** (*Solanum melongena* L.)", submitted in partial fulfilment of the requirements for the degree of **Doctor of Philosophy in Genetics and Plant Breeding**, C.S. Azad, University of Agriculture and Technology, Kanpur, U.P., India, is a record of bonafied research work carried out by **Sri Kailash Ram, Id.No. CA-5026/01** under my supervision. The thesis embodies the work of the candidate himself.

Dated : Oct. 05, **2005**

(P. Singh)

DEPARTMENT OF GENETICS AND PLANT BREEDING

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CERTIFICATE

We, undersigned, members of the advisory committee of **Shri Kailash Ram, Id. No. CA-5026/01**, a candidate for the degree of **Doctor of Philosophy in Genetics and Plant Breeding**, agree that the thesis entitled **"Line x tester analysis for combining ability in egg plant (*Solanum melongena* L.)"**, may be submitted by him in partial fulfilment of the requirements for the degree.

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Associate Professor,
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Date : Oct. 05, 2005

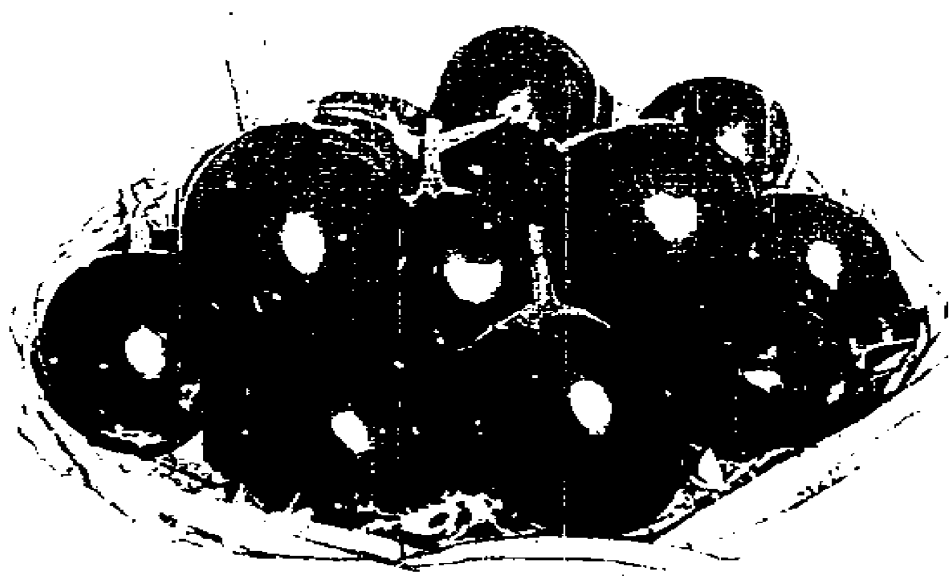
Place : Kanpur

(KAILASH RAM)

CONTENT

CHAPTER -I

INTRODUCITON



Chapter-I

INTRODUCTION

Vegetables are emerging as major source for human health and growth. The country's urgent requirement is to enhance the production of nutritious food in a sustainable manner and to improve the farm family income in order to ensure house hold food security, nutritional security and economic security. Vegetables are rich source of minerals, vitamins and dietary fibers and thus play an important role in human nutrition and also play a significant role in the economy of majority of small and marginal farmers.

Although India is the second largest producer of vegetables next only to China, accounting for about 10 per cent of the world's production. More than 50 species of vegetable crops are grown in India. The total area under vegetables in world is around 46.96 million hectares with total production of 787.4 million tonnes. Asia produces 53.3 million tonnes of vegetables from 33.31 million hectares of land. In India, the area, production and productivity is about 5.73 million hectares, 78.2 million tonnes and 500kg/ha, respectively; (The Hindu Survey of Indian Agriculture, 2004). Vegetable production of our country is still dominated by the locally available varieties which may be due to farmer's ignorance and poor extension activities. Development of hybrid varieties in country has advantage by production and protection technologies and increasing awareness of nutritional security among the masses. Karnataka, Maharashtra, Gujrat and parts of Andhra Pradesh are the pioneer states to adopt hybrid production of tomato, cabbage, capsicum, brinjal, cucumber and water melon.

Among various vegetable crops, egg plant (*Solanum melongena* L.) is one of the most popular vegetable grown in India. It belongs to the family Solanaceae and is an important commercial crop grown all over the country except on higher altitudes. It has high yielding potential and adaptability to various agro-climatic conditions throughout the country and capacity to grow around the year. **Thompson and Kelly (1957)** were of the opinion that India is a centre of variation of brinjal, one of many names probably derived from the Arabic. The cultivated brinjal is undoubtedly of Indian origin and has been in cultivation for a long time. A number of cultivars are grown depending upon the yield, consumer's preference, colour, size and shape of the various cultivars. Yet it is of particular importance in the warmer areas of far east, being grown extensively in India, Bangladesh, Pakistan, China, Philippines and also popular in France, Italy and the United States.

Egg plant fruit is a staple vegetable in many countries. It is liked by both poor and rich people. As regard nutritive value, it has about 1.4% protein, 4% carbohydrate, 0.3% fat, 0.3% minerals and 1.3% fiber. Vitamin C content is around 6mg/100mg and vitamin A is 30 IU. White cultivars contain twice amount of crude fiber than purple and green cultivars. The amino acid contents are higher in purple and low in white cultivars. Potassium and Chloride contents are higher in green and lower in purple varieties. **Bajaj *et al.* (1979)** reported that,on an average,the oblong fruited brinjal cultivars are rich in total water soluble sugars, whereas the long fruited cultivars contain large amount of free reducing sugars, anthocynin, phenols, glycoalkaloids, dry matter and amide proteins. A higher anthocynin content and low glycoalkaloid content are considered essential, regardless of how the fruit is to be used. For processing purposes, the fruit should have a high dry matter content and low level of phenolics. It is further observed that,on an average,the round types of brinjal have higher polyphenol oxidase activity and glycoalkaloid content than long types. Bitterness in brinjal is due to presence of glycoalkaloids which are of wide occurrence in species belonging to Solanaceae family. Generally, high amount of glycoalkaloids (20mg/100g fresh weight) produces a bitter taste and off flavour. Usually glycoalkaloid content varies from 0.37 mg/100g to 4.83mg/100g fresh weight in most of the commercial cultivars. In addition to its nutritional value, it also has medicinal value. White varieties are treated to be good for diabetic patients. It has also been found to be an appetizer cardio tonic and beneficial in *Vata* and *Kapha* **(Kirtikar and Basu, 1957)**. It can also cure toothache if fried brinjal fruit in til oil is taken and acts as an excellent remedy for those suffering from liver complaints.

The breeding methodology in autogamous crops, particularly in brinjal, have gone practically no further than pure line selection in maturity groups or hybridization induced genetic variability following the traditional pedigree method of breeding. Such conventional methods have failed to bring out any significant shift in the yielding potential of this crop. In general, hybrids are known to have higher yield potential in egg plant with uniform fruit size, early maturity, improved quality and pest resistance. Thus findings of the present study will certainly help in formulating appropriate breeding programmes for the development of hybrids in this crop.

For the development of superior varieties/hybrids to the existing once genetic amelioration is needed. In this regard, the selection of desirable parents for hybridization is an important step in any breeding programme. It is, therefore, essential to sort out desirable lines through various analytical methods, which can be utilized in further breeding programmes. For the purpose various mating designs like diallel, partial diallel and line x tester have been used to know the genetic architecture of breeding material. Among these, line x tester analysis is the potent method to test more number of lines at a time.

Therefore, the present study "Line x tester analysis for combining ability in egg plant (*Solanum melongena* L.)" was undertaken with the following objectives to gather the information on various aspects.

1- To estimate the extent of variability present in parents and their progenies.

2- To determine general and specific combining ability variances and effects for characters under study.

3- To estimate components of gene effects for yield and its contributing traits.

4- To workout heterosis over economic parent in F_1 and inbreeding depression in F_2.

5- To estimate the heritability and expected genetic advance.

6- To determine the genetic correlation between yield and contributing traits.

7- To partition the genetic correlation into direct and indirect effects for all the characters under study.

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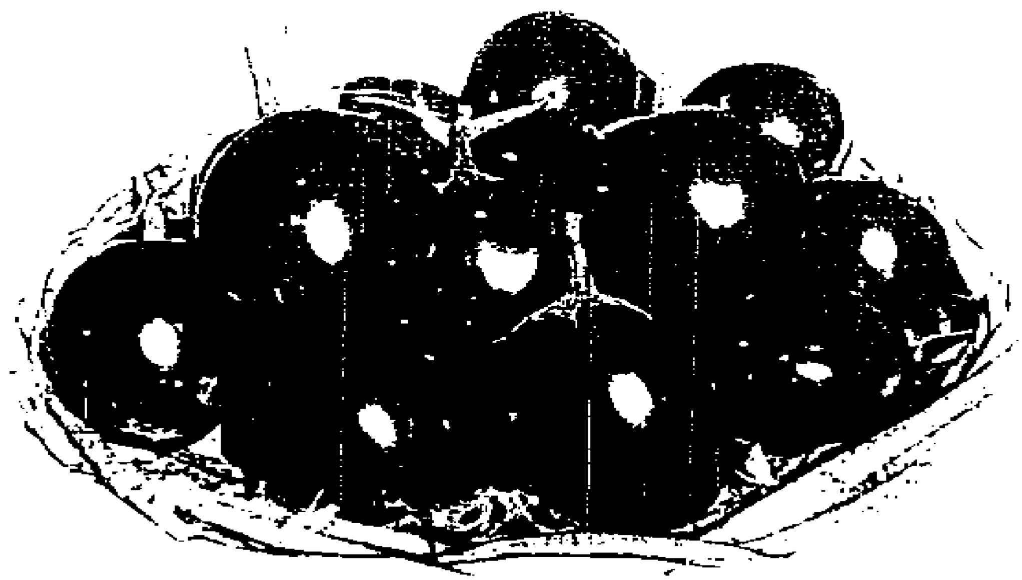
CHAPTER -II

REVIEW OF LITERATURE



Chapter - II

REVIEW OF LITERATURE

The sole objective of any plant breeding programme is to improve those characters of a species that contribute to its economic value. Complete information pertaining to inheritance of yield and its component traits is the prerequisite for the formulation of an efficient breeding programme. The relevant literature on various aspects which have direct relation to the present investigation is reviewed briefly under the following heads :

1. Components of genetic variance.
2. Concept of combining ability and its estimation.
3. Heterosis and inbreeding depression.
4. Heritability and genetic advance.
5. Correlation and path coefficients.

COMPONENTS OF GENETIC VARIANCE :

The study of quantitative characters in plants started with the work of **Johannsen (1909), Nilsson Ehle (1909) and East (1916)**. Theoretical basis of quantitative genetics was first established by **Ronald Fisher (1918)** who partitioned hereditary variance into (i) an additive component arising from average effect of gene,(ii) dominance component arising from the intra-allelic interaction and (iii) epistatic part associated with non-allelic interactions.

Wright (1921,1935) concluded that hereditary components of variation are composed of additive and non-additive (dominance and epitasis) types of gene action.

Mather (1949) partitioned the observed phenotypic variance into three components as :

(i) Heritable - fixable (additive and additive x additive).

(ii) Heritable - non-fixable (dominance and epistatic variance expect additive x additive component).

(iii) Non-heritable - non-fixable (environmental variance).

Robinson *et al.* (1949) stated that additive genetic variance indicates the extent of relation between parents and progenies.

Cockerham (1954) and Kempthorne (1955) further partitioned epistatic variance into fractional components of digenic and higher order interactions, such as (i) additive x additive, (ii) additive x dominance and (iii) dominance x dominance for two loci situations and additive x additive x additive for three loci and so on.

Jinks (1955) and Gamble(1962b) found that epistasis was correlated with yield. **Santz *et al.* (1954), Bauman (1959), Johnson (1963) and Eberhart (1964)** have reported the importance of epistasis in specific combining ability.

Gardner (1963) postulated the following genetic parameters which are very useful to plant breeders :

1. Additive genetic variance (δ^2A) : Which results from the additive effects of genes at all segregating loci.

2. Dominance variance (δ^2D) : Which results from intra-allelic interactions of genes at all segregating loci.

3. Epistatic variance (δ^2E) : Which results from inter-allelic interactions of genes at all segregating loci and which is divisible into additive x additive (δ^2_{AA}), additive x dominance (δ^2_{AD}) and dominance x dominance (δ^2_{DD}) for two loci situation and into additive x additive x additive,etc., for three loci and so on.

4. Average degree of dominance $(\delta^2_D/\delta^2_A)^{0.5}$: It is represented by the ratio of dominance to additive genetic variances.

5. Genotype x environmental interaction, which may be divided into additive gene effects x environment and non-additive effects x environment.

6. Genotypic correlations among quantitative characters for the particular crop.

Schnell (1963) developed an expectation for partitioning of genotypic variability into different components in the presence of linkage. The generalized equations, though very complicated, are extremely useful under such situations.

METHODS FOR THE ESTIMATION OF GENETIC PARAMETERS :

The following methods have commonly been utilized by different workers for the estimation of genetic parameters :

1. Estimates based on segregating generations from crosses of two pure lines **(Mather, 1949).**

2. Covariance of half -sibs and full-sibs **(Comstock and Robinson, 1948; 1952; Anderson and Kempthorne, 1954 ; Kempthorne ,1957).**

3. Diallel analysis **(Jinks and Hayman, 1953; Hayman, 1954a, 1954b, 1958; Griffing, 1956a, 1956b; Gamble, 1962a).**

4. Partial diallel analysis **(Kempthorne and Curnow, 1961; Gilbert, 1958).**

5. Powers partitioning method **(Powers, 1951, 1963).**

6. Triallel and quadriallel analyses **(Rawlings and Cockerham, 1962a, 1962b; Ponnuswamy, 1971).**

7. Inference about gene action from combining ability studies **(Sprague and Tatum, 1942; Rojas and Sprague, 1952; Griffing, 1956a, 1956b; Kempthorne and Curnow, 1961).**

8. Generation mean analysis **(Mather, 1949; Hayman, 1958; Jinks and Jones, 1958).**

9. Line x tester analysis **(Kempthorne, 1957; Arunachalam, 1976).**

10. Triple test cross analysis **(Kearsey and Jinks, 1968; Ketata *et al.* 1976).**

11. Phenotypic stability analysis **(Finley and Wilkinson, 1963; Eberhart and Russell, 1966; Perkins and Jinks, 1968; Freeman and Perkins, 1971).**

CONCEPT OF COMBINING ABILITY AND ITS ESTIMATION :

The concept of general and specific combining ability was first developed by **Sprague and Tatum (1942)**. They concluded that general combining ability occurs due to additive gene effect and specific combining ability from intra or inter allelic interactions. According to them general combining ability (gca) is the average performance of a line in hybrid combinations,while specific combining ability (sca) is to designate those cases in which certain combinations do relatively better or worse than would be expected on the basis of the average performance of the line involved.

Handerson (1952) explained gca as the average merit with respect to some traits or weighed combination of traits of large number of progenies of an individual or line which mated with a random sample from some specified population under a specified set of environmental conditions. The sca was defined as the "deviation of an average of an indefinitely large number of progenies of two individuals or lines from the values which would be expected on the basis of known gca of these two lines or individuals and the maternal ability of the female parent".

Griffing (1956a) pointed out that general combining ability involved both additive as well as additive x additive interaction. He also outlined the procedures for determining the general and specific combining ability effects and variances **(1956b)**. The following equations were derived by **Griffing** for the estimation of general and specific combining ability variances.

$$2\delta^2_{gca} = \delta^2 A + 1/2\, \delta^2 AA + \ldots\ldots\ldots\ldots\ldots\ldots$$

$$\delta^2_{sca} = \delta^2 D + 1/2\, \delta^2 AA + \delta^2 AD + \delta^2 DD + \ldots\ldots\ldots\ldots\ldots$$

Where,

δ^2_{gca} = Variance due to gca.

$\delta^2 A$ = Additive genetic variance.

$\delta^2 AA$ = Additive x additive type inter allelic interaction.

δ^2_{sca} = Variance due to sca.

$\delta^2 D$ = Dominance variance.

$\delta^2 AD$ = Additive x dominance interaction.

$\delta^2 DD$ = Dominance x dominance interaction.

Kempthorne (1957) proposed line x tester analysis which is analogous to design II of **Comstock and Robinson (1952)**.He explained general and specific combining ability variances in terms of covariance of half-sib (H.S.) and full-sib (F.S.) in random mating population.

Where,

δ^2_{gca} = Covariance (H.S.).

δ^2_{sca} = Cov. (F.S.) - 2 Cov. (H.S.).

LINE X TESTER ANALYSIS :

Davis (1927) was the first to suggest the use of inbred variety cross popularly known as 'top cross' as a method of evaluating inbred lines of maize but the credit for establishing the top crosses test on a firm footing goes to **Jenkins and Brunson (1932)**.They suggested that crosses of inbred lines with open pollinated varieties could well be used for the rapid screening of new lines in maize.

Kempthorne (1957) advanced the method of line x tester analysis which was analogous to the North Carolina Design II of **Comstock and Robinson (1952)**. In this design hybrid progenies are produced with different genetical relations like full-sibs and half-sibs. These genetical relations among individual aid in the analysis of such polygenic system in terms of Cov. (H.S.) and Cov. (F.S.) conducting the experiment in which random samples of a sire were mated to each of **d** dame.

In this design, relatively large number of varieties can be tested. This approach is not only useful for practical screening work but is also more comprehensive for the enquiry of genetical basis at population level than other techniques like diallel, which are generally based on fewer parents.

Arunachalam (1974) reported the utility of line x tester design in deciding about the relative capacity of a number of male and female parents to produce desirable hybrids. In this design, a large number of lines (female parents) are tested against a small number of testers (male parents).

NATURE AND NUMBER OF TESTERS IN EVALUATING LINES :

Jenkins and Brunson (1932) concluded on the basis of their studies that heterozygous tester has more capacity than homozygous one for evaluating the superior lines for breeding programme.

Federer and Sprague (1947) observed that an increase in number of testers in many cases would have greater value than more extensive replications and the use of single tester.

Hull (1947) pointed out that theoretically the most efficient testers would be homozygous recessive at all loci and that homozygosity for dominant alleles at any locus should be avoided.

Keller (1949) made a comparison involving the number and relationship between testers in evaluating the inbred lines of maize and concluded that high and low combining lines were, on an average, of equal value testers.

Matzinger (1953) defined a tester as "one that combiners the greatest simplicity in use with maximum information on the performance to be expected from the tested lines when used in other combinations or grown in other experiment." No single tester can fulfill these requirements. Therefore, in such breeding programme one has to keep a set of desirable testers to evaluate the lines efficiently.

Zongic and Morice (1958) used three different types of testers in maize, and found that the tester W.F.9. one of the best combining American inbred line had low additive or high dominance effects. The lowest yield of crosses with this tester was reported.

Thomson and Rawlings (1960) evaluated four single cross testers of different ear height in corn and reported that testers were equally effective for measuring either ear height or yield. Only a slight advantage was indicated for the two lowest yielding testers for yield evaluation.

Studies on the nature and number of testers were also made by **Bolton (1948), Grogan and Zuber (1957), Burton (1959), Singh (1961), Vahtin (1962) and Singh and Joshi (1966).**

In general, most of the workers agreed that for initial evaluation of large collection of inbred lines, more than one tester with good combining ability possessing high additive genetic components and having broad genetic base should be used.

DEGREE OF DOMINANCE :

In polygenic inheritance, the effect of individual genes can not ordinarily be distinguished from one another. Therefore, the determination of mode of action of single gene is not feasible. However, on the basis of the study of their combined effects in segregating populations, one can judge some insight into their behaviour and can derive inference about the average level of dominance involved in the expression of a particular quantitative character.

Comstock and Robinson (1948) furnished the procedure for estimating the degree of dominance using the data of biparental progenies. They defined 'a' (degree of dominance) as a means of dominance overall the loci as :

If, 'a' = 1.0 means complete dominance

'a' > 1.0 over dominance

'a' < 1.0 partial dominance

Comstock and Robinson (1948) stated that magnitude of variance due to dominance deviation relative to that of the additive genetic variances, furnished another basis for estimating the degree of dominance.

Mather (1949) developed a formula $\sqrt{H/D}$ for determining the degree of dominance. **Robinson *et al.* (1949)** and **Gardner (1963)** recognized that the estimates of degree of dominance in over dominance range for yield could be obtained as a result of repulsion phase linkage, even though none of the genes involved was more than completely or partially dominant to its alleles. **Gardner and Lonnquist (1959), Robinson and Moll (1963), Moll *et al.* (1964) and Williams *et al.* (1965)** have provided experimental evidence indicating linkage bias in the results reported earlier.

Kempthorne and Curnow (1961) estimated the degree of dominance as $(\hat{\sigma}^2_s/\hat{\sigma}^2_g)^{0.5}$.

A brief review of the recent work done on combining ability, gene action and average degree of dominance on egg plant is given below :

Dharmegowda *et al.* (1979) carried out combining ability in egg plant and reported that yield per plant, number of fruits per plant and days to flowering had the highest significant effects for general combining ability.

Bhutani *et al.* (1980) evaluated combining ability and related general and specific combining ability (GCA and SCA) variances in brinjal and showed the significance for all the characters except yield (for GCA), plant height and fruit girth (for sca). Both additive and non-additive gene effects were observed, the later being predominant for yield. Parents P_1, P_3 and P_4 were observed as good general combiners for most of the characters, crosses with high SCA values were P1 x P5, P2 x P4 and P3 x P6 for yield, P2 x P3 for earliness and P1 x P5 for fruits number.

Sidhu *et al.* (1980) studied genetic component in all possible combinations of brinjal cultivars and reported that yield, length of fruit, and days to flowering exhibited additive and dominant gene effects. Additive gene effects were more important than dominant gene effects for fruit number and fruit weight.

Dixit *et al.* (1982) studied general and specific combining ability for days to flowering, plant height, number of branches per plant, number of fruits per plant, length of fruit, fruit diameter, fruit weight and yield per plant in brinjal cultivars and reported that general combining ability variances (GCA) were greater than specific combining ability (SCA) variances for all characters. Highly significant differences for GCA and SCA were found for all characters except length of fruit and first harvest of fruit for SCA. The best combiners for most of characters were Pusa Purple Long, PH-4, S-16 and Aushey. The best specific combinations were Pusa Purple Long x Aushey; BR-112 x R-34, PH-4 x Pusa Kranti, PH-4 x S-16 and PH-4 x Aushey for total yield per plant; Pusa Purple long x R-34 and Pusa Kranti x Aushey for number of fruits per plant and PH-4 x BR-12 and Pusa Kranti x S-16 for fruit weight.

Raghavaish and Joshi (1982) studied combining ability in 10 lines and 4 testers and their 40 hybrids for the characters days to flowering, plant height, number of branches/plant, fruits/plant, fruit length, fruit girth, fruit weight and yield/plant in egg plant, and reported that general combining ability and specific combing ability variances were highly significant for all the characters under study. The gca variances were higher for all the characters, suggesting the predominance of additive gene action. The gca effects indicated that none of the parents was a good general combiner for all characters, suggesting that separate parent will have to be used for improvement of different traits studied. The predictability ratio is near unity for fruits/plant, followed by leaf area and days to flowering, suggesting greater importance of additive genetic variance for these characters.

Singh *et al.* (1982) studied gene action for yield and its components in a fractional diallel design for the characters days to flower, days to first harvest, plant height, number of branches per plant, number of fruits per plant, fruit length, fruit diameter, fruit weight, yield per plant in brinjal and assessed all the characters with over dominance except fruit length which was found to be partial dominance.

Salehuzzaman and Alam (1983) did genetic analysis on *Solanum melongena* and reported that additive gene action predominated for fruit weight, while dominance and duplicate epistasis were most important for fruit number and yield.

Dixit *et al.* (1984) reported gene action in *Solanum melongena* and indicated the importance of both additive and non-additive gene actions for yield per plant, fruits per plant and plant height. Additive gene action was important for length of fruit, plant spread and weight of fruit. There was partial dominance for all the characters except yield per plant and plant height, which were controlled by over dominance and complete dominance, respectively. Yield per plant, fruit circumference and fruit weight were mainly determined by dominant alleles.

Dahiya *et al.* (1985) evaluated ten females, four males and their 40 hybrids in brinjal for days to flowering, branches/plant, fruit length, fruit weight, fruits/plant and total yield/plant. Variances due to general combining ability (GCA) of the parents and specific combining ability (SCA) of the hybrids were significant for all characters studied.

Gopinath and Madalageri (1986) analysed the gene action for yield/plant and five related characters, viz., first flowering, plant height, number of branches/plant, fruit number and fruit weight in brinjal. Additive dominance and epistatic gene effects were significant for all characters except fruit number.

Kumar and Ram (1987) observed combining ability from 6 x 6 diallel cross, excluding reciprocalsin egg plant and revealed that Pusa Purple Long, Pusa Purple Cluster, Pant Samrat and T3 were the best general combiners among the parents.

Singh and Mital (1988) studied genetics of yield and its components in a diallel crosses in egg plant and reported that days to flowering, plant height and yield/plant were controlled chiefly by non-additive gene action.

Chadha and Sharma (1989) revealed that fruit yield and fruits/plant exhibited negative dominance effects. Duplicate epistasis was noted for these characters in both crosses.

Mishra and Mishra (1990) reported that Round White, Pusa Kranti, Bhubaneshwar-4 and Keonjhar-1 were good general combiners for most of the characters under study. The crosses Pusa Purple Cluster x Bhubaneshwar-4, Pusa Purple Cluster x Keonjhar-1, Bhumchai x Keonjhar-1, Deogarh x Bhubaneshar-4 and Deogarh x Keonjhar-1 were good specific combinations for yield/ plant.

Singh and Prasad (1992) observed variances due to general and specific combining ability for the characters, plant height, fruits/plant, number of branches/plant and fruit weight. Both the variances were highly significant indicating the importance of additive and non-additive gene action.

Ponnuswami and Irulappan (1992) studied combining ability analysis for the morphological traits (plant height, earliness, branches, number of fruits /plant, and fruit weight) in 6 testers and 17 lines and their 102 F_1 hybrids in brinjal and reported that useful material showing good combining ability for individual character or all characters together were SM 78 and SM 75.

Vadivel and Babu (1993) found predominant role of additive gene action in the control of plant height, fruit yield/plant, number of fruits per plant and fruit length.

Prakash *et al.* (1994) studied combining ability for 11 yield components in 18 hybrids from 9 lines x 2 testers in brinjal and reported that Eregere, Arka Shirish and Arka Sheel varieties were good general combiners for most of the characters. The cross WCGR x P 1269663 was a good specific combination for fruit yield, while SM6 x Eregere and WCGR x J1 performed well for number of fruits per plant, fruit length and diameters.

Kumar *et al.* (1996) observed combining ability analysis in the brinjal cultivars and reported that significant differences for fruit yield per plant, number of fruits per plant and fruit weight were observed. SM6 was good general combiner for days to 50% flowering, fruit yield per plant and number of fruits per plant. SM6 x Pusa Purple Long, BB9 x PH4 and Pant Samrat x T3 had significant sca effect for fruit yield per plant.

Ingale and Patil (1997) reported that a predominance of additive gene action was observed for length and girth of fruit. Non-additive gene action was predominant for yield/plant.

Patil *et al.* (2000) studied the gene effects for fruit weight, number of fruits per plant and yield per plant in brinjal. They reported the pattern of dominance and additive gene effects for these traits.

Babu and Thirumurugan (2001) studied combining ability effects using four lines and two testers in brinjal and found that parent and hybrids differed significantly for general and specific combing ability effects. The parents EP 39, EP 165 and Pusa Kranti were good combiners for most of the characters. High SCA effects were expressed by the hybrid EP 39 x Pusa Kranti for fruit length, fruit weight, number of fruits per plant and fruit yield per plant.

Das and Barua (2001) studied combining ability in aubergine cultivars and reported that the significant differences among geotypes were observed for characters days to first flowering, days to 50 per cent flowering, plant height, primary branches per plant, fruit length, fruit girth, number of fruits per plant, fruit weight and yield. Both general and specific combining abilities were significant for plant height, fruit length, fruits per plant, fruits weight and yield per plant indicating the importance of both additive and non-additive gene actions. Parents JC 2, and JC 4 were good combiners for yield, fruit weight, fruits per plant and fruit girth. JC 2 x JC 4 and JC 4 x JC 6 were good specific combinations for yield, fruit weight, fruits per plant and earliness.

Kaur *et al.* (2001) observed combining ability of aubergine cultivars and reported that significant general combining ability (gca) effects were observed for fruit yield and branches. Approximately 1/3 of the hybrids exhibited favourable specific combining ability effect for days to flower and days to first picking.

Singh *et al.* (2002) studied combining ability for yield and its component using 28 hybrids and their 8 parents in brinjal for the characters, days to flowering, plant height, number of branches per plant, number of fruits per plant, length of fruit, fruit diameter, fruit size and yield per plant and reported that general and specific combining ability variances were significant for all characters except plant height and fruit weight. In all yield components except plant height and fruit length, GCA variance was higher than SCA variance and the additive type of gene action was predominant. It was also observed that the superior performance of F_1 hybrids was largely due to epistatic interactions. The predominance of additive gene effects for all yield components suggested that single plant selection in the early segregating generation of crosses would be highly effective in abergine. The additive and dominance components were significant for all characters. The additive component was predominant for number of branches per plant, fruit length and diameter and number of fruits per plant. The additive and additive x additive components were predominant for fruits size, whereas the dominance and additive x additive components were predominant for plant height, fruit size and yield per plant.

HETEROSIS AND INBREEDING DEPRESSION :

The term heterosis is referred to the phenomenon in which the F_1 hybrid obtained by crossing of the two genetically dissimilar individuals which show increased or decreased vigour over the better parent or mid parent or standard parental value. **Shull (1914)** referred to this phenomenon as stimulus of heterozygosity. Now, it is widely recognized that this phenomenon is the result of action and interaction of unlike gametes in the heterozygote and the heterosis is only the better or worse than expected manifestation of this biological behaviour of hybrids. Further, it is pointed out that inbreeding depression is associated with unfavourable biological effects resulting in loss of vigour. **Wright (1921)** stated that with the dominance hypothesis, the decline of vigour due to inbreeding was proportional to decrease in heterozygosity.

The work done on heterosis and inbreeding depression by various workers in brinjal is presented as under :

Andronicescu (1960) reported heterosis in numerous inter varietal hybrids and found heterosis for yield and earliness in F_1 hybrids of brinjal. The heterotic effect being considerably reduced in the F_2 generation.

Biswas (1964) reported heterosis for yield and related characters in ten all possible single crosses between five varieties. He reported that crosses of high x low yielding varieties gave the most productive hybrids while, low x low combinations yielded slightly more than hybrids between the high yielding parents.

Komochi (1966) observed heterotic effects in the hybrids for plant height.

Randhawa and Sukhija (1973) reported maximum heterosis for yield, fruits/plant, fruit weight, number of primary branches and plant height.

Lal *et al.* (1974) observed maximum heterosis of 112.37 per cent in the cross T2 x T3 for yield per plant over superior parent. Positive heterosis for fruit length (16.96%), negative heterosis in fruit thickness (-13.04%) and increased number of fruits per plant (49.35%) over superior parent was reported.

Peter and Singh (1974) studied heterosis and showed that non-additive genetic variance was the more important for days to flowering and number of primary branches, while additive genetic variance was more important for number of flowers per inflorescence, and fruits per plant was controlled by both additive and non additive gene actions.

Singh *et al.* (1974) studied heterosis in brinjal cultivars and noted heterosis over the better parent for plant height, days to flowering, fruit length, fruit width, fruit number, and yield per plant and predominance of negative heterosis for fruit width. Considerable inbreeding depression was occurred in the F_2 for all traits measured.

Popova *et al.* (1976) observed intervarietal crosses with heterosis for number of fruits per plant and number of seeds per fruit. Higher yield was obtained when the mixture of pollen from many plants was taken in pollination, rather than pollen from one plant. When the female parent was early, the hybrid also showed marked earliness.

Hani *et al.* (1977) assessed maximum heterosis for yield per plant. Only two hybrids exceeded the better parent for number of fruits per plant.

Dharmegowda *et al.* (1979) observed maximum heterosis in days to flowering, height, number of fruits per plant, number of branches per plant, fruit density and yield per plant. Additive and non additive effects were pronounced for all of these characters.

Partap and Dhankhar (1980) observed maximum heterosis for fruit yield/plant, number of fruits/plant and number of branches per plant.

Joarder *et al.* (1981) observed high heterosis for fruit weight, fruit volume and fruit number per plant. Dominance effects were more important than additive effects for most characters as F_2 means showed high inbreeding depression.

Balamohan *et al.* (1983) studied maximum heterosis in number of branches, fruit length and number of fruits.

Dahiya *et al.* (1984) studied heterosis from the crosses between 10 females and 4 males in brinjal. They reported significant positive heterosis over the superior parent and best parent for fruit length, weight, number of branches per plant and yield. The best hybrid with heterosis for yield and fruit number was observed.

Patil and Shinde (1984) observed heterosis in egg plant and reported that heterosis in fruits/plant was positively associated with heterosis in fruits/cluster and fruit number/plant in 50% of the crosses studied.

Singh (1984) studied heterosis and inbreeding depression from ninety crosses in egg plant and reported that partial dominance or over dominance effects contributed to heterosis in all hybrids. Heterosis for yield/plant was highest in PPL x 5317 and was due to heterosis for fruit number and weight. For all traits, except fruit shape index, crosses between forms with low GCA and between forms with high and low GCA had high heterosis. Non-additive gene action predominated overall and hybrid breeding is recommended to exploit it. The maximum heterosis was recorded for yield/plant, fruit number and fruit weight.

Gopinath and Madalageri (1986) reported that significant heterosis over the mean parental value was observed for fruit number/plant, yield, fruit length and plant height.

Dixit and Gautam (1987) observed maximum significant positive heterosis over the better parent for number of fruits, fruit weight and fruit length.

Shankaraiah and Rao (1990) reported maximum heterosis for plant height, plant spread and earliness.

Saha *et al.* (1991) found high heterosis in fruit length and yield/plant in the F_1, indicating good potential for hybrid varieties.

Mandal and Dana (1993) studied heterosis in brinjal cultivar and reported that the greatest heterosis was estimated for the number of secondary branches/plant followed by yield/ plant.

Mankar *et al.* (1995) studied heterosis of brinjal cultivars. They noted considerable heterosis over better parent for number of branches per plant, number of fruits per plant, diameter of fruit, fruit length, yield per plant, days to first harvest and fruit weight.

Ingale and Patil (1997a) presented data on mean, range and heterotic effects in egg plant and reported that heterosis over the better parent was significant for fruit yield, fruit weight, fruit girth, fruit length, indicating the presence of over dominance.

Ingale and Patil (1997b) observed greatest heterosis for earliness, fruit yield, number of fruits, plant height, plant spread, primary branches and secondary branches in brinjal and reported that the range of mean performance of hybrids was higher than the parents for all the characters except plant height. The magnitude of heterosis ranged between 77.9 and 82.7 per cent over mid, better and top parent values for these characters. The positive association between *per se* performance and degree of heterosis was observed for all characters. The frequency and magnitude of heterotic hybrids were observed more towards desired direction for days to flower, fruit yield, plant height, plant spread and fruits/plant, indicating the presence of overdominance.

Babu and Thirumurugan (2000) observed heterosis among the hybrids of *solanum melongena* and reported significant positive heterosis for plant height, number of branches per plant, fruit length, number of fruits per plant and fruit yield.

Prasath *et al.* (2000) studied heterotic effects from crossing of ten lines and three testers in brinjal and reported that yield/plant, plant height, branches/ plant, fruit length, fruit weight and fruits per plant possessed maximum heterosis over the better parent revealing the presence of overdominance. Positive association between *per se* performance and heterotic effects was noticed in all the characters.

Babu and Thirumurugan (2001) observed heterosis from the crosses of brinjal cultivars and reported that plant height, number of branches per plant, fruit length, number of fruits per plant, fruit weight and fruit yield per plant exhibited maximum heterosis.

Das and Barua (2001) found better heterotic cross in yield, fruit weight, fruits per plant, days to 50 per cent flowering and days to first harvest in brinjal.

Patil *et al.* (2001) studied heterosis for 6 fruit characters of aubergine. The heterosis over better parent was significant for fruit yield, fruit weight, length of fruit and girth of fruit.

HERITABILITY AND GENETIC ADVANCE :

The concept of heritability is important in determining whether phenotypic differences observed among various individuals are due to genetical changes or due to effects of environmental factors. Heritability indicates the possibility and extent to which improvement can be brought about through selection.

Lush (1949) defined heritability as "the portion of the observed variance for which difference in heredity is responsible." A destination is made between heritability estimates in narrow and broad sense. **Robinson (1966)** defined heritability in broad sense as "the ratio of the total genotypic variance to the total phenotypic variance" and provides a measure of the overall importance of hereditary determination of a trait. Heritability in the narrow sense is, "the ratio of additive genetic variance to the total phenotypic variance" and measures the portion of the total variation which can be utilized for improvement of a given population with respect to that trait. He also categorized the heritability estimates, as follows :

1. Low heritability (below 10 per cent).
2. Medium heritability (10 to 30 per cent).
3. High heritability (above 30 per cent).

Several methods **(Mather, 1949; Warner, 1952; Crumpacker and Allard, 1962; Mather and jinks, 1971)** have been developed for estimation of heritability in narrow sense.

Genetic advance is still a more useful estimate because heritability value by itself is not of much significance as it fails to account for the magnitude of absolute variability. It is, therefore, necessary to utilize heritability in conjunction with selection differential which would then indicate the expected genetic gain resulting from selection. The expected response to selection is proportional to the narrow sense heritability **(Falconer, 1960)**. Thus genetic gain in a character is the product of the heritability and selection differential expressed in terms of phenotypic standard deviation of that character.

The expected genetic advance dependsupon (i) the amount of genetic variability, (ii) the magnitude of masking effect of the environmental and interaction components of variability on the genetic diversity, and (iii) the intensity of selection **(Comstock and Robinson, 1952)**. According to **Mather and Jinks (1971)** the speed of selective progress will depend upon (i) the vigour of selection (i.e., proportion of F_2 chosen in breeding), (ii) the number of genes, as organized into effective factors, (iii) the variation in magnitude of action of genes for factors, (iv) their dominance relations. (v) their linkage relations, (vi) the heritability of the characters in the F_2. (vii) the sampling variances of the genotypic frequencies.

The available information on heritability and genetic advance of yield and other quantitative characters has been reviewed as under :

Dheshi *et al.* (1964) observed high heritability for yield, fruit girth, number of fruits, fruit weight, plant height, number of primary branches per plant and fruit length. Low value of heritability was recorded for days to flowering.

Srivastava and Sachan (1973) reported that fruits per plant, plant height, yield per plant and number of branches per plant had heritability value of 98.85%, 92.12%, 53.56% and 45.09%, respectively, with high genetic advance as percent of mean for number for fruits per plant.

Singh *et al.* (1974) studied heritability and genetic advance in brinjal and recorded high heritability for days to flowering, height, fruit length, number of primary branches, number of secondary branches, fruit weight and yield per plant.

Mishra and Roy (1976) observed high heritability values and high percentage of genetic advance for yield per plant, number of fruits per plant and average fruit weight.

Mital *et al.* (1976) recorded high estimates of heritability for days to flowering and fruit weight, but yield per plant exhibited a low value.

Bhutani *et al.* (1977) found high habitability estimates with high genetic advance for yield per plant and number of fruits per plant.

Mehrotra and Dixit (1977) observed high heritability accompanied by high genetic advance as a percentage of mean for number of branches per plant, plant height and bottom girth of the fruit.

Sidhu *et al.* (1980) studied heritability for yield per plant and length of fruit, with values of 20.9% and 98.8%, respectively.

Singh and Singh (1981) reported high estimates of genetic advance with high heritability for yield per plant, number of fruits per plant and fruit length, while days to flowering exhibited low value for both parameters.

Joarder *et al.* (1981) observed high estimates of genetic advance for fruit number and fruit yield per plant.

Salehuzzaman and Alam (1983) reported that narrow sense heritability was high for fruit number, moderate for fruit weight and low for yield per plant.

Gopimony *et al.* (1986) reported range of heritability from 38.78 to 99.12%, being highest for single fruit weight and genetic advance ranged from 18.56 to 201.38% of the overall mean being highest for single fruit weight. The association of high heritability and high genetic advance was shown by yield per plant, single fruit weight and fruit diameter.

Vadivel and Babu (1989b) studied heritability and genetic advance in brinjal cultivars. They noted that days to flowering, plant height, number of fruits/plant and fruit yield/plant had moderate heritability in the F_2 and F_3. Secondary branches, fruit length and fruit diameter recorded high heritability. Secondary branches, fruit length, fruit diameter, number of fruits/plant and fruit yield/plant also exhibited high value of genetic advance.

Nainar *et al.* (1991) observed high heritability coupled with high genetic advance for fruits/plant, fruit weight and yield/plant.

Gautam and Srinivas (1992) studied genetic advance in brinjal. They noted that plant spread and number of fruits per plant had high genetic advance.

Bora and Shadeque (1993) reported high genetic advance with high heritability for fruit diameter, fruit weight, number of fruits per plant and yield per plant.

Vadivel and Babu (1994) noted that fruit yield, number of fruits per plant, fruit weigh and fruit girth had high heritability and high genetic gain.

Sanwal *et al.* (1998) observed high heritability coupled with high genetic advance for number of fruits per plant and fruit yield per plant.

Behera *et al.* (1999) noted high heritability together with high genetic advance in fruit diameter, length of fruit and fruit yield per plant.

Chaudhary (1999) reported heritability in brinjal cultivars and noted that dominant and recessive alleles were symmetrically distributed among the parents for fruit length, days to 50% flowering, yield/plant, days to first picking and fruit weight.

Mohanty (1999) reported that average fruit weight, number of fruits, and branches per plant, plant height, days to first harvest and yield exhibited high heritability with high genetic gain.

Patel *et al.* (1999) reported high heritability for most of the characters studied. Fruit weight, fruit volume and plant height had high heritability coupled with high genetic advance as percentage of mean which suggested that these traits are under the control of additive gene action and would be improved through simple selection.

Rai *et al.* (1999) reported high value of heritability coupled with high genetic advance for fruit weight, yield, equatorial fruit length and total number of fruits.

Singh and Gopalakrishnan (1999) reported the highest heritability estimates (0.94) for plant spread, average fruit weight, days to 50 per cent harvest, number of fruits per plant and yield per plant alongwith high genetic advance.

Negi *et al.* (2000) reported high genetic advance coupled with high heritability for number of fruits per plant, fruit yield per plant and average fruit weight.

Sharma *et al.* (2002) observed high estimates of heritability for length of fruit, number of fruits per plant, mean fruit weight and yield per plant. In spite of high heritability values for most of the traits, the expected genetic advance ranged from 11.47 to 95.36 per cent.

CORRELATION AND PATH COEFFICIENTS :

Association of characteristics with yield, its component and other economical traits is important for making selection in the breeding programme. It suggests the degree and direction of selection for more than one character at a time. The concept of correlation was presented by **Galton (1989)** which was elaborated later by **Fisher (1918)** and **Wright (1921a)**. The statistics which measures the relationship and its extent, between two or more variables is known as correlation coefficient.

The concept of path analysis was originally developed by **Wright (1921)** but the technique was first used for plant selection by **Dewey and Lu (1959)**. Path coefficient analysis is simply a standardized partial regression coefficient which splits the correlation coefficient into the measures of direct and indirect effects. It measures the direct and indirect contribution of independent variables on dependent variable. The path analysis reveals whether the association of these characters with yield is due to their direct effect or indirect effects *via* other component characters.

Peter and Singh (1973) found non-significant correlation between number of days to flowering and all other characters. Positive correlation was noted between number of flowers per inflorescence and number of fruits per plant, plant height and number of primary branches per plant.

Hiremath and Rao (1974) reported that yield per plant had high significant positive correlation with number of fruits per plant, whereas it has negative correlation with rind thickness. Number of fruits per plant showed negative correlation with fruit weight and girth of fruit.

Prabhu (1974) worked out phenotypic and genotypic correlations in egg plant and observed significant positive phenotypic correlation between days to first fruit set and equatorial perimeter of the fruit, flowers per inflorescence and fruits per plant. In general,genotypic correlation coefficients were higher than phenotypic correlation coefficients.

Singh and Nandpuri (1974) reported significant positive correlation of fruit yield with number of fruits per plant and the number of branches per plant, between fruit weight and height of the plant and between days taken to first picking, and height of the plant and number of fruits per plant. Significant negative correlations were observed between yield per plant, number of branches per plant and number of days taken upto first picking and the fruit weight.

Singh and Khanna (1978) observed genotypic correlation coefficients between plant height and plant spread, plant height and number of branches, fruit number and yield which were higher than phenotypic correlation coefficients. The fruit yield, plant spread, number of fruits and number of branches showed positive and significant correlations among themselves.

Sinha (1983) reported that yield was positively correlated with fruits per plant, plant height and branches per plant. Path analysis indicated that fruits per plant and fruit length had the maximum direct effects on yield per plant.

Singh (1983) studied path co-efficient analysis of yield and related traits in brinjal and reported that yield was positively correlated with fruits/plant, plant height and branches per plant at the phenotypic and genotypic levels, and with fruit length at the phenotypic level. Path analysis indicated that fruits/plant and fruit length had the maximum direct effect on yield/plant.

Chadha *et al.* (1984) reported that yield per plant was positively correlated with fruits per plant and plant height.

Gupta and Yadav (1984) noted that yield/plant displayed the positive direct genotypic and phenotypic correlation effects on dry fruit yield/plant. Genotypic correlations was higher than phenotypic correlations.

Krusteva (1985) observed highest positive correlation of yield per plant with number of fruits per plant and mean fruit weight.

Sharma *et al.* (1985) observed path analysis from 39 genotypes in egg plant cultivars and revealed that total yield/plant was positively correlated with fruit number at both the phenotypic and genotypic levels. Total yield was directly affected by fruit number.

Nualsri *et al.* (1986) observed that yield per plant showing high positive correlation with fruit number per plant. It is considered that varietal development could involve breeding either purelines or hybrids, the latter being preferred.

Khurana *et al.* (1988) reported that fruit yield showed positive correlation with fruit diameter and mean fruit weight. These characters were positively and significantly correlated with number of branches per plant, length and width. Number of fruits was negatively correlated with fruit diameter.

Randhawa *et al.* (1989) in correlation studies revealed that fruits per plant was positively correlated with total yield. Fruits/plant had maximum direct effect on yield. The long styled flowers also had high direct effect on total yield.

Kumar *et al.* (1990) reported that yield per plant was positively correlated with fruit length, number of primary branches per plant and number of fruits per plant.

Mishra and Mishra (1990) observed that yield per plant was significantly and positively associated with plant height, fruit weight, number of branches per plant and fruits per plant, while fruits per plant was negatively correlated with fruit girth and weight. Path analysis revealed that fruits, fruit weight and branches per plant were the most important traits contributing towards yield.

Nainar *et al.* (1990) reported that the number of fruits per plant gave the highest, positive and most significant correlation with yield. Other characters in order of importance were plant height, number of branches, plant spread and fruit weight with positive correlation among themselves. For path analysis yield was considered as dependent variable. Other traits are treated as independent variables.

Vadivel and Babu (1990) observed that fruit yield was significantly and positively correlated with number of fruits per plant, fruit length, number of branches per plant and plant height. Path analysis reported that number of fruits /plant had the greater direct effect on yield. but fruit length and weight had negative effects. Path analysis ranked the main traits directly affecting yield in the following descending order of importance : number of fruits/plant, number of branches/plant, plant height and fruit weight.

Gautam and Srinivas (1992) reported that plant spread and number of fruits per plant showed significant positive correlation with yield.

Mandal and Dana (1992) studied 20 genotypes of brinjal and noted the direct effect of fruits per plant and branches per plant on yield per plant indicating the importance for selection of superior genotypes.

Bora and Shadeque (1993) observed that fruit yield was significantly correlated with plant height and fruit diameter.

Usha Kumari and Subramanian (1993) observed genotypic and phenotypic correlations among 10 yield components of aurbergine and revealed that number of fruits had the highest positive correlation followed by number of branches with fruit yield. Path coefficient analysis for number of fruits and fruit breath had the highest direct effect on fruit yield followed by fruit length.

Kumar (1995) studied correlations of 11 yield related characters in brinjal genotypes and reported that yield was positively associated with flowers per cluster, fruit length, fruit value, primary branches and fruits per plant.

Saraswathi *et al.* (1996) observed path analysis in F_2 of crosses for yield components of brinjal and reported that fruits /plant and fruit weight had direct positive effects.

Sanwal *et al.* (1998) reported that fruit yield per plant had positive significant correlation with number of fruits per plant, total flowers per plant and percent fruit set.

Mohanty (1999) observed the path analysis of 15 genotypes in brinjal and reveated that yield displayed positive and significant genotypic and phenotypic association with plant height and number of fruits/plant. Path coefficients studies explained that number of fruits /plant and height exerted maximum positive direct effect on yield.

Negi *et al.* (1999) reported that number of fruits per plant and fruit setting exhibited significant positive correlation with yield. Width of fruit showed positive relationship with fruit weight. However, negative association with number of fruits per plant and other traits were observed.

Mohanty (2001) reported high positive direct effect on yield followed by number of fruits per plant.

Singh and Singh (2001) observed correlation in brinjal cultivars and reported that fruit yield was positively correlated with number of fruits per plant at both genotypic and phenotypic levels. In path analysis fruits per plant, average fruit weight and number of branches per plant had maximum direct effect on yield per plant at the both genotypic and phenotypic levels.

Sharma *et al.* (2002) reported that genotypic correlations were higher in magnitude over phenotypic correlations. Most of the characters were positively correlated with yield except days to 50 per cent flowering. Maximum direct effect of number of fruits per plant, mean fruit weight and diameter of fruit was observed both at genotypic and phenotypic level. Number of branches per plant, plant height and length of fruit had positive indirect effect towards yield per plant *via*. number of fruits per plant.

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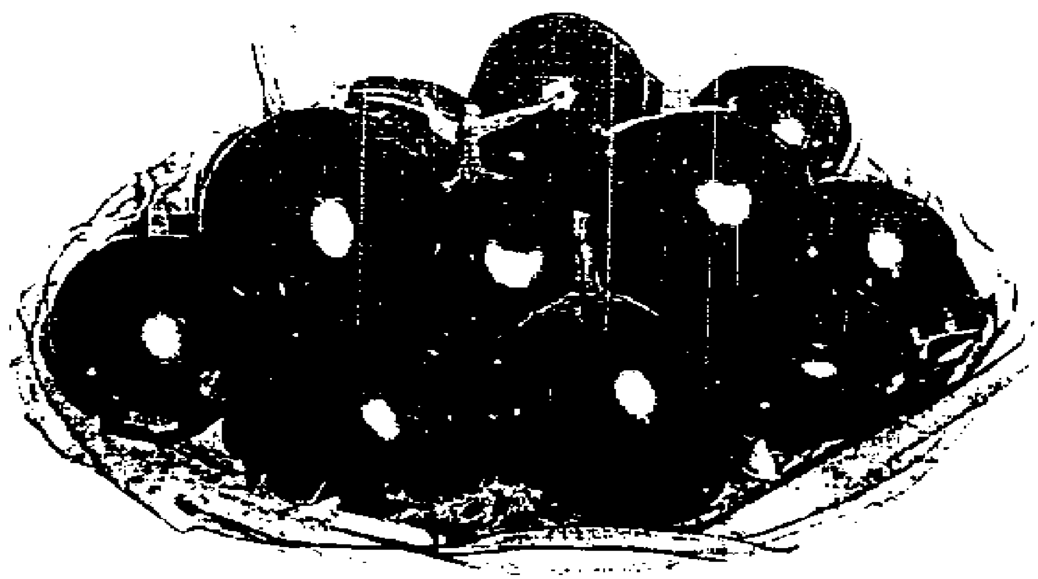
CHAPTER -III

MATERIAL & METHODS



Chapter-III

MATERIALS AND METHODS

The details of materials used, experimental procedures and techniques followed are described as under.

EXPERIMENTAL SITE AND CLIMATE:

The present investigation entitled, "Line x tester analysis for combining ability in egg plant (*Solanum melongena* L.)" was carried out in *Kharif* season of 2001-02, 2002-03 and 2003-04 at Vegetable Research Station, Kalyanpur, C.S.Azad University of Agriculture and Technology, Kanpur.

Geographically, Kanpur is situated between 26^0, 28' N latitude, 80^0,12'E longitude and at altitude of 125.9 meters above the sea level. This area falls in sub-tropical climate zone. The soil type of area is fertile, alluvial loam and is characterised as the typical soil of the Indo-Gangetic plains. Nearly 60-110cm of total rainfall was received during mansoon season from July to September with few showers in the winter. The meteorological data of the crop season is presented in Table1. The soil of the experimental site was sandy loam, low in organic carbon, nitrogen, and phosphorus and rich in potash.

A. EXPERIMENTAL MATERIAL :

Experimental material used for the present investigation comprised fifteen lines, viz., KS219, KS247, KS253, KS262, KS228, KS233, KS250, KS263, KS235, KS227, ACC5114, ACC8204, ACC8206, ACC8207, ACC2623 and four testers, viz., T3, AB1, KS224 and DBR8 and their sixty F_1 hybrids derived by crossing the fifteen lines used as female parent with each of the four testers used as male parent in line x tester fashion. The source of experimental material is given in Table2.

Table 1. Meteorological data for the crop season, 2003-2004.

Month	Temperature (^0C)		Relative humidity (%)		Rainfall (cm)
	Minimum	Maximum	Maximum	Minimum	
July	24.7	33.8	69.7	88.7	334.0
August	25.0	32.6	73.3	88.2	129.2
September	23.4	30.9	78.2	93.8	453.6
October	16.9	31.9	45.8	91.0	00.0
November	10.2	28.2	45.2	90.0	00.0
December	7.9	21.6	61.3	92.7	36.0
January	8.2	17.4	76.5	93.0	37.4
February	10.7	25.5	76.7	89.6	00.0
March	16.4	33.5	35.4	73.0	00.0
April	23.1	38.2	35.7	57.5	5.0

Table 2. Characteristic features and source of the genotypes/ cultivars.

Genotypes/ cultivars	Source	Characteristic features
Females (Lines)		
KS 219	Vegetable Research Station, Kalyanpur, Kanpur (UP)	Semi-erect, sparse branching, early flowering, round fruited, purple colour, moderate yielder.
KS 247	"	Erect, intermediate branching, early flowering, round fruited, purple colour, moderate yielder
KS 253	"	Erect, sparse branching, early flowering, round fruited, purple colour, moderate yielder.
KS 262	"	Erect, sparse branching, intermediate flowering, round fruited, purple colour, moderate yielder
KS 228	"	Erect, intermediate branching, medium in flowering, round fruited, purple colour, low to moderate yielder.
KS 233	"	Erect, sparse branching, medium in flowering, round fruited, purple colour, low yielder
KS 250	"	Erect, sparse branching, medium in flowering, round fruited, purple colour, moderate yielder.
KS 263	"	Erect, sparse branching, medium in flowering, round fruited, purple colour, low yielder
KS 235	"	Erect, sparse branching, medium in flowering, round fruited, purple colour, low to moderate yielder
KS 227	"	Bushy, sparse branching, medium in flowering, round fruited, purple colour, moderate yielder
ACC 5114	"	Erect, sparse branching, medium in flowering, round fruited, purple colour, low yielder
ACC 8204	"	Erect, sparse branching, intermediate in flowering, round fruited, purple colour, low yielder.
ACC 8206	"	Erect, sparse branching, early flowering, round fruited, purple colour, low yielder.
ACC 8207	"	Erect, sparse branching, medium in flowering, round fruited, purple colour, low to moderate yielder.
ACC 2623	"	Erect, profuse branching, medium in flowering, round fruited, purple colour, moderate yielder.
Males (Tester)		
T 3	"	Spreading type, intermediate branching, late flowering, fruit oblongish oval, purple colour, high yielder.
AB 1	"	Erect, compact plant, broad and thick leaves, sparse branching, medium in flowering, round fruited, purple colour, high yielder
KS 224	"	Erect, sparse branching, early flowering, fruit oblongish oval, purple colour, medium to high yielder.
DBR 8	"	Semi-erect, intermediate branching, medium in flowering, round fruited, dark purple colour, moderate yielder

BUILDING UP OF MATERIAL :

During *Kharif* 2001-02, all the15 lines (females) and 4 testers (males) were grown for making crosses in line x tester fashion and F_0 seeds of all the resultant 60 hybrids were procured. During Kharif 2002-2003, the F_1s were raised to get their seeds for raising F_2 population. Besides, fresh crosses were again attempted to get F_0 seeds for raising F_1s.

METHODS :

Plan of layout for the experiment :

The experiment comprising 139 treatments (19 parents, 60F_1s and 60F_2s) was conducted in Randomized Block Design with three replications during *Kharif* 2003-04. The parents had 2 rows,whereas F_1s and F_2s each had 3 rows of 3m length in each replication. The row to row and plant to plant distance was kept 60cm in each treatment. Recommended agronomic practices were followed to raise a good crop.

Five plants from each parent and F_1s, and 10 plants in F_2s in each replication were selected at random for recording data on days to flowering, days to marketable maturity, plant height, number of branches per plant, number of fruits per plant, length of fruit , fruit width, fruit weight, plant spread and yield per plant.

OBSERVATIONS :

Five plants of each parent and F_1s and 10 plants in F_2s were randomly selected and tagged for recording the observations. The data were recorded on ten quantitative characters as under :

1. Days to flowering :

The date of opening of the first flower of each plant was recorded. The number of days taken from the date of sowing to the date of opening of frist flower was counted.

2. Days to marketable maturity :

Days to marketable maturity were recorded as the interval in days from the date of flowering to date of marketable maturity.

3. Plant height :

The data on plant height were recorded when harvesting of fruits was almost over in all the treatments. The length from the ground level to the top of the plant was recorded in centimeter for plant height.

4. Number of branches per plant :

Total number of branches emerging from the main shoot of tagged plants of each treatment were counted.

5. Number of fruits per plant :

The harvested fruits were counted at the time of each picking and the total number of fruits per plant were recorded in the end of the complete harvesting of the crop.

6. Length of fruit :

The length in centimeter of 5 randomly chosen marketable fruits of equal age was recorded after every harvest and averaged to take length of fruit. Fruit length was measured from its stalk junction to the tip of fruit.

7. Fruit width :

Five marketable fruits were chosen after every harvest and the diameter was taken by vernier calipers in centimeter at the thickest portion of the fruit. The average was taken for recording fruit width.

8. Fruit weight :

The average weight in gram of fruit in each treatment was calculated by dividing the total yield by number of fruits.

9. Plant spread :

The vertical length of plant from ground level to top and horizontal length from one side end to other were recorded in centimeter at the end of harvesting. The recorded vertical and horizontal length were multiplied and converted into meter to record plant spread in square meter (m^2).

10. Yield per plant :

The average yield per plant was obtained by harvesting marketable size fruits at the interval of ten days. The yield per plant was calculated in kilogram by averaging the total yield of all picking.

C. STATISTICAL AND BIOMETRICAL ANALYSES OF DATA :

The experimental data were compiled by taking the mean of each treatment over replications. Then it was subjected to the following statistical and biometrical analyses :

1. Analysis of variance (ANOVA).
2. Mean, range and variability in parents, F_1s and F_2s.

3. Combining ability analysis :

    i. Analysis of variance for combining ability.

    ii. Estimates of components of variance, their magnitude and average degree of dominance.

    iii. General combining ability effects.

    iv. Specific combining ability effects.

    v. Proportional contribution of females, males and females x males.

4. Estimates of heterosis and inbreeding depression.

5. Estimates of selection parameters :

    i. Heritability

    ii. Genetic advance

6. Estimates of correlation coefficient

7. Path analysis

The out line of methodology used in the above analyses are given below :

ANALYSIS OF VARIANCE :

The analysis of variance for the experimental design was carried out according to the usual procedure suggested by **Panse and Sukhatme (1967)**.

COMBINING ABILITY ANALYSIS :

The analysis of variance for combining ability was carried out according to the method outlined by **Kempthorne (1957) and Singh and Chaudhary (1977)**. The partitioning of treatments was done into females, males and females x males. The skeleton of analysis of variance for combining ability is given below :

Source of Variation	d.f.	M.S.	E(M.S.)
Replications	r-1		
Crosses	fm-1		
Females	f-1	m_2	δ^2e + r [Cov. (F.S.) -2 Cov. (H.S.)] + rl [Cov. (H.S.)]
Males	m-1	m_1	δ^2e + r [Cov.(F.S.)-2 Cov. (H.S.)] + rt [Cov. (H.S.)]
Females x Males	(f-1) (m-1)	m_3	δ^2e + r[Cov.(F.S.) -2 Cov. (H.S.)]
Error	(r-1) (fm-1)	m_4	δ^2e

Where,

$$\text{Cov. (H.S.)} = [(m_1 - m_3) + (m_2 - m_3)] / r (f + m)$$

$$\text{Cov.(F.S.)} = \frac{[(m_1 - m_3) - (m_2 - m_3)]}{3r} - \frac{[6r \text{ Cov. (H.S.)} - r (f + m) \text{ Cov. (H.S.)}]}{3r}$$

$$= \delta^2 s + 2 \text{ Cov. (H.S.)}$$

(i) Estimates of general and specific combining ability variances :

Estimates of general and specific combining ability variances were worked out as per methodology given by **Kempthorne (1957)**.

$$\delta^2_{gca} = \text{Cov. (H.S.)}$$

$$\delta^2_{sca} = \text{Cov. (F.S.)} - 2\ \text{Cov. (H.S.)}$$

(ii) Estimates of components of variance :

$$\hat{\delta}^2_{gm} = (m_1 - m_3)/fr$$

$$\hat{\delta}^2_{gf} = (m_2 - m_3)/mr$$

$$\hat{\delta}^2_{g(pooled)} = [(m_1 - m_3) + (m_2 - m_3)]/r(f + m)$$

$$\hat{\delta}^2_{s} = (m_3 - m_4)/r$$

Where,

$\hat{\delta}^2_{gm}$ = variance due to gca of males.

$\hat{\delta}^2_{gf}$ = variance due to gca of females.

$\hat{\delta}^2_{g(pooled)}$ = variance due to gca (pooled).

$\hat{\delta}^2_{s}$ = variance due to sca.

(iii) Estimates of general and specific combining ability effects :

The model to estimate the general and specific combining ability effects of ijkth observation is given below :

$$X_{ijk} = \mu + g_i + g_j + s_{ij} + e_{ijk}$$

Where,

μ = population mean.

g_i = gca effect of the i^{th} male parent.

g_j = gca effect of the j^{th} female parent.

s_{ij} = sca effect of the ij^{th} combination.

e_{ijk} = error common to all individuals.

i = number of male parents.

j = number of female parents.

k = number of replications.

The individual effects were estimated with the help of following relationship.

$\mu = X .../mfr$

Where,

$X ...$ = total of all hybrid combinations

$g_i = X_i .. / fr - X.../mfr$

Where,

$Xi..$ = total of i^{th} male parent over all the females and replications.

$g_i = X.j./mr - X... / mfr$

Where,

$X.j.$ = total of j^{th} female parent over all the males and replications.

$s_{ij} = X_{ij.} / r - X_i.. / fr - X.j. / mr + X ... / mfr$

Where,

$X_{ij.}$ = ij^{th} combination total over all the replications.

Test of significance for general and specific combining ability effects :

Standard errors of effects were calculated as the square root of variance of effects as follows :

$$S.E.(\hat{g}_i) = \sqrt{\delta_e^2 / fr}$$

$$S.E.(\hat{g}_j) = \sqrt{\delta_e^2 / mr}$$

$$S.E.(\hat{s}_{ij}) = \sqrt{\delta_e^2 / r}$$

Standard error of difference between the values of two general and specific combining ability effects were calculated as follows :

$$S.E.(g_i - g'_i) = \sqrt{2\delta_e^2 / fr}$$

$$S.E.(g_j - g'_j) = \sqrt{2\delta_e^2 / mr}$$

$$S.E.(s_{ij} - s'_{ij}) = \sqrt{2\delta_e^2 / r}$$

Average degree of dominance :

It was calculated according to method suggested by **Kempthorne and Curnow (1961)**.

Average degree of dominance = $(\hat{\delta}_s^2 / \hat{\delta}_g^2)^{0.5}$

Where,

$\hat{\delta}_s^2$ = Estimated variance due to sca

$\hat{\delta}_g^2$ = Estimated variance due to gca

(iv) Proportional contribution of lines, testers, and their line x tester interaction :

$$\text{Contribution of lines (females)} = \frac{\text{S.S. (l)} \times 100}{\text{S.S. (crosses)}}$$

$$\text{Contribution of testers (males)} = \frac{\text{S.S. (t)} \times 100}{\text{S.S. (crosses)}}$$

$$\text{Contribution of lines x testers (females x males)} = \frac{\text{S.S. (l x t)} \times 100}{\text{S.S. (crosses)}}$$

ESTIMATION OF VARIABILITY :

(i) Mean

The mean of i^{th} trait was measured by dividing the total of observation (Σxij) by their number and was denoted by $\overline{X}$.

$$\overline{X} = \frac{i}{n} \sum_{j=1}^{n} X_{ij}$$

Where,

$\overline{X}$ = Mean of the i^{th} trait.

$\overline{X}_{ij}$ = The value of j^{th} observationsof i^{th} trait.

n = Number of observations.

(ii) Range

It was estimated as the difference between the lowest and the highest values of a series of observation of accessions.

ESTIMATION OF SELECTION PARAMETERS :

(i) Heritability :

Heritability in narrow sense ($\hat{h}^2$) was estimated using the formula suggested by **Kempthorne and Curnow (1961)**.

$$\hat{h}^2(\%) = \frac{2\hat{\delta}^2 g}{2\hat{\delta}^2 g + \hat{\delta}^2 s + \hat{\delta}^2 e} \times 100$$

Where,

$2\hat{\delta}^2 g$ = Variation due to GCA.

$\hat{\delta}^2 s$ = Variance due to SCA.

$\hat{\delta}^2 e$ = Variance due to error.

(ii) Genetic advance :

The expected genetic advance (GA) was calculated by using the formula of **Robinson *et al.* (1949)**.

$$GA = K \times \hat{h}^2 \times \delta_{ph}$$

Where,

GA = Expected genetic advance under selection.

K = Standardized selection differential (2.06), at 5 per cent selection intensity.

$\hat{h}^2$ = Estimate of heritability coefficient.

δ_{ph} = Phenotypic standard deviation, i.e. $\sqrt{(2\delta^2 g + \delta^2 s + \delta^2 e}$

Genetic advance in per cent of mean was worked out by formula

$$= \frac{\text{Genetic advance}}{\bar{X}} \times 100$$

Where,

$\bar{X}$ = Mean of the character concerned, i.e., grand mean of the population.

Estimation of heterosis :

Heterosis in percent over economic parent was calculated by using the formula :

$$\text{Heterosis over economic (standard) variety} = \frac{\bar{F_1} - \overline{SV}}{\overline{SV}} \times 100$$

Where,

$\bar{F_1}$ = mean of the F_1 hybrid.

$\overline{SV}$ = Mean of the standard (economic) variety (T3).

Significance of the estimates was tested with help of C.D. at p = 0.05 and p = 0.01 level of significance as :

S.E. $= \sqrt{2\hat{\delta}_e^2 / r}$

C.D. = S.E. x 'f' ('t' values at 5 and 1 per cent)

Where,

$\hat{\delta}_e^2$ = estimate of error variance.

r = number of replication.

ESTIMATION OF INBREEDING DEPRESSION :

The inbreeding depression was calculated as follows :

$$\text{Inbreeding depression (\%)} = \frac{\bar{F}_1 - \bar{F}_2}{\bar{F}_1} \times 100$$

Where,

$\bar{F}_1$ = mean value of F_1 generation

$\bar{F}_2$ = mean value of the F_2 generation

Significance of estimates inbreeding depression was tested against C.D. value.

ESTIMATION OF CORRELATION COEFFICIENT :

The following formulae were used for calculating the genotypic and phenotypic correlation coefficients as suggested by **Al-Jibouri *et al.* (1958).**

(a) Correlation between characters x and y at genotypic level

$$r_{gxy} = \frac{Cov.xy\ (g)}{\sqrt{Var.x(g).Var.y(g)}}$$

(b) Correlation between characters x and y at phenotypic level.

$$r_{pxy} = \frac{Cov.xy\ (p)}{\sqrt{Var.x(p).Var.y(p)}}$$

Where,

r_{xy} = Correlation coefficient between character x and y.

$Cov._{xy}$ = Co-variance between characters x and y.

$Var._x$ = Variance of character x.

$Var._y$ = Variance of character y.

Test of significance of correlation coefficients :

Phenotypic correlations (rp) were tested against the table value of correlation coefficients **(Fisher and Yates, 1938)** at n-2 degree of freedom at 5 and 1 per cent level of probability.

PATH COEFFICIENT ANALYSIS :

Path coefficients were obtained according to the procedure suggested by **Dewey and Lu (1959)** using genotypic and phenotypic correlation coefficients.

Fifteen characters were included in the path coefficient analysis to find out their direct and indirect effects upon fruit yield.

Residual factor was also included in the causal system, representing all the factors, which might affect the end-products, i.e., fruit yield. The correlation of 'cause' with effects were calculated by solving the following simultaneous equations :

r m p = p m p + r m n p n p + r m o p o p ....(1)

r n p = r n m p m p + p n p + r n o p o p ....(2)

r o p = r o m p m p + r o n p n p + p o p ....(3)

where,

p m p, p n p and p o p are direct ' effects' of m, n and o on 'cause' p and r m n, p n p, r m o, p o p...... are indirect effects on cause. These simultaneous equations were solved by using matrix method and are expressed as :

$$\begin{bmatrix} rmp \\ rnp \\ rop \end{bmatrix} = \begin{bmatrix} rmm & rmn & rmo \\ rnm & rnn & rno \\ rom & ron & roo \end{bmatrix} \begin{bmatrix} pmp \\ pnp \\ pop \end{bmatrix} \text{ or } A = B.C.$$

Here,

A and B vectors are known for calculating **c** vector, the formula used as:

$$C = B^{-1} A$$

Here,

B^{-1} is the inverse matrix of B vector.

Residual factor was calculated as follows :

$$Rxy\sqrt{1-R^2}$$

Where,

$$R^2 = \sum_{j} P_{iy} \, r_{iy}$$

The $r_{ij's}$, i.e., $r_{1.2}$ to $r_{15.16}$ denoted correlations between all possible combinations of independent characters and P_{iy}, i.e., P_{1y} t P_{10y} denote direct of various character Y.

r_{iy} = correlation coefficient between i^{th} and Y character.

P_{iy} = direct effect of i^{th} character on Y.

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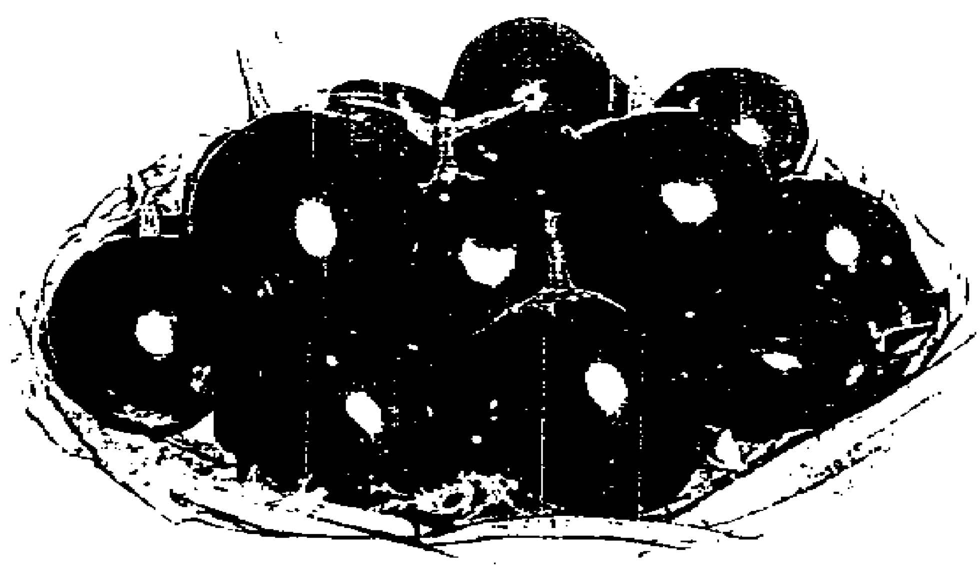
CHAPTER -IV

EXPERIMENTAL FINDINGS



Chapter - IV

EXPERIMENTAL RESULTS

The data derived from present investigation, " Line x tester analysis for combining ability in egg plant" for 10 characters, viz., days to flowering, days to marketable maturity, plant height, number of branches per plant, number of fruits per plant, length of fruit, width of fruit, fruit weight, plant spread and yield per plant were subjected to biometrical analyses and the results obtained on genetic estimates are described under the following heads :

1. Analysis of variance (ANOVA).
2. Mean, range and variability in parents, F_1s and F_2s.
3. Combining ability analysis :
    (i) Analysis of variance (ANOVA) for combining ability.
    (ii) Estimates of components of variance, their magnitude and degree of dominance.
    (iii) General Combining ability effects.
    (iv) Specific combining ability effects.
    (v) Proportional contribution of females, males and females x males.
4. Estimates of heterosis and inbreeding depression
5. Estimates of selection parameters :
    (i) Heritability
    (ii) Genetic advance
6. Estimates of correlation coefficient.
7. Path analysis.

Analysis of variance (ANOVA) :

The analysis of variance for all the characters was carried out involving 19 parents, 60 F_1s and 60 F_2s for testing significance of differences among the treatments. In order to know the clear picture of parents and crosses, the treatment variance was further partitioned into its components, viz., parents, F_1s, F_2s, parents *vs* F_1s and F_1s *vs* F_2s. the mean squares for all the treatments are presented in Table 3.

The 'F' test revealed that variances due to treatments, F_1s and F_2s were highly significant for all the characters under study. Significant differences among parents were observed for all the characters except width of fruit which showed non significant difference. Among parents *vs* F_1s, significant differences were observed for all the characters except number of branches per plant. Highly significant differences for all the characters except days to marketable maturity were also reported for F_1s *vs* F_2s .

MEAN, RANGE AND COEFFICIENT OF VARIATION IN PARENTS, F_1s AND F_2s :

Mean value of the parents, F_1s and F_2s for all the characters are presented in appendices I, II and III. In general, the mean values of F_1s were higher in comparison to parents and F_2s for all the characters except plant height.

Among the parents, the maximum variability was recorded in number of branches per plant followed by number of fruits per plant, yield per plant, width of fruit and length of fruit. In F_1 generation, number of branches per plant had highest variability followed by number of fruits per plant, width of fruit, length of fruit and yield per plant. Among F_2 populations, the maximum

Table 3. Analysis of variance for 10 metric traits involving parents, F_1s and F_2s.

Source of variation	df	Mean squares									
		Days to flowering	Days to marketable maturity	Plant height	Number of branches per plant	Number of fruits per plant	Length of fruit	Width of fruit	fruit weight	plant spread	yield per plant
Replications	2	13.88**	5.25	24 63**	3.34**	3 50	0.36	0.26	26.25	0.002	0.09**
Treatments	138	56.33**	103.29**	237.13**	6.29**	83.74**	2.26**	1 72**	322 11**	0.037**	0.78**
Parents	18	146.74**	333.45**	504.48**	4.59**	28.27**	2 07*	0.96	329.22**	0.045**	0.37**
F_1s	59	43.80**	73.80**	200.34**	7.92**	81.52**	2.53**	2 12**	347.18**	0 040**	0.73**
F_2s	59	38.82**	64 10**	172 61**	3 46**	50 17**	1 97**	1 56**	272 56**	0 028**	0.22**
Parent Vs F_1s	1	99 53**	95 69**	1237 84**	0.61	1955.54**	1 96*	3 27**	1359 94**	0 009*	19 82**
F_1s Vs F_2s	1	69.35**	0 69	960.48**	94.15**	352 09**	8.82**	1 39**	105.00**	0.227**	10 10**
Error	276	7.68	7.80	9 06	1.69	7 76	1 12	1 11	35.25	0.002	0.03

* Significant at 5 per cent probability level.

** Significant at 1 per cent probability level.

Table 4. Variability among parents and crosses (F_1s and F_2s) for 10 characters in egg plant.

Characters	Generation mean			Minimum range		Maximum range	
	Parents	F_1s	F_2s	Mean value	Parents	Mean value	Parents
Days flowering	52.23	54.62	53.74	38.67	KS 219	67.33	T 3
Days to marketable maturity	71.39	72.96	72.87	51.33	KS 219	87.33	T 3
Plant height (cm)	78.19	76.11	72.84	59.73	KS 219	110.47	ACC 623
No. of branches per plant	7.32	8.46	7.44	5.87	ACC 8204	10.87	ACC 2623
No. of fruits per plant	11.93	20.63	18.65	7.47	ACC 8206	16.52	T 3
Length of fruit (cm)	9.52	9.62	9.31	8.36	DBR 8	11.38	ACC 2623
Width of fruit (cm)	7.92	8.07	8.20	6.77	KS 227	9.21	AB 1
Fruit weight (g)	99.48	106.16	105.09	75.33	DBR 8	119.33	AB 1
Plant spread (m^2)	0.52	0.59	0.54	0.36	KS 262	0.69	T 3
Yield per plant (kg)	1.15	2.16	1.82	0.65	ACC 8206	1.95	T 3

Characters	Minimum range		Maximum range		Minimum range		Maximum range	
	Mean value	F_1s crosses	Mean value	F_1s crosses	Mean value	F_2s population	Mean value	F_2s population
Days flowering	43.00	KS 253 x KS 224	62.67	KS 233 x DBR 8	45.00	ACC 8206 x KS 224	62.77	KS 263 x DBR 8
Days to marketable maturity	61.67	KS 247 x DBR 8	82.67	ACC 8206 x T 3	63.00	ACC 8206 x KS 224	80.67	KS 233 x AB 1
Plant height (cm)	62.53	KS 262 x T 3	101.07	ACC 2623 x AB 1	62.93	KS 253 x DBR 8	91.13	ACC 2623 x KS 224
No. of branches per plant	4.87	ACC 8207 x KS 224	11.87	KS 247 x T 3	6.00	ACC 8204 x AB 1	9.83	ACC 8206 x T 3
No. of fruits per plant	12.21	ACC 5114 x T 3	33.60	KS 227 x AB 1	12.52	ACC 8204 x AB 1	27.95	KS 227 x AB 1
Length of fruit (cm)	7.68	KS 262 x AB 1	12.14	KS 235 x T 3	7.52	ACC 5114 x DBR 8	11.40	ACC 2623 x T 3
Width of fruit (cm)	6.38	ACC 2623 x DBR 8	10.43	KS 253 x T 3	6.66	KS 228 x DBR 8	9.70	ACC 2623 x T 3
Fruit weight (g)	88.20	ACC 5114 x DBR 8	125.00	ACC 8204 x T 3	87.47	KS 253 x DBR 8	123.80	KS 233 x T 3
Plant spread (m^2)	0.43	KS 263 x AB 1	0.85	ACC 8206 x T 3	0.39	KS 263 x AB 1	0.81	ACC 8206 x T 3
Yield per plant (kg)	1.51	ACC 8204 x DBR 8	3.30	KS 219 x T 3	1.31	ACC 8204 x DBR 8	2.54	KS 247 x T 3

variability was recorded in number of branches per plant followed by number of fruits per plant, width of fruit, length of fruit and plant spread.

COMBINING ABILITY ANALYSIS :

(i) ANALYSIS OF VARIANCE FOR COMBINING ABILITY :

The analysis of variance for combining ability was done for all the characters in both F_1 and F_2 generations and findings are presented in Table5. The variances due to females were highly significant for days to flowering, days to marketable maturity, plant height, number of fruits per plant, plant spread and yield per plant in both the generations, and length of fruit and number of branches per plant in F_1 generation, while width of fruit in F_1 and number of branches per plant in F_2 generation exhibited only significant differences. The variancesdue to males were observed highly significant for all the characters. Significant differences amongst the females x males were also observed for all the characters in both F_1 and F_2 generations, except length of fruit and width of fruit in F_2 populations.

(ii) ESTIMATES OF COMPONENTS OF VARIANCE, THEIR MAGNITUDE AND DEGREE OF DOMINANCE :

The estimates of components of variance, *viz.*, $\hat{\delta}^2 g$ (pooled) and $\hat{\delta}^2 s$ were worked out from combining ability variance for all the characters in both F_1 and F_2 generations. Further, the $\hat{\delta}^2 g$ (pooled) was partitioned into $\hat{\delta}^2 g$ due to females and $\hat{\delta}^2 g$ due to males. The ratio between $\hat{\delta}^2 g$ (pooled) and $\hat{\delta}^2 s$, ($\hat{\delta}^2 g / \hat{\delta}^2 s$) and average degree of dominance $(\hat{\delta}^2 s / \hat{\delta}^2 g)^{0.5}$ were also worked out. A ratio of 1:1 between $\hat{\delta}^2 g / \hat{\delta}^2 s$ indicated the equal importance of $\hat{\delta}^2 g$ and $\hat{\delta}^2 s$ for expression of particular character, while deviation from 1:1 indicated

Table 5. Analysis of variance for combining ability of different characters in egg plant.

Source of variation	d.f.	Mean squares									
		Days to flowering		Days to marketable maturity		Plant height		Number of branches per plant		Number of fruits per plan	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Females	14	62.93**	55.61**	147.42**	108.17**	545.55**	450.51**	5 24**	2.39*	101.76**	59.92**
Males	3	204.90**	63.31**	276.94**	105.79**	405.15**	661.50**	41 19**	16 17**	257.53**	133.45*
Females x males	42	25.92**	31.47**	34.75**	46.43**	70.66**	45.06**	6 43**	2.91**	62.20**	40.98**
Error	118	7.50	7.64	7.13	8.71	8.31	10.37	1.91	1.53	8.63	7.93

Source of variation	d.f.	Mean squares									
		Length of fruit		Width of fruit		fruit weight		plant spread		yield per plant	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Females	14	2 80*	1.27	1.69	1.58	33.10	51 37	0 015**	0 012**	0.75**	0.31**
Males	3	7.77**	13.55**	7.98**	11.05**	5158 96**	4069.31**	0 650**	0.420**	4.38**	0.98**
Females x males	42	2.06**	1.41	1.84**	0.87	108.17**	75.92**	0 004**	0.005**	0.46**	0.14**
Error	118	1.07	1.19	0.89	1.31	31.48	38.04	0 001	0.002	0.003	0.02

* Significant at 5per cent probability level.

** Significant at 1per cent probability level.

the relative importance of $\hat{\delta}^2g$ or $\hat{\delta}^2s$ depending on the magnitude. The values of estimates of either $\hat{\delta}^2g$ (females) or $\hat{\delta}^2g$ (males) for some characters were negative and were considered as zero. Hence, the ratio between $\hat{\delta}^2g$ and $\hat{\delta}^2s$, degree of dominance, heritability and genetic advance for such traits could not be computed.

The estimates of variance components, their ratio, degree of dominance, heritability and genetic advance for all the traits in F_1 and F_2 generationsare presented in Table 6.

The estimates of $\hat{\delta}^2g$ due to females were found to be lower than $\hat{\delta}^2g$ due to males for plant spread and yield per plant both in F_1 and F_2 generations; days to flowering, number of fruits per plant only in F_1 progeny; plant height and width of fruit in F_2 populations. The value of $\hat{\delta}^2g$ due to females was higher than $\hat{\delta}^2g$ due to males for days to marketable maturity in both generations; plant height and length of fruit only in F_1 progeny; days to flowering and number of fruits per plant only in F_2 population. Estimated $\hat{\delta}^2g$ due to females was negative for number of branches per plant and fruit weight both in F_1 and F_2 generations; width of fruit in F_1 and length of fruit in F_2 population.

The estimated value of δ^2g (pooled) were lower than δ^2s for days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant and yield per plant both in F_1 and F_2 generations; plant height, length of fruit and width of fruit only in F_1 progenies which indicated the preponderance of non-additive gene effects. The value of δ^2g (pooled) was higher than δ^2s for fruit weight and plant spread in both the generations;

Table 6. Estimates of components of variance, ratio $(\hat{\delta}_g^2/\hat{\delta}_s^2)$, degree of dominance $(\hat{\delta}_s^2/\hat{\delta}_g^2)^{0.5}$, heritability and genetic advance.

Source of variation	Days to flowering		Days to marketable maturity		Plant height		Number of branches per plant		Number of fruits per plant		Length of fruit		Width of fruit		fruit weight		plant spread		yield per plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
$\hat{\delta}_g^2$ (females)	3.09	2.01	9.39	5.15	39.57	33.79	@	@	3.30	1.58	0.06	@	@	0.06	@	@	0.000	0.000	0.02	0.01
$\hat{\delta}_g^2$ (males)	3.98	0.71	5.38	1.32	7.43	13.70	0.77	0.29	4.34	2.05	0.13	0.27	0.14	0.23	112.24	88.76	0.010	0.010	0.09	0.02
$\hat{\delta}_g^2$ (pooled)	3.79	0.98	6.23	2.12	14.20	17.93	0.59	0.22	4.12	1.95	0.11	0.21	0.11	0.19	87.29	69.66	0.010	0.007	0.07	0.02
$\hat{\delta}_s^2$	6.14	7.94	9.21	12.57	20.78	11.57	1.51	0.46	17.86	11.02	0.33	0.07	0.32	@	25.56	12.35	0.001	0.001	0.14	0.04
$\hat{\delta}_g^2/\hat{\delta}_s^2$	0.62	0.12	0.68	0.17	0.68	1.55	0.39	0.48	0.23	0.18	0.33	3.00	0.34	@@	3.42	5.64	10.000	7.000	0.50	0.50
$(\hat{\delta}_s^2/\hat{\delta}_g^2)^{0.5}$	1.27	2.85	1.22	2.44	1.21	0.80	1.60	1.45	2.08	2.38	1.73	0.58	1.71	@@@	0.54	0.42	0.320	0.380	1.41	1.41
Heritability (%)	61.70	57.60	75.70	67.90	88.50	83.90	51.20	29.60	73.80	64.00	31.20	18.00	31.40	5.80	77.00	67.30	90.500	81.800	87.00	76.50
Genetic advance (%) of mean	54.62	53.74	72.96	72.87	76.11	72.84	8.46	7.44	20.63	18.65	9.62	9.31	8.07	8.20	106.16	105.09	0.590	0.540	2.16	1.82

@ Estimates of variance were negative; @@ denominator was negative, @@@ numerator was negative

$\hat{\delta}_g^2$ = estimate of gca variance

$\hat{\delta}_s^2$ = estimate of sca variance plant height, length of fruit and width of fruit only in F_2 population. It indicated the preponderance of additive gene effects.

The estimates of $\hat{\delta}^2 s$, $\hat{\delta}^2 g / \hat{\delta}^2 s$ and average degree of dominance for width of fruit in F_2 populations could not be computed due to negative values.

The average degree of dominance expressed as $(\hat{\delta}^2 s / \hat{\delta}^2 g)^{0.5}$ was found less than unity for fruit weight and plant spread in both generations; plant height and length of fruit in F_2 populations, suggesting partial dominance. The characters, days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant and yield per plant in both generations and plant height, length of fruit and fruit weight in F_1 progenies having value more than unity expressed over dominance.

(iii) GENERAL COMBINING ABILITY (GCA) EFFECTS :

The estimates of general combining ability (gca) effects of 19 parents (15 linesand 4 testers) for all the characters in F_1 progenies and F_2 populations alongwith their *per se* performance are tabulated in Table 7. The significant negative values of gca effects were considered desirable for days to flowering, days to marketable maturity, plant height, length of fruit and plant spread, whereas, for rest of the traits significant positive values were desirable.

1. Days to flowering :

Parents which started flowering earlier were considered better than those flowered late. As evident from the values of gca effects, the females KS 253, and KS 247 in both the generations and KS 219 in F_2 generation were found to be good general combiners with significant negative valuesand

Table 7 : Estimates of general combining ability(gca)effects for 10 characters in egg plant.

Parent	Days to flowering			Days to marketable maturity			Plant Height			Number of branches per plant			Number of fruits per plant		
	mean	gca effect		mean	gca effect		mean (cm)	gca effect		mean	gca effect		mean	gca effect	
		F_1	F_2		F_1	F_2		F_1	F_2		F_1	F_2		F_1	F_2
Lines (Females)															
KS 219	38.67	-0.71	-2.58**	51.33	1.71*	-0.12	59.73	-3.56**	-4.42**	6.53	1.09**	0.29	14.64	3.03**	2.31**
KS 247	40.67	-4.21**	-2.49**	54.33	-6.96**	-4.96**	94.10	1.69*	3.73*	8.37	0.79*	0.04	15.30	1.29	1.82*
KS 253	39.67	-4.71**	-2.49**	55.00	-6.21**	-4.21**	78.00	-1.84*	-5.89**	7.27	0.06	-0.50	15.37	1.22	0.40
KS 262	59.33	2.63**	0.17	75.67	2.29**	-1.04	65.60	-8.06**	-8.11**	6.27	-0.61	-0.56	11.12	-0.23	-2.19**
KS 228	52.67	-1.21	-0.49	68.00	-3.21**	-3.12**	75.20	-5.02**	-2.76	8.53	0.62	0.11	10.88	3.37**	3.33**
KS 233	53.00	3.54**	3.42**	71.33	4.13**	3.54**	63.33	-6.44**	-5.49**	5.93	-0.13	0.34	9.60	0.95	0.97
KS 250	55.33	1.79*	-0.08	73.33	0.79	-1.04	72.87	-2.36**	-4.43**	7.07	-0.43	0.34	9.53	-0.67	0.15
KS 263	55.00	0.04	5.09**	76.33	0.46	5.96**	77.67	0.08	1.98	6.07	0.34	0.44	8.69	3.06**	1.05
KS 235	55.00	1.04	-0.99	75.67	-1.62**	-0.12	77.40	-1.74*	1.51	6.53	0.37	0.34	11.61	1.71*	-0.25
KS 227	51.67	-0.96	0.92	70.33	0.46	1.04	66.73	-6.41**	-2.65	7.27	0.47	0.44	14.49	3.11**	3.39**
ACC 5114	55.00	-0.21	-0.16	77.00	-1.21	-1.04	93.93	8.30**	7.51**	7.27	1.23**	-1.01	7.88	-6.63**	-4.20**
ACC 8204	58.00	2.54**	1.92**	83.67	5.79**	4.54**	94.67	6.56**	6.36**	5.87	0.05	-0.19	8.90	-2.82**	-1.87*
ACC 8206	46.67	0.46	-0.16	73.33	3.29**	0.88	86.60	4.54**	2.83	7.13	-0.03	0.25	7.47	-2.20**	-0.51
ACC 8207	53.00	-0.37	-1.33	82.67	0.13	-0.54	71.60	-2.94**	-4.26**	6.83	-1.15**	-0.51	10.20	-1.73*	-1.88*
ACC 2623	55.67	0.29	-0.74	85.67	0.13	0.21	110.67	17.18**	14.08**	10.87	-0.21**	0.16	9.35	-3.47**	-2.57**
SE (S_{gi})	-	0.79	0.79	-	0.77	0.85	-	0.83	1.50	-	0.40	0.36	-	0.85	0.81
SE (S_{gi}-S'_{gi})	-	1.12	1.13		1.09	1.20	-	1.18	0.93	-	0.56	0.50	-	1.20	1.15
Testers (Males)															
T 3	67.33	2.58**	0.50	87.33	2.69**	0.84	76.73	-1.99**	-3.93**	8.80	1.33**	0.73**	16.52	3.11**	2.04**
AB 1	53.67	-0.07	0.34	71.00	-0.04	0.62	83.03	3.99**	4.27**	7.00	-0.10	-0.02	15.13	-0.74*	-0.59
KS 224	49.67	-2.64**	-1.74**	59.00	-3.29**	-2.92**	66.47	-2.59**	-2.44**	6.93	-0.95**	-0.74**	13.55	-2.62**	-2.02**
DBR 8	51.33	0.13	0.90*	65.33	0.64	0.84*	71.40	0.60	2.11*	8.60	0.27	0.04	16.40	0.25	0.57
SE m±	-	2.24	2.26	-	2.18	2.41	-	2.35	2.63	-	1.13	1.01	-	2.94	2.30
SE (S_{gi})	-	0.41	0.41	-	0.40	0.44	-	0.43	0.48	-	0.21	0.18	-	0.44	0.42
SE (S_{gi}-S'_{gi})	-	0.58	0.58	-	0.32	0.622	-	0.61	0.23	-	2.90	0.26	-	0.62	0.59
										-			-		

* significant at 5 per cent level.

** significant at 1 per cent level.

Cont........

Parent	Length of fruit			Width of fruit			Fruit weight			Plant spread			Yield per plant		
	mean	gca effect		mean	gca effect		mean	gca effect		mean	gca effect		mean	gca effect	
	(cm)	F_1	F_2	(cm)	F_1	F_2	(g)	F_1	F_2	(m^2)	F_1	F_2	(Kg)	F_1	F_2
Lines (Females)															
KS 219	9.23	0.75*	-0.14	7.95	0.35	-0.58	100.53	1.03	-1.52	0.57	0.05**	0.02	1.39	0.43**	0.19**
KS 247	9.55	0.61*	-0.36	8.33	0.30	-0.16	94.17	0.74	-1.55	0.48	-0.03**	-0.04*	1.20	0.15**	0.19**
KS 253	9.34	0.22	0.04	8.13	-0.08	0.24	92.20	0.22	-0.93	0.49	-0.01	-0.02	1.25	0.02	0.02
KS 262	9.21	-0.68*	-0.17	8.24	-0.28	0.05	100.67	-2.84	0.38	0.36	-0.07**	-0.04*	1.05	-0.10*	-0.06
KS 228	9.92	-0.37	-0.40	7.85	-0.31	-0.54	94.73	-0.93	-2.32	0.45	0.02**	-0.01	0.98	0.26**	0.18**
KS 233	10.14	-0.67*	-0.04	8.01	-0.40	-0.04	95.40	0.94	0.78	0.38	-0.04**	-0.02	0.87	0.09	0.04
KS 250	8.96	-0.52	-0.02	7.76	0.11	-0.11	113.93	-3.88	-2.95	0.49	-0.02**	-0.01	1.03	-0.00	-0.05
KS 263	9.11	0.08	0.41	7.41	0.70**	0.30	106.40	1.49	1.85	0.43	-0.02**	-0.04*	0.93	0.21**	0.17**
KS 235	8.49	0.23	0.15	7.35	0.55*	0.31	93.73	-0.18	3.50	0.47	0.00	0.00	1.04	0.25**	0.06
KS 227	8.54	-0.43	-0.13	6.77	-0.50	-0.18	90.13	1.37	-0.36	0.49	0.02**	-0.02	1.27	0.20**	0.16**
ACC 5114	10.93	0.04	-0.34	8.82	-0.02	-0.27	94.87	-1.73	-0.64	0.56	0.03**	0.03	0.73	-0.40**	-0.27**
ACC 8204	9.22	-0.13	0.02	7.98	0.32	0.22	95.00	0.67	-1.27	0.53	0.02**	0.03	0.75	-0.28**	-0.25**
ACC 8206	9.51	-0.06	0.03	7.73	-0.05	-0.17	98.13	0.69	-0.97	0.56	0.06**	0.06**	0.65	-0.24**	-0.12**
ACC 8207	9.53	0.08	0.13	7.45	-0.33	0.04	92.60	1.92	4.21*	0.50	0.01	0.02	0.93	-0.21**	-0.10**
ACC 2623	11.38	0.84**	0.83**	7.70	-0.38	0.86**	110.40	0.27	1.76	0.59	0.04**	0.04*	1.01	-0.30**	-0.17**
SE (S_{gi})	-	0.30	0.31	-	0.27	0.33	-	1.62	1.78	-	0.009	0.02	-	0.05	0.04
SE (S_{gi}-S'_{gi})	-	0.42	0.45	-	0.39	0.47	-	2.29	2.52	-	0.013	0.02	-	0.07	0.06
Testers (Males)															
T3	9.69	0.49**	0.64**	8.63	0.56**	0.52**	113.40	10.41**	7.65**	0.96	0.18**	0.14**	1.95	0.43**	0.21**
AB1	10.29	-0.06	0.21	9.21	-0.02	0.26	119.33	6.25**	6.24**	0.50	-0.07**	-0.06**	1.75	0.04	-0.01
KS224	10.63	0.09	-0.23	7.61	-0.08	-0.15	109.20	-2.96**	-1.06	0.53	-0.06**	-0.06**	1.61	-0.25**	-0.10**
DBR8	8.35	-0.52**	-0.62**	7.55	-0.46**	-0.62**	75.33	-13.70**	-13.02**	0.56	-0.05**	-0.03**	1.41	-0.21**	-0.10**
SE m±	-	0.84	0.89	-	0.77	0.93	-	4.58	5.04	-	0.03	0.04	-	0.14	0.12
SE (S_{gj})	-	0.15	0.16	-	0.14	0.17	-	0.84	0.92	-	0.005	0.01	-	0.03	0.02
SE (S_{gj}-S'_{gj})	-	0.22	0.23	-	0.20	0.24	-	1.18	1.30	-	0.007	0.01	-	0.04	0.03

* significant at 5 per cent level

** significant at 1 per cent level

low mean performance for early flowering. Among males KS 224 was best general combiner in both the generations with significant negative values and low mean performance.

2. Days to marketable maturity :

The negative values of gca effect for this trait was considered desirable. The estimates of gca effects revealed that the females, KS 247, KS 253, and KS 228 in both generation; and KS 235 in F_1 showed highly significant and negative values for early marketable maturity. Male parent KS 224 exhibited negatively significant value in both the generations. Thus, these parents identified as good general combiners on the basis of gca effects and *per se* performance for early picking of fruits.

3. Plant height :

The pattern of desirable general combining ability effect with negative value for plant height was same as in case of days to flowering and days to marketable maturity. The females KS 262, KS 233, KS 219, AC 8207, KS 250, KS 228 and KS 253 were found desirable for dwarfness on the basis of gca effect and *per se* performance in both F_1 and F_2 generations. While, KS 227, KS 228 and KS 235 with negative and significant values and low mean performance were found desirable for dwarfness only in F_1 generation. Among males, KS 224 and T3 were good general combiners in both the generations.

4. Number of branches per plant :

Among females, KS 219 and KS 247 in F_1 generation and among males T 3 in both the generationswere found to be good general combiners as they had significant positive gca effects and high mean performance for more number of branches per plant.

5. Number of fruits per plant :

In general, number of fruits per plant has a significant contribution to yield per plant. Among females, KS 228, KS 227 and KS 219 exhibited highly, significant and positive values expressing good general combining ability effect in both the generations, whereas KS 247 in F_2; KS 235 and KS 263 in F_1 exhibited significant and positive gca effects for more number of fruits per plant. Among the males T 3 was best general combiner over the generations.

6. Length of fruit :

If the length of fruit alongwith width of fruit is constant for round fruit then it may be advantageous and would get preference in marketing. Therefore, negative effects of general combining ability may be taken into consideration. On the basis of *per se* performance and gca effects, male DBR8 in both the generations and females KS 262 and KS 233 in F_1 generation were good general combiners.

7- Width of fruit :

Among females, KS 263 and KS 235 in F_1, and ACC 2623 in F_2 generation and T 3 among males over generations were found to be good general combiners as the parents exhibited significant positive gca effects and high *per se* performance for the trait.

8. Fruit weight :

For fruits weight, female parent ACC 8207 only in F_2 generation showed significant gca effect. However, parent KS 263 and ACC 2623 had high and non-significant value of gca effect and *per se* performance for better fruit size. Among males, T 3 and AB 1 with positively significant value of gca and high *per se* performance were considered as good general combiners.

9. Plant spread :

Similar to the characters days to flowering, days to marketable maturity, plant height and length of fruit, parents with negative value are preferred for compact nature of plant. The female parents, KS 262, KS 247 and KS 263 and males, AB 1, KS 224 and DBR 8 in both generations; and females KS 233 and KS 250 in F_1 progenies were found to be good general combiners with negative and significant gca effects and low *per se* performance.

10. Yield per plant :

As evident by the significant and positive gca effects, female parents KS 219, KS 228, KS 263, KS 227 and KS 247 and male T 3 in both the generations; and female KS 235 only in F_1 had positive and significant gca effects and were considered as good general combiners for this complex trait.

(iv) SPECIFIC COMBINING ABILITY (SCA) EFFECTS :

The mean values of F_1 and F_2 and their respective estimates of sca effects for yield and yield contributing traits are presented in Table 8. The criteria for sorting out the desirable and significant combiners are the same as described for gca effects. The characterwise description is given as under :

1. Days to flowering :

For this trait, the longest mean duration was recorded by the cross KS 233 x DBR 8 (63 days) and shortest by KS 253 x KS 224 (43 days) in F_1,

Table 8. Estimate of specific combining ability effects and corresponding mean value of crosses for 10 characters in egg plant.

Cross	Days to flowering				Days to marketable maturity				Plant height				Number of branches per plant				Number of fruits per plant			
	sca effects		mean		Sca effects		mean		sca effects		Mean (cm)		sca effects		mean		sca effects		mean	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
KS 219 x T 3	-1.49	-2.67	55.00	49.00	-2.36	1.59	75.00	72.00	-7.69**	-5.08**	62.87	59.40	-1.01	-0.59	9.87	7.87	3.27	-0.02	30.04	22.9
KS 219 x AB 1	1.82	-0.84	56.67	50.67	2.04	1.63	76.67	75.00	0.99	1.12	77.53	73.80	1.69*	1.49*	11.13	9.20	3.42*	4.95**	26.33	25.3
KS 219 x KS 224	1.06	2.58	52.33	52.00	0.62	0.54	72.00	71.00	-4.36**	1.96	65.60	67.93	-0.87	-0.79	7.73	6.20	-2.67	-3.79*	18.37	15.1
KS 219 x DBR 8	-1.38	0.93	52.67	53.00	-0.31	-0.59	75.00	73.00	11.05**	2.01	84.20	72.53	0.19	-0.10	9.49	7.67	-4.01*	-1.13	19.90	20.4
KS 247 x T 3	2.67	2.58	55.67	54.33	4.31**	2.24	73.00	71.00	-1.41	-4.57	74.40	68.07	1.29	1.26	11.87	9.47	3.44*	6.61**	28.47	29.1
KS 247 x AB 1	1.65	0.41	52.00	52.00	-4.29*	-2.87	61.67	65.67	3.01	3.23	84.80	84.07	-1.61*	-1.25	7.53	6.20	-3.60*	-3.72*	17.57	16.1
KS 247 x KS 224	0.89	-1.17	48.67	48.33	4.96*	0.38	67.67	66.00	6.13**	1.87	81.33	76.00	0.13	0.33	8.43	7.07	-3.13	-2.94	16.17	15.5
KS 247 x DBR 8	-5.22*	-1.82	45.33	50.33	-4.96**	0.24	61.67	69.00	-7.73**	-0.54	70.67	78.13	0.19	-0.35	9.17	7.17	3.29	0.04	25.46	21.0
KS 253 x T 3	0.84	-0.08	53.33	51.67	1.23	1.16	70.67	70.67	0.46	1.38	72.73	64.40	0.58	0.73	10.43	8.40	3.64*	4.31**	28.60	25.4
KS 253 x AB 1	2.82	-2.26	52.67	49.33	-0.04	-5.62**	66.67	63.67	2.94	3.92	81.20	75.13	-0.69	-0.08	7.73	6.43	-1.71	-3.03	19.40	15.4
KS 253 x KS 224	-4.27**	1.16	43.00	50.67	-1.46	1.63	62.00	68.00	0.39	0.82	72.07	65.33	0.29	-0.40	7.87	5.80	-2.36	-1.79	16.87	15.2
KS 253 x DBR 8	0.62	1.18	50.67	53.33	0.27	2.83	67.67	72.33	-3.80*	-6.12**	71.07	62.9[illegible]	-0.18	-0.25	8.07	6.73	0.43	0.51	22.52	20.1
KS 262 x T 3	-3.49*	0.58	56.33	55.00	-3.27*	-0.67	74.67	72.00	-3.52*	-0.73	62.53	61.53	-1.64*	-0.88	7.53	6.73	-4.57**	-3.15	18.93	15.3
KS 262 x AB 1	-0.18	-1.93	57.00	52.33	0.13	-1.12	75.33	71.33	4.56**	0.47	76.60	69.47	-0.35	0.01	7.40	6.87	-2.18	-0.70	17.47	15.1
KS 262 x KS 224	2.73	1.16	57.33	53.33	1.71	4.13*	73.67	73.67	-0.46	-1.17	65.00	63.47	0.43	0.26	7.33	6.40	1.76	3.11	19.53	17.5
KS 262 x DBR 8	0.95	0.18	58.33	55.00	1.44	-2.34	77.33	70.33	-0.58	-2.37	68.07	64.47	1.56	0.61	9.13	7.53	4.99**	0.74	25.63	17.77
KS 228 x T 3	-2.99	4.58**	53.00	58.33	-1.11	2.41	71.33	73.00	1.18	-0.15	70.27	66.00	-2.61**	-1.14	7.80	7.13	-7.84**	-7.09	19.27	16.93
KS 228 x AB 1	2.32	1.41	55.67	55.00	2.96	4.63**	72.67	75.00	-0.81	-0.28	74.27	74.07	1.75*	0.67	10.73	8.20	6.18**	4.40**	29.43	25.80
KS 228 x KS 224	-2.11	-4.17	48.67	47.33	-1.46	-4.12*	65.00	63.33	-3.42*	-1.31	65.07	66.33	0.00	-0.61	8.13	6.20	0.74	2.72	22.12	22.68
KS 228 x DBR 8	2.78	-1.82	56.33	52.33	-0.39	-2.92	70.00	67.67	3.05	1.74	74.73	73.93	0.86	1.08	9.67	8.67	0.92	-0.05	25.17	22.52
KS 233 x T 3	-3.74*	-0.67	57.00	57.00	-4.11**	-2.59	75.67	74.67	-2.67	-0.58	65.00	64.00	1.54	1.29	11.20	9.80	5.92**	1.39	30.61	23.04
KS 233 x AB 1	-1.77	2.16	56.33	59.67	2.29	3.63*	79.33	80.67	1.27	-3.48	74.93	68.13	-1.36	-1.09	6.87	6.67	-4.73**	-3.09	16.11	15.93
KS 233 x KS 224	1.14	-3.09	56.67	52.33	1.21	-3.46*	75.00	70.67	-0.67	-1.64	66.40	63.27	-0.05	-0.58	7.33	6.47	-1.33	-0.11	17.60	17.49
KS 233 x DBR 8	4.37**	1.60	62.67	59.67	0.61	2.41	78.33	79.67	2.07	4.54*	72.33	74.00	-0.13	0.38	7.93	8.20	0.14	1.82	21.97	22.00
KS 250 x T 3	-3.66*	-3.83*	55.33	50.33	-1.77	-4.67**	74.67	68.00	1.24	2.56	73.00	67.03	-1.89*	-1.44*	7.47	7.07	-6.77**	-4.25*	16.30	16.58
KS 250 x AB 1	1.32	5.66**	57.67	59.67	0.29	4.88**	74.00	77.33	-1.48	-1.21	76.27	71.47	0.60	0.51	8.53	8.27	1.01	-1.66	20.22	16.55
KS 250 x KS 224	2.56	0.08	56.33	52.00	3.21*	1.46	73.67	71.00	-1.29	-0.50	69.87	65.73	0.98	2.22**	8.07	8.27	5.52**	3.40*	22.85	20.18
KS 250 x DBR 8	-0.22	-1.90	56.33	52.67	-1.73	-1.67	72.67	71.00	1.52	-0.85	75.87	69.67	0.31	-1.29	8.07	6.53	0.23	2.51	20.43	21.87
KS 263 x T 3	0.42	-5.67**	57.67	53.67	0.23	-5.01**	76.33	74.67	2.74	4.65*	76.93	75.53	-1.19	0.00	8.93	8.60	-4.06*	-4.02*	22.73	17.75
KS 263 x AB 1	2.07	1.49	56.67	60.67	1.63	0.88	75.00	80.33	0.62	-2.95	80.80	76.13	2.64**	0.28	11.33	8.13	6.16**	4.95**	29.10	24.09
KS 263 x KS 224	-1.36	1.24	50.67	58.33	-2.79	1.13	67.33	77.67	0.61	-1.78	74.20	70.60	-1.52	-0.90	6.33	6.23	-3.63*	-0.90	17.43	16.82
KS 263 x DBR 8	-1.13	2.93	53.67	62.77	0.94	2.99	75.00	82.67	-3.98*	0.08	72.80	77.00	0.07	0.62	8.60	8.53	1.54	-0.02	25.47	20.28

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Cross	Days to flowering				Days to marketable maturity				Plant height				Number of branches per plant				Number of fruits per plant			
	sca effects		mean		sca effects		mean		sca effects		mean (cm)		sca effects		mean		sca effects		Mean	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
KS 235 x T 3	4.09*	3.08	62.33	56.33	2.98	2.08	77.00	75.67	3.96*	3.25	76.33	73.67	1.57*	0.09	11.73	8.60	1.05	1.52	26.50	21.9
KS 235 x AB 1	0.40	-1.76	56.00	51.33	2.38	-1.37	73.67	72.00	-3.29*	1.85	75.07	80.47	-1.20	-0.56	7.53	7.20	-4.02*	-3.74*	17.57	14.0
KS 235 x KS 224	-1.36	-0.01	51.67	51.00	-4.38**	1.88	63.67	72.33	-4.04*	-1.38	67.73	70.53	0.98	0.02	8.87	7.07	2.18	1.39	21.89	17.7
KS 235 x DBR 8	-3.13*	-1.32	52.67	52.33	-0.98	-2.59	71.00	71.00	3.37*	-3.72**	78.33	72.73	1.36	0.45	7.20	8.27	0.79	0.84	23.37	19.8
KS 227 x T 3	-3.24*	-2.50	53.00	52.67	-7.11**	-3.09	69.00	71.67	-0.51	-2.72	67.20	63.53	-2.59**	-0.68	7.67	7.93	-7.35**	-4.84**	19.50	19.2
KS 227 x AB 1	-0.27	0.99	53.33	56.00	0.96	0.80	74.33	75.33	1.84	-0.99	75.53	73.47	2.37**	1.67*	11.20	9.53	10.60**	6.50**	33.60	27.9
KS 227 x KS 224	6.31**	7.74**	57.33	60.67	6.87**	6.71**	77.00	78.33	-2.97	-3.65*	64.13	64.10	0.55	-0.94	8.53	6.20	-1.32	-0.67	19.80	19.3
KS 227 x DBR 8	-2.80	-6.23**	51.00	49.33	-0.73	-4.42*	73.33	70.33	1.64	7.37**	71.93	79.67	-0.33	-0.05	8.33	7.87	-1.93	-0.99	22.06	21.6
ACC 5114x T 3	0.67	0.92	57.67	55.00	-1.44	0.66	73.00	73.33	3.48*	4.65*	85.90	81.07	-0.96	-1.43*	7.60	5.73	-4.91**	-2.30	12.21	14.1
ACC 5114 x AB 1	-4.02*	-3.59*	50.33	50.33	-3.37*	-5.12**	68.33	67.33	-3.13	0.58	85.27	85.20	-0.86	-0.08	6.27	6.33	-0.56	-0.73	12.70	13.1
ACC 5114 x KS 224	0.56	1.83	52.33	53.67	1.87	4.79**	70.33	74.33	3.79**	2.68	85.60	80.60	1.38	0.51	7.67	6.20	3.92*	2.21	15.30	14.6
ACC 5114 x DBR 8	2.78	0.85	57.33	55.33	2.94	-0.34	75.33	72.33	-4.14	-7.92**	80.87	74.53	0.44	1.00	7.40	7.47	1.55	0.81	15.80	15.8
ACC 8204x T 3	1.26	-1.50	61.00	54.67	0.89	-0.92	82.33	77.33	5.26	2.27	85.93	77.53	1.89*	0.76	11.73	8.73	4.94**	6.48**	25.87	25.3
ACC 8204 x AB 1	-1.43	-1.34	55.67	54.67	-0.71	-3.03	78.00	75.00	-12.19**	-8.00**	74.47	75.47	-1.01	-1.23	7.40	6.00	-2.30	-3.68*	14.77	12.5
ACC 8204 x KS 224	0.14	3.74*	54.67	57.67	1.54	4.88**	77.00	80.00	6.13**	1.97	86.20	78.73	0.17	0.76	7.73	7.27	0.58	1.48	15.77	16.2
ACC 8204 x DBR 8	0.03	-0.90	57.53	55.67	-1.73	-0.92	77.67	77.33	0.80	3.76*	84.07	85.07	-1.04	-0.29	7.20	7.00	-3.22	-4.29**	14.83	13.0
ACC 8206x T 3	3.34	2.25	61.00	56.33	3.73*	2.74	82.67	77.33	2.88	-0.67	81.53	71.07	1.84	1.41*	11.60	9.83	7.11**	4.73**	28.66	24.9
ACC 8206 x AB 1	-0.68	0.74	54.33	54.67	-2.21	0.97	74.00	75.33	1.56	3.20	86.20	83.13	-0.86	-0.87	7.47	6.80	-4.16*	-3.94*	13.53	13.6
ACC 8206 x KS 224	-2.44	-6.84**	50.00	45.00	-1.96	-8.46**	71.00	63.00	0.34	-2.63	78.40	70.60	-1.28	0.05	6.20	7.00	-2.71	-3.46*	13.10	12.6
ACC 8206 x DBR 8	-0.22	3.85*	55.00	58.33	0.44	4.74**	77.33	79.33	-4.78**	0.09	76.47	77.87	0.31	-0.60	8.47	7.13	-0.25	2.67	18.43	21.3
ACC 8207x T 3	1.51	1.08	58.33	54.00	1.89	4.16*	77.67	77.33	4.43**	-1.45	75.60	63.20	1.69*	0.67	10.33	8.33	1.99	0.47	24.00	19.2
ACC 8207 x AB 1	-1.85	0.24	52.33	53.00	-0.04	0.72	73.00	73.67	0.31	2.68	77.47	75.53	-0.41	0.09	6.80	7.00	-1.59	1.95	16.57	18.1
ACC 8207 x KS 224	-0.27	-1.67	51.33	49.00	-2.46	-4.37*	67.33	65.67	-5.17**	-4.28*	65.40	61.87	-1.50	-0.13	4.87	6.07	1.14	-0.22	17.42	14.5
ACC 8207 x DBR 8	0.62	0.35	55.00	53.67	0.61	-0.51	74.33	72.67	0.44	3.04	74.20	73.73	0.22	-0.64	7.27	6.33	-1.53	-2.20	17.62	15.1
ACC 2623x T 3	3.84*	1.83	61.33	55.33	5.89**	3.08	81.67	77.00	-9.82**	-5.45**	81.47	77.53	1.49	-0.06	11.07	8.27	4.16*	0.18	24.42	18.3
ACC 2623 x AB 1	-2.18	-1.34	52.67	52.00	-2.04	0.97	71.00	74.67	3.79	-0.12	101.07	91.07	-0.68	0.42	7.47	8.00	-2.52	1.53	13.90	17.0
ACC 2623 x KS 224	-3.61*	-2.59	48.67	48.67	-7.46**	-7.12**	62.33	63.67	4.98**	6.66**	95.67	91.13	0.30	0.21	7.60	7.07	1.33	-0.42	15.87	13.6
ACC 2623 x DBR 8	1.95	2.10	57.00	56.00	3.61*	3.08	77.33	77.00	1.05	-1.09	94.93	87.93	-1.11	-0.57	6.87	7.07	-2.95	-1.29	14.46	15.3
SE (S_{ij}) ±	1.58	1.60	-	-	1.54	1.70	-	-	1.66	1.86	-	-	0.80	0.71	-	-	1.70	1.63	-	-
SE (S_{ij} - S'_{ij}) ±	2.34	2.26	-	-	2.18	2.41	-	-	2.35	6.91	-	-	1.13	1.01	-	-	2.40	2.30	-	-

* significant at 5 per cent level.

** significant at 1 per cent level

Cross	Length of fruit				Width of fruit				Fruit weight				Plant spread				Yield per plant			
	sca effects		mean (cm)		sca effects		mean (cm)		sca effects		mean (g)		sca effects		mean (m^2)		sca effects		mean	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	
KS 219 x T 3	0.34	-0.61	11.20	9.21	0.04	-0.29	9.02	7.85	-1.11	-2.82	116.48	108.60	0.01	0.00	0.83	0.70	0.28**	0.05	3.30	2
KS 219 x AB 1	-0.50	-0.05	9.82	9.33	0.20	-0.35	8.60	7.52	9.96**	3.93	123.40	113.73	0.09**	0.03	0.65	0.53	0.67**	0.41**	3.29	2
KS 219 x KS 224	0.50	0.42	11.04	9.35	-0.19	0.79	8.22	8.26	-5.23	-1.70	99.00	100.80	-0.04*	0.00	0.54	0.51	-0.52**	-0.28**	1.82	1
KS 219 x DBR 8	-0.42	0.24	9.44	8.79	-0.11	-0.16	7.85	6.84	-3.62	0.59	89.87	91.13	-0.06**	-0.03	0.53	0.50	-0.43**	-0.17**	1.94	1
KS 247 x T 3	-0.50	-0.12	10.22	9.47	-0.29	-0.16	8.64	8.39	-5.11	-7.05*	112.20	104.33	-0.07**	0.09**	0.67	0.55	0.31**	0.31**	3.05	2
KS 247 x AB 1	0.14	-1.00	10.31	8.16	-0.41	-0.57	7.95	7.72	-2.75	-2.04	110.40	107.73	0.02	0.03	0.50	0.47	-0.34**	-0.21**	2.01	1
KS 247 x KS 224	0.19	0.97	10.51	9.69	0.22	0.51	8.51	8.39	9.13**	9.66**	113.07	112.13	0.03	0.03	0.53	0.48	-0.12	-0.11	1.94	1
KS 247 x DBR 8	0.17	0.15	9.88	8.48	0.48	0.23	8.40	7.65	-1.26	-0.58	91.93	89.93	0.02	0.03	0.53	0.50	0.14	0.00	2.23	1
KS 253 x T 3	0.45	-0.28	10.78	9.71	0.69	0.08	9.24	9.04	0.41	2.86	117.20	114.87	0.00	-0.05	0.76	0.61	0.41**	0.18**	3.02	2
KS 253 x AB 1	-0.25	-0.64	9.54	8.92	-0.14	-0.16	7.83	8.54	-6.64*	-5.26	106.00	105.13	-0.03	0.01	0.48	0.47	-0.36**	-0.15	1.85	1
KS 253 x KS 224	0.35	0.32	10.29	9.44	-0.36	0.00	7.55	8.28	7.24**	6.06	110.67	109.15	0.02	0.00	0.54	0.46	0.04	-0.04	1.97	1.
KS 253 x DBR 8	-0.56	0.60	8.77	9.32	-0.19	0.07	7.35	7.89	-1.01	-3.66	91.67	87.47	0.00	0.03	0.54	0.51	-0.08	0.01	1.88	1.
KS 262 x T 3	0.38	0.62	9.81	10.41	0.38	0.91	8.73	9.67	-2.06	-4.06	111.67	109.27	0.00	0.00	0.69	0.64	-0.56**	-0.21**	1.93	1.
KS 262 x AB 1	-1.20*	-0.18	7.68	9.17	-0.75	-0.16	7.02	8.34	-2.84	-0.90	106.73	110.80	0.01	0.02	0.45	0.46	-0.06	0.00	2.03	1.
KS 262 x KS 224	0.94	-0.51	9.97	8.40	0.44	-0.57	8.16	7.52	2.04	2.46	102.40	106.87	-0.01	0.02	0.45	0.46	0.17	0.05	1.99	1.
KS 262 x DBR 8	-0.12	0.08	8.31	8.60	-0.07	-0.17	7.27	7.46	2.85	2.49	92.47	94.93	0.00	-0.03	0.47	0.44	0.45**	0.16*	2.29	1.8
KS 228 x T 3	-0.18	-1.08	9.56	8.48	-0.36	-0.48	7.96	7.69	-0.60	1.85	115.03	112.47	-0.04*	-0.02	0.70	0.65	-0.68**	- 39**	2.16	1.8
KS 228 x AB 1	0.37	1.78**	9.57	10.90	0.29	1.20	8.03	9.11	6.72*	0.14	118.20	109.15	0.03	0.02	0.52	0.48	0.59**	0.26**	3.04	2.2
KS 228 x KS 224	-0.74	-1.12	8.61	7.56	0.00	-0.35	7.68	7.15	-8.33*	-3.31	93.93	98.40	0.06**	0.05	0.56	0.52	0.03	0.02	2.14	1.9
KS 228 x DBR 8	0.55	0.41	9.28	8.70	0.07	-0.37	7.37	6.66	2.21	1.32	93.73	91.07	-0.04*	-0.04	0.48	0.46	0.13	0.12	2.34	2.0
KS 233 x T 3	1.12	0.53	10.56	10.44	1.28*	0.32	9.52	8.99	5.36	10.08**	122.87	123.80	-0.04*	0.01	0.69	0.67	0.56**	0.18*	3.24	2.2
KS 233 x AB 1	0.10	0.17	8.99	9.65	-0.31	-0.54	7.35	7.87	-0.82	-0.50	112.53	111.60	0.03	0.01	0.51	0.47	-0.39**	-0.16	1.90	1.6
KS 233 x KS 224	-0.65	-0.57	8.40	8.46	-0.38	-0.23	7.21	7.77	-3.94	-7.60*	100.20	97.20	-0.02	-0.02	0.47	0.44	-0.14	-0.06	1.86	1.7
KS 233 x DBR 8	-0.57	-0.12	7.87	8.52	-0.60	0.45	6.62	7.99	-0.60	-1.98	92.80	90.87	0.03	0.00	0.53	0.49	-0.04	0.04	2.00	1.8
KS 250 x T 3	-1.05	0.08	8.54	10.01	-1.07*	-0.94	7.62	7.67	-3.76	-2.92	108.93	107.07	0.00	-0.01	0.74	0.65	-0.77**	-0.32**	1.74	1.6
KS 250 x AB 1	0.16	0.19	9.20	9.68	0.49	0.80	8.65	9.14	4.40	0.90	112.93	109.27	-0.01	0.00	0.48	0.46	0.36**	-0.09	2.47	1.6
KS 250 x KS 224	0.06	-0.90	9.26	8.15	0.20	-0.79	8.29	7.14	-8.59**	-5.40	90.73	95.67	-0.03	-0.02	0.47	0.45	0.26**	0.18*	2.09	1.8
KS 250 x DBR 8	0.83	0.63	9.42	9.29	0.38	0.93	8.10	8.40	7.95	7.42*	96.53	96.53	0.04*	0.03	0.56	0.52	0.15	0.24	2.02	1.9
KS 263 x T 3	-1.71**	-0.64	8.48	9.73	-1.83**	-0.30	7.51	8.71	-11.52**	-5.29	106.53	108.87	0.04*	0.01	0.78	0.65	-0.32**	-0.22**	2.48	1.9
KS 263 x AB 1	1.28	0.04	10.92	9.97	1.49**	-0.11	10.25	8.64	10.50**	2.36	124.40	115.53	-0.06**	-0.04	0.43	0.39	0.61**	0.29**	3.01	2.2
KS 263 x KS 224	-0.12	1.01	9.67	10.50	0.06	0.76	8.76	9.10	4.78	3.46	109.47	109.33	-0.01	0.02	0.49	0.45	-0.28**	-0.08	1.84	1.8

Cont …….

Cross	Length of fruit				Width of fruit				Fruit weight				Plant spread				Yield per plant			
	sca effects		mean (cm)		sca effects		mean (cm)		sca effects		mean (g)		sca effects		mean (m²)		sca effects		mean(	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	
KS 263 x DBR 8	0.55	-0.40	9.73	8.69	0.27	-0.36	8.59	7.52	-3.75*	0.09	90.20	94.00	0.03	0.02	0.55	0.48	-0.01	0.01	2.14	1.
KS 235 x T 3	1.80**	0.64	12.14	10.74	1.25*	0.37	10.43	9.40	4.94	4.10	121.33	120.53	0.03	0.06*	0.80	0.74	0.28**	0.02	3.12	2.
KS 235 x AB 1	-0.83	0.01	8.96	9.69	-0.57	-0.42	8.04	8.35	0.16	-1.49	112.40	113.33	-0.03	0.00	0.48	0.48	-0.62**	-0.33**	1.83	1.
KS 235 x KS 224	-0.46	-0.32	9.48	8.91	-0.02	0.24	8.53	8.59	-1.96	-0.92	101.07	106.60	-0.02	-0.07**	0.51	0.42	0.32**	0.24**	2.49	2.
KS 235 x DBR 8	-0.51	-0.33	8.83	8.51	-0.66	-0.19	7.50	7.70	-3.15	-1.69	89.13	93.87	0.01	0.01	0.55	0.52	0.01	0.07	2.21	1.
KS 227 x T 3	0.91	-0.25	8.77	9.58	-1.16*	-0.13	6.97	8.41	-4.67	-1.84	113.29	110.73	0.03	-0.05	0.81	0.61	-0.29**	-0.19*	2.50	2.
KS 227 x AB 1	0.52	0.62	9.65	10.02	0.31	0.62	7.86	8.90	5.55	4.57	119.33	115.53	-0.08**	-0.04	0.45	0.41	0.51**	0.27**	2.91	2.
KS 227 x KS 224	0.19	-0.20	9.47	8.75	0.05	-0.41	7.54	7.45	-2.97	-5.79	101.60	97.87	0.05**	0.07*	0.59	0.53	-0.18	-0.10	1.93	1.
KS 227 x DBR 8	0.21	-0.17	8.88	8.38	0.80	-0.08	7.91	7.32	2.10	3.06	95.93	94.76	-0.01	0.02	0.55	0.51	-0.04	0.02	2.11	1.
ACC 5114x T 3	-0.29	0.11	9.85	9.72	-0.93	-0.09	7.68	8.34	-4.57	-4.97	110.27	107.33	0.00	-0.02	0.80	0.69	-0.25*	-0.07	1.94	1.
ACC 5114 x AB 1	1.26*	0.15	10.86	9.33	0.64	0.40	8.66	8.58	2.45	2.91	113.13	113.60	-0.01	-0.01	0.53	0.49	0.00	0.02	1.80	1.
ACC 5114 x KS 224	-1.29*	0.56	8.46	9.29	-0.15	0.27	7.81	8.04	4.66	2.35	106.13	105.73	0.00	-0.02	0.55	0.50	0.22*	0.16*	1.73	1.
ACC 5114 x DBR 8	0.33	-0.82	9.47	7.52	0.44	-0.57	8.03	6.73	-2.53	-0.29	88.20	91.13	0.01	0.05	0.59	0.59	0.03	-0.11	1.57	1.
ACC 8204x T 3	0.90	0.68	10.88	10.65	1.01	0.43	9.96	9.36	7.56*	2.27	125.00	113.93	0.02	0.08**	0.80	0.79	0.16	0.39**	2.47	2.
ACC 8204 x AB 1	-0.48	0.67	8.96	10.21	-0.20	0.27	8.17	8.95	-8.09*	0.68	105.20	110.73	0.00	-0.01	0.53	0.49	-0.14	-0.15	1.78	1.
ACC 8204 x KS 224	0.14	-0.83	9.73	8.26	0.03	-0.48	8.37	7.78	-1.74	-9.15*	102.33	93.60	0.01	-0.02	0.55	0.49	0.13	-0.08	1.76	1.
ACC 8204 x DBR 8	-0.56	-0.51	8.41	8.19	-0.87	-0.22	7.07	7.58	2.27	6.21	95.60	97.00	-0.03	-0.05	0.53	0.49	-0.16	-0.17*	1.51	1.
ACC 8206x T 3	0.49	0.01	10.54	9.99	0.05	0.27	8.64	8.82	5.54	0.45	122.80	112.47	0.03	0.07*	0.85	0.81	0.21*	0.28**	2.56	2.2
ACC 8206 x AB 1	-0.23	-0.36	9.27	9.20	-0.20	-0.11	7.80	8.17	-4.64	-1.54	108.47	108.87	0.01	-0.03	0.58	0.51	-0.19	-0.25**	1.77	1.4
ACC 8206 x KS 224	0.46	0.34	10.11	9.45	0.36	-0.13	8.31	7.75	1.64	1.16	105.53	104.27	-0.03	-0.03	0.55	0.51	-0.06	0.01	1.61	1.6
ACC 8206 x DBR 8	-0.71	0.01	8.33	8.72	-0.25	-0.04	7.35	7.37	-2.55	-0.08	90.60	91.07	0.00	-0.01	0.59	0.56	0.03	-0.04	1.73	1.5
ACC 8207x T 3	-1.17	-0.33	9.03	9.75	0.59	-0.12	7.71	8.63	3.04	5.92	121.53	123.07	0.01	0.01	0.79	0.71	0.26**	0.03	2.64	1.9
ACC 8207 x AB 1	-0.51	-0.49	9.14	9.16	-0.86	-0.14	6.86	8.35	-4.80	-1.27	109.53	114.27	0.01	0.02	0.54	0.51	-0.28**	0.01	1.70	1.7
ACC 8207 x KS 224	0.74	0.42	10.54	9.63	0.32	0.06	7.98	8.14	1.01	2.70	106.13	110.93	-0.03	-0.01	0.51	0.49	0.07	0.07	1.77	1.6
ACC 8207 x DBR 8	0.94	0.39	10.13	9.20	1.13*	0.20	8.41	7.82	0.75	-7.34*	95.13	88.93	0.00	-0.01	0.55	0.51	-0.06	-0.11	1.67	1.5
ACC 2623x T 3	0.32	0.62	11.26	11.40	1.53**	0.12	9.79	9.70	6.56*	2.03	123.40	116.73	-0.01	0.01	0.79	0.73	0.37**	-0.05	2.66	1.8
ACC 2623 x AB 1	0.18	-0.89	10.58	9.46	0.01	-0.74	7.68	8.56	-9.15**	-2.49	103.53	110.60	0.01	0.00	0.56	0.52	-0.36**	0.08	1.54	1.7
ACC 2623 x KS 224	-0.37	0.41	10.19	10.32	-0.68	0.35	6.94	9.26	2.26	6.01	105.73	111.80	0.01	-0.01	0.57	0.51	0.11	0.04	1.72	1.5
ACC 2623 x DBR 8	-0.12	-0.15	9.82	9.36	-0.86	0.26	6.38	8.70	0.34	-5.56	93.07	88.27	-0.01	0.00	0.57	0.55	-0.11	-0.07	1.54	1.4
SE (S_{ij}) ±	0.60	0.63	-	-	0.54	0.66	-	-	3.24	3.56	-	-	0.02	0.03	-	-	0.10	0.08	-	-
SE (S_{ij} - S_{kl}) ±	0.84	0.89	-	-	0.77	0.93	-	-	4.58	5.04	-	-	0.03	0.04	-	-	0.14	0.12	-	-

* significant at 5 per cent level ** significant at 1 per cent level

and in F_2 by KS 263 x DBR 8 (63 days) to ACC 8206 x KS 224 (45 days). As earliness is the desirable character; the negative estimates of sca effects were considered desirable. Out of sixty, only two crosses ACC 5114 x AB 1 and KS 250 x T 3 had significant sca effect over the generations.

However, the crosses with significant negative sca effects, *viz.*, KS 253 x KS 224, KS 247 x DBR 8, ACC 2623 x KS 224, KS 235 x DBR 8, KS 227 x T 3, KS 262 x T 3 and KS 233 x T 3 in F_1 and ACC 8206 x KS 224, KS 228 x KS 224, KS 227 x DBR 8, KS 250 x T 3 and KS 263 x T 3 in F_2 were good specific combiners for earliness.

The cross combination KS 227 x KS 224 was superior specific combiner over generationsfor late flowering.

2. Days to marketable maturity :

The highest mean value was recorded in ACC 8206 x T 3 (83 days) and lowest in KS 247 x DBR 8 (62 days) in hybrid progenies. The longest mean duration was recorded by the cross KS 233 x AB 1 (81 days) and shortest by ACC 8206 x KS 224 (63 days) in F_2 population. Negative sca effects were marked for their superiority with regards to earliness. The crosses showing negative and significant sca effects in both the generations were ACC 2623 x KS 224 and ACC 5114 x AB 1.

The significant negative sca effects in F_1 progenies were observed in KS 247 x AB 1, KS 247 x DBR 8, KS 235 x KS 224, KS 227 x T 3, KS 262 x T 3 and KS 233 x T 3, whereas crosses ACC 8206 x KS 224, KS 228 x KS 224, KS 253 x AB 1, ACC 8207 x KS 224, KS 250 x T 3, KS 227 x DBR 8, KS 233 x KS 224 and KS 263 x T 3 showed negative and significant sca effects in F_2 generations.

3. Plant height :

For plant height, the highest mean value was recorded by ACC 2623 x AB 1 (101.07cm) and lowest by KS 262 x T 3 (62.53cm) in F_1 and for F_2, ACC 2623 x KS 224 (91.13cm) to KS 253 x DBR 8 (62.93cm). The crosses ACC 8204 x AB 1 and ACC 2623 x T 3, KS 219 x T 3, ACC 5114 x DBR 8, ACC 8207 x KS 224 and KS 253 x DBR 8 were categorised as the better combinations for dwarfness exhibiting negative sca effects and comparatively low performance over the generations.

Besides, 11 crosses in F_1 and 4 crosses in F_2 generations with significant negative sca effects were superior for dwarfness.

4. Number of branches per plant :

The mean values for this character ranged from 4.87 (ACC 8207 x KS 224), to 11.87 (KS 247 x T 3) in F_1 and 6.00 (ACC 8204 x AB 1) to 8.53 (KS 263 x DBR 8) in F_2.

Among 60, seven combinations in F_1 and four in F_2 had positive and significant sca effects for more number of branches per plant. However, crosses KS 227 x AB 1 and KS 219 x AB 1 exhibited significant positive values of sca effect over the generations. These crosses also showed high *per se* performance.

5. Number of fruits per plant :

The mean values of hybrids for number of fruits per plant ranged from 12.21 (ACC 5114 x T 3) to 33.60 (KS 227 x AB 1), whereas, in segregating F_2 generation from 12.52 (ACC 8204 x AB 1) to 27.95 (KS 227 x AB 1).

For this important yield trait, 13 combinations in F_1 and 9 combinations in F_2 showed significant positive estimates of sca effects. Crosses KS 227 x AB 1, KS 228 x AB 1, KS 263 x AB 1, ACC 8206 x T 3, KS 253 x T 3, KS 247 x T 3, KS 219 x AB 1, ACC 8204 x T 3, and KS 250 x KS 224 were good specific combiners over the generations on the basis of sca effects and *per se* performance.

6. Length of fruit :

The highest mean value for length of fruit was exhibited by cross KS 235 x T 3 (12.14cm) and lowest by KS 262 x AB 1 (7.68 cm) in F_1, and ACC 2623 x T 3 (11.40cm) to ACC 5114 x DBR 8 (7.52cm) in F_2. Among 60 crosses, only 3 cross combinations, viz., KS 262 x AB 1, ACC 5114 x KS 224 and KS 263 x T 3 were found to be desirable with negative and significant sca effects in F_1 hybrids. None of the crosses were negatively significant for reduced length of fruit in F_2 generation.

7. Width of fruit :

The range of mean for the hybrids varied from 6.38 cm (ACC 2623 x DBR 8) to 10.43 cm (KS 235 x T 3), while in segregants it was from 6.66cm (KS 228 x DBR 8) to 9.20 cm (ACC 2623 x T 3). Increase in width of fruit also increases fruit weight, which directly influences the total yield.

Out of 60 crosses, five promising combinations with significant and positive sca effects in order of merit were KS 235 x T 3, KS 263 x AB 1, ACC 2623 x T 3, KS 228 x AB 1 and ACC 8207 x DBR 8 in hybrid progenies. None of the crosses was with positive and significant sca effects in F_2 generations.

8. Fruit weight :

In the present study, fruit weight ranged from 88.20g (ACC 5114 x DBR 8) *to 125.00g (ACC 8204 x T 3) in hybrids and 87.47g (KS 253 x DBR 8) to 123.80g (KS 233 x T 3) in F_2. Out of 60 combinations, the positive and* significant crosses were recorded in F_1 and F_2 were seven and three, respectively. The promising crosses on the basis of high sca effect were ACC 8204 x T 3, KS 263 x AB 1, KS 219 x AB 1, ACC 2623 x T 3, KS 228 x AB 1 and KS 253 x KS 224 in F_1, and KS 233 x T 3 and KS 250 x DBR 8 in F_2 populations. Besides, cross KS 247 x KS 224 was best specific combination over the generation.

9. Plant spread :

The significant and negative sca effects were considered for the compact ideotype per unit area for spread of plant. The mean values for this trait ranged from 0.85 m^2 (ACC 8206 x T 3) to 0.43m^2 (KS 263 x AB 1) in F_1, while in F_2 generation it was from 0.81 m^2 (ACC 8206 x T 3) to 0.39 m^2 (KS 263 x AB 1). For this character 8 and 2 combinations exhibited negative and significant sca effects in F_1 and F_2 generation, respectively. The lowest and significant sca effects for compact plant type was recorded by KS 263 x AB 1 (0.43) in hybrids and by KS 235 x KS 224 (0.42) in F_2. Cross KS 247 x T 3 was found as best specific combiner over the generation on the basis of sca effect and *per se* performance.

10. Yield per plant :

The mean value of yield per plant ranged from 1.51 kg (ACC 8204 x DBR 8) to 3.30kg (KS 219 x T 3) in hybrids and from 1.31 kg (ACC 8204 x DBR 8) to 2.54 kg (KS 247 x T 3) in F_2 populations. Among 60 hybrids and sergeants, 17 Cross combinations in F_1 and 13 in F_2 possessed significantly positive sca effect for the trait. Twelve crosses, *viz.*, KS 219 x AB 1, KS 233 x T 3, KS 247 x T 3, KS 228 x AB 1, KS 253 x T 3, KS 263 x AB 1, KS 227 x AB 1, ACC 8206 x T 3, KS 235 x KS 224, KS 262 x DBR 8, KS 250 x KS 224 and ACC 5114 x KS 224 were superior specific combiners over the generations.

(v) PROPORTIONAL CONTRIBUTION OF FEMALES, MALES AND FEMALES AND MALES :

Proportional contribution of females, males and females x males for ten characters have been presented in Table 9. In general, the contribution of females was lower than that of males and females x males. The maximum contribution of males was recorded for plant spread, fruit weight, width of fruit in F_1 and F_2; yield per plant, number of branches per plant, days to flowering, number of ffuits per plant in F_1 and length of fruit in F_2 generation. The maximum contribution of females was recorded for plant height, days to marketable maturity, days to flowering both in F_1 and F_2; yield per plant, number of fruits per plant, number of branches per plant, length of fruit, width of fruit only in F_1 generations. The proportional contribution due to interaction of females and males varied from 11.04 per cent for plant spread to 147.18 per cent for yield per plant in F_1 and 8.12 per cent for plant spread to 51.14 per cent for days to flowering in F_2. The maximum contribution of females x males was recorded for days to flowering, days to marketable maturity, number of branches per plant, length of fruit and width of fruit in both F_1 and F_2 generation and plant height, number of branches per plant and yield per plant in F_1 generation only.

Table 9. Proportional contribution of females, males and females x males interaction to different characters in egg plant.

Source / character	Days to flowering		Days to marketable maturity		Plant height		Number of branches per plant		Number of fruits per plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Females	38.47	30.13	54 57	34.78	74.99	53 36	35.96	7.17	48 12	17 44
Males	26.84	7 35	21 97	7.29	11.93	16.79	60.56	10.38	26.10	8.32
Females x Males	47 53	51 14	38 59	44 79	29 14	16 01	132 42	26.12	88 25	35.78

Source / character	Length of fruit		Width of fruit		Fruit weight		Plant spread		Yield per plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Females	33.70	11 00	25 77	17 72	2 88	3 51	12 88	7 26	80 08	10 23
Males	20.01	27.27	26 04	26.55	96 24	59 60	119 63	53.85	100.31	6.85
Females x Males	74.27	39.87	84 10	29.31	28.25	15 40	11 04	8 12	147 18	13.45

HETEROSIS AND INBREEDING DEPRESSION :

The extent of heterosis as per cent of increase or decrease of hybrids over the standard variety (SV) in F_1 and inbreeding depression (ID) in F_2 (in per cent) have been presented in Table-10. The promising strain (T-3) was used as standard variety for the calculation of standard heterosis. Negative and significant values of heterosis were desirable for days to flowering, days to marketable maturity, plant height, length of fruit and plant spread. On the other hand,positive and significant values were considered desirable for rest of the characters. The character wise results of heterosis and inbreeding depression are given as under:

1. Days to flowering :

As stated earlier, negative heterosis for earliness is usually considered desirable for this character. The extent of heterosis ranged from -36.14 (KS 253 x KS 224) to -6.92 (KS 233 x DBR 8). Out of 60 crosses, all the cross combinations had significant negative heterosis over standard variety, suggesting the duration of almost all the crosses were shorter than that of the standard variety.

Among 60 F_2 population, inbreeding depression varied from -17.84 (KS 253 x KS 224) to 13.30 (ACC 5114 x T 3) per cent. Out of sixty F_2 populations, only eleven crosses showed significant and positive inbreeding depression over F_1 hybrids for earliness. The maximum inbreeding depression was recorded in cross ACC 5114 x T 3 (10.91) followed by KS 219 x T 3 (10.91), ACC 8204 x T 3 (10.38), ACC 8206 x KS 224 (10.00) and ACC 2623 x T 3 (9.78).

Table 10. Estimates of heterosis (%) over standard variety (SV) and inbreeding depression (%) for ten characters in egg plant.

Cross	Days to flowering		Days to marketable maturity		Plant height		Number of branches per plant		Number of fruits per plant		Length of fruit		Width of fruit		Fruit weight		Plant spread		Yield per pla	
	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	I
KS 219 x T 3	-18.31**	10.91**	-14.12**	4.00	-18.06	5.52	12.16	20.26	81.84	23.50	23.21*	17.77*	0.52	12.97	2.72	6.77**	-13.54**	15.66**	69.23**	30.
KS 219 x AB 1	-17.32**	8.98*	-12.21**	2.18	1.04	4.81	26.48*	17.34	59.38	3.84	8.03	4.99	-0.35	12.56	8.82*	7.84**	-32.29**	18.46**	68.72**	26.
KS 219 x KS 224	-22.28**	0.63	-17.55**	1.39	-14.51**	-3.55	-12.16	19.79	11.20	17.53	21.45*	15.31*	-4.75	-0.49	-12.70**	-1.82	-43.75	5.56	-6.67	10.
KS 219 x DBR 8	-21.77**	-0.63	-14.12**	1.39	9.74**	-3.55	7.16	19.01	11.46	-2.51	3.85*	6.89*	-9.04	12.87	-20.75**	-1.40	-44.79**	5.66	-0.51	9.
KS 247 x T 3	-17.32**	2.41	-16.41**	2.74	-3.04	8.51*	34.89**	20.22	72.34**	-2.28	12.43	7.34	0.12	2.89	-1.06	7.01**	-30.21**	17.91**	56.41**	16.
KS 247 x AB 1	-22.77**	0.00	-29.39**	-6.49	10.52**	0.55	-14.42	17.66	6.36	8.03	13.42	20.85*	-7.88	2.89	-2.65	2.42*	-47.92**	6.00	3.08	10.
KS 247 x KS 224	-27.71**	0.70	-22.51**	2.47	6.00*	6.56*	-4.20	-16.13	-2.12	4.02	15.62	7.80	-1.39	1.41	-0.29	0.83	-44.79**	9.43	-0.51	6.
KS 247 x DBR 8	-32.67**	-11.03*	-29.38**	-11.89**	-7.90**	-10.56**	4.20	21.81	54.12**	17.20	8.69	14.17	-2.67	8.93	-18.93**	2.18	-44.79**	5.68	14.36*	13.
KS 253 x T 3	-20.79**	3.11	-19.08**	0.00	-5.21	11.45**	18.52	19.46	73.12**	11.19	18.59*	9.93	7.07	2.16	3.35	1.99	20.83**	19.74**	54.87**	25
KS 253 x AB 1	-21.77**	6.34	-23.66**	4.50	5.83*	7.48*	-12.16	11.64	17.43	20.46	4.95	6.50	-9.27	-9.07	-6.53	0.82	-50.00**	2.08	-5.13	9
KS 253 x KS 224	-36.14**	-17.84**	-29.00**	-9.68**	-6.07*	9.35**	-10.57	26.30*	2.12	9.66	13.20	8.26	-12.51	-9.67	-2.41	1.37	-43.75**	14.81*	1.03	13
KS 253 x DBR 8	-24.74**	-5.25	-22.51**	-6.89**	-7.38*	11.45**	-8.30	15.60	36.32**	10.66	-3.52	-6.27	-14.83	-7.35	-19.16**	4.58**	-43.75**	5.56	-3.59	6
KS 262 x T 3	-16.34**	2.36	-14.50**	3.58	-18.51**	1.60	14.43	10.62	14.59	18.91	-7.92	-6.12	1.16	-10.76	-1.53	2.15	-28.13**	7.25	-1.03	8
KS 262 x AB 1	-15.34**	8.82*	-13.74**	5.31	-0.17	9.31**	-15.91	7.16	5.75	13.17	-15.51	-19.40	-18.66*	-18.80	-5.88	-3.81*	-53.13**	-2.22	4.10	13
KS 262 x KS 224	-14.49**	6.98	-15.64**	0.00	-15.29**	2.35	-16.70	12.69	18.22	10.14	9.68	15.75	-5.45	7.84	-9.70	-4.37	-53.13**	-2.22	2.05	14.
KS 262 x DBR 8	-13.37**	5.71	-11.45**	9.05**	-11.29**	5.29	3.75	17.52	55.15**	24.80*	-8.58	-3.49	-15.76	-2.61	-18.46**	-2.66	-51.04**	6.38	17.44*	20.0
KS 228 x T 3	-21.20**	-10.06*	-18.32**	-2.34**	-8.42**	6.08	-11.36	8.59	16.65	12.14	5.17	11.30	-7.76	3.39	1.44	2.33	-27.06**	7.14	10.77	15.2
KS 228 x AB 1	-17.32**	1.20	-16.79**	-3.21	-3.21	0.27	21.93	23.58*	78.15**	12.18	5.28	-13.90	-6.95	-13.45	4.23	7.66**	-45.83**	7.69	55.90**	25.9
KS 228 x KS 224	-27.71**	2.75	-25.51**	2.57	-15.20**	-1.94	-7.61	23.74	33.90*	-2.53	-5.28	12.20	-11.06	6.90	-17.17**	-4.76**	-41.67**	7.14	9.74	9.8
KS 228 x DBR 8	-16.34**	7.10	-19.84**	3.33	-2.61	1.07	9.89	10.34	52.36**	10.53	2.09	6.25	-14.60	9.63	-17.35**	2.84	-50.00**	4.17	20.00**	13.6
KS 233 x T 3	-15.34**	0.00	-13.35**	1.32	-15.29**	1.54	27.27*	12.50	85.29**	24.73**	16.17	1.14	10.31	5.57	8.35*	-0.76	-28.13**	2.90	66.15**	30.2
KS 233 x AB 1	-16.34**	-5.93	-9.16**	-1.69	-2.35	9.08**	-21.93	2.91	-2.46	1.12	-1.10	-7.34	-14.83	-7.07	-0.77	0.83	-40.88**	7.84	-2.56	11.
KS 233 x KS 224	-15.83**	7.66	-14.12**	5.78	-13.46**	4.71	-16.70	11.73	6.54	0.63	-7.59	-0.71	-16.45	-7.77	-11.64**	2.99*	-51.04**	6.38	-4.62	8.6
KS 233 x DBR 8	-6.92*	4.79	-10.31**	-1.71	-5.73**	2.31	-9.89	-3.40	32.99**	6.97	-13.42	-8.26	-23.23*	-20.69	-18.17**	2.08	-44.79**	7.55	2.56	9.5
KS 250 x T 3	-17.82**	9.04*	-14.50**	8.93**	-4.86	8.18**	-15.11	5.35	-1.33	-1.72	-6.05	-17.21	-11.70	-0.66	-3.94	1.71	-22.92**	12.16*	-10.77	4.6
KS 250 x AB 1	-14.35**	-3.47	-15.26**	-4.50	-0.60	6.29	-3.07	3.05	22.40	18.15	1.21	-5.22	0.23	-5.66	-0.41	3.24*	-50.00**	4.17	26.67**	32.3
KS 250 x KS 224	-16.34**	7.69	-15.64**	3.62	-8.94**	6.30	-8.30	-14.87	38.32**	11.68	1.87	11.99	-3.94	13.87	-19.99**	-5.44**	-51.04**	4.26	7.18	11.
KS 250 x DBR 8	-16.34**	6.50	-16.79**	2.30	-1.12	8.17*	-8.30	19.08	23.67	-7.05	3.63	1.38	-6.14	-3.70	-14.68**	0.00	-41.67**	7.14	3.59	5.4
KS 263 x T 3	-14.35**	6.94	-12.60**	2.17	0.26	1.82	1.48	3.70	37.59**	21.91**	-6.71	-14.74	-12.98	-15.98	-6.06	-2.20	-18.75**	16.67**	27.18**	19.7
KS 263 x AB 1	-15.83**	-7.06	-14.12**	-7.11*	5.30	5.78	28.75*	28.24**	76.15**	17.22**	20.13*	8.70	21.67*	15.71	9.70*	7.13**	-55.21**	9.30	54.36**	24.2

Cross	Days to flowering		Days to marketable maturity		Plant height		Number of branches per plant		Number of fruits per plant		Length of fruit		Width of fruit		Fruit weight		Plant spread		Yield per pla	
	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	ID	SV	
KS 263 x KS 224	-24.74**	-15 12**	-22.90**	-15.36**	-3.30	4.85	-28.07*	-1.58	5.51	3.50	6.38	-8.58	1.51	-3.88	-3.47	0 13	-48.96**	8.16	-5.64	1.6
KS 263 x DBR 8	-20.79**	-16 77**	-14.12**	10.23**	-5.12	-5 77	-2.27	0 81	54 18**	20.38*	7 04	10 69	-0 46	12.46	-20 46	-4 21	-42.71**	12 73	9.74	11.
KS 235 x T 3	-7.43*	9 63*	-11.83**	1.73	-0.52	3.48	33.30**	26 68**	60.41**	17 17	33.55**	11 53	20 36*	9.88	6 99	0 66	-16 67**	7 50	60.00**	32.0
KS 235 x AB 1	-16 83**	8 34*	-15.64**	2.27	-2.16	-7 19	-14.43	4.38	6 36	19 92	-1.43	-8 15	-6.84	-3.86	-0 88	-0 83	-50 00**	0.00	-6 15	15.
KS 235 x KS 224	-23 26**	1 30	-27 09*	-13.60**	-11.73**	-4.13	0.80	20 29	32.51*	18 82	4.29	6.01	-1 16	-0 70	-10 8***	-5.67**	-46.88**	17.65*	27 69**	18 8
KS 235 x DBR 8	-21 77**	0.65	-18.70**	0 00	2 09	7 15*	-18.18	-14 86	41 46**	15 23	-2.86	3.62	-13 09	-2 67	-21 40**	-5.31**	-42 71**	5.45	13.33	16.
KS 227 x T 3	-21 28**	0 62	-20.99**	-8.67	-12.42**	5.46	-12 84	-3 40	18 04	1 38	-3.53	-9.24	-19 24*	-20 66	-0 11	2 24	-15 63**	24.69**	28 21**	19.6
KS 227 x AB 1	-20 79**	-5.01	-14.89**	-1 35	-1 56	2.73	27 27*	14.91	103.39**	16.82**	6 16	-3 83	-8.92	-13 23	5 23	3.18*	-53 13**	8.89	49 23**	22.6
KS 227 x KS 224	-14 85**	-5 83	-11.83**	-1 73	-15 42**	0 05	-3.07	27 32**	19 85	2 27	4 18	7 60	-12 63	1 19	-10 41*	3 74*	-38.54**	10 17	-1.03	7 7
KS 227 x DBR 8	-24 25**	3.27	-16 03**	4 09	-6 26*	-10.76**	-5.34	5 52	33.54*	1 99	-2 31	5 63	-8 34	7 46	-15 41**	1 22	-42 71**	7 27	8.21	9.5
ACC 5114x T 3	-14 35**	13 30**	-16.41**	-0.45	11.95**	5 62*	-13.64	24 61	-26 09	16 22	8.36	1 32	-11.01	-8 59	-2 76	2 67	-16 67**	13 75**	-0.51	12.
ACC 5114 x AB 1	-25 25**	0 00	-21 76**	1.46	11 13**	0.08	-28.75*	-0 96	-23 12	-3 39	19.47*	4 09	0 35	0 92	-0 24	-0 42	-44.79**	7 55	-7.69	13.
ACC 5114 x KS 224	-22 28**	2 56	-19.47**	-5 69	11.56**	5 84*	-12.84	19 17	-7 38	4.25	-6.93	-9 81	-9 50	-2 94	6 41	0 38	-42 71**	9.09	-11.28	6.3
ACC 5114 x DBR 8	-14 85**	3 40	-13.74**	3 98	5 40	7 84**	-15 91	-0 95	-4 36	-0 19	4 18	20 59*	-6 95	15 19	-22 22**	3 32	-38 54**	0 00	-19 49**	14.
ACC 8204x T 3	-9 40**	10 38**	-5 73*	6 07*	11 99**	9 78**	33 30**	25 58**	56 60**	2 20	19 69*	2 11	15 41	6 02	10 23*	8 86**	-16 67**	1 25	26 67**	11 7
ACC 8204 x AB 1	-17 32**	1 80	-10 68**	3 85	-2 95	-1 34	-15 91	18 92	-10 59	15 23	-1 43	-13 95	-5 33	-9 55	1 23	5 26**	-44 79**	7 55	-8 72	20 7
ACC 8204 x KS 224	-18 60**	-5 49	-11 83**	-3 40	12 34**	8 67**	-12 16	5 95	-4 54	-3 04	7 37	15 11	-3 01	7 06	9 76*	8 53**	-42 71**	10 91	-9 74	21 0
ACC 8204 x DBR 8	-14 85**	2 89	-11 06**	0 44	9 57**	-1 19	-18 18	2 78	-10 23	11 87	-7 48	2 62	-18 68*	-7 21	-15 70**	1 46	-44 79**	7 55	-22 56**	13.
ACC 8206x T 3	-9 40**	7 66*	-5.34*	6 46*	6 26**	12 83**	31 82*	15 26	73 49**	13 08	15 95	5 22	0 12	-2 08	6 29*	8 41**	-11 46**	4 71	31 28**	14 0
ACC 8206 x AB 1	-19 31**	-0 63	-15 26**	-1 80	12 34**	3 56	-15 11	8 97	-18 10	-0 59	1 98	0 76	9 62	-4 74	-4 35	-0 37	-39 58**	12 07	-9 23	18 6
ACC 8206 x KS 224	-25 74**	10 00*	-18 70**	11.27**	2 18	9 95**	-29 55*	-12 90	-20 70	3 36	11 22	6 53	-3 71	6 74	-6 94	1 19	-42 71**	7 27	-17.44**	0 0
ACC 8206 x DBR 8	-18 31**	-6 05	-11 45**	-2 29	-0 34	-1 83	-3 75	15 82	11 56	-16 01	-8 36	-4 68	-14 83	-0 27	-20 11**	-0 52	-38 54**	5 08	-11.28	9 8
ACC 8207x T 3	-13.37**	7.42	-11.06**	0.44	-1 47	16.40**	17.39	19.36	45.28**	19.67**	-0 66	-7 92	-10 66	-11 93	7 17	-1 27	-17 71**	10 13*	35.38**	25.3
ACC 8207 x AB 1	-22.28**	-1.28	-16.41**	-0.92	0.95	2.50	-22.73	-2.94	0 30	9 41	0 55	-0 22	-20 51*	-21 72	-3.41	-4 32**	-43 75**	5.56	-12.82	-1.
ACC 8207 x KS 224	-23 76**	4 54	-22.90**	2.47	-14.77**	5 40	-44.06**	24 64	5 45	5.59	15 95	6 83	-7 53	-2 01	-6 41	-4 52**	-46 88**	3.92	-9.23	4 5
ACC 8207 x DBR 8	-18 31**	2 42	-14 89**	2 23	-3.30	0 63	-17 39	12 93	6 66	14 07	11.44	9 18	-2 55	7 02	-16 11**	6.52**	-42 71**	7 27	-14.36*	8 9
ACC 2623x T 3	-8.91**	9 78**	-6.48**	5 72*	6.18*	4.84	25 80*	25 29**	47 82**	25.06**	23.67**	-1 24	13 44	6 03	6 62*	5 41**	-17 71**	7 69	36 41**	31 9
ACC 2623 x AB 1	-21.77**	1.27	-18.70**	-5 17	31 72**	9.89**	-15 11	-7 10	-15 86	22 45	16.39	10 59	-11 01	-11 72	-8 70*	-6 83	-41 67**	7 14	-21 03**	-11
ACC 2623 x KS 224	-27 71**	0.00	-28 63**	-2.15	24.68**	4 75	-13.64	6 97	-3 93	14 05	12 10	-1 29	-19 58*	-33 43**	-6 76	-5 74	-40 63**	10 53	-11 79	7 5
ACC 2623 x DBR 8	-15 34**	1 75	-11.45*	0.43	23.72**	7 37**	-21 93	-2 91	-12.47	-6 15	8.03	4 68	-20 07**	-36.36**	17 93**	5 16**	-40 63**	3 51	-21 03**	3 9
No of hybrids with +ka sig	0 00	43 00	0.00	37.00	23.00	50 00	20.00	49 00	45.00	49.00	41 00	38 00	13 00	25.00	13 00	39 00	1 00	58 00	32 00	58.
No of hybrids with - Ve sig	60.00	17 00	60.00	23.00	37.00	10.00	40.00	11.00	15 00	11 00	19.00	22.00	47 00	35 00	47 00	21 00	59.00	2 00	28 00	2 0
Minimum heterosis	-36 14	-17 84	-29.38	-15.36	-18.51	-10.76	-44 06	-16 13	-20 70	-16.01	-15.51	-19 40	-26 07	-36 36	-22 22	-5 74	-55 21	-2 22	-22.56	-11.
Maximum heterosis	-6 92	13.30	-5.34	11.27	31.72	16 40	34.89	28 24	103.39	25.06	33 55	20 85	21 67	16 19	10 23	8 86	20 83	24 69	69 33	32.

2. Days to marketable maturity :

The pattern of desirable heterosis is same as in case of days to flowering at which they emerged first. The heterosis over standard variety ranged form -29.38 (KS 247 x AB 1 and KS 247 x DBR 8) to -5.34 (ACC 8206 x T 3) per cent. Almost all the crosses showed significant negative heterosis for days to marketable maturity,indicating earlier harvesting of first fruit than standard variety (T 3). Best cross in order of merit was KS 247 x AB 1 followed by KS 247 x DBR 8, KS 253 x KS 224, ACC 2623 x AB 1 and KS 228 x KS 224.

The inbreeding depression varied from -15.36 (KS 263 x KS 224) to 11.27 (ACC 8206 x KS 224) per cent. Significant inbreeding depression with positive values were considered desirable for this particular trait. Crosses ACC 8206 x KS 224 (11.27%), KS 263 x DBR 8 (10.23%), KS 262 x DBR 8 (9.05%) and KS 250 x T 3 (8.93%) were identified for earlier harvesting of fruits than F_1 hybrids.

3. Plant height :

In the present study, dwarf hybrid was considered as better one. Heterosis for plant height over standard variety ranged from -18.51 (KS 262 x T 3) to 31.72 (ACC 2623 x AB 1) per cent. Among the 60 crosses studied, significant and negative heterosis was observed in eighteen crosses for dwarfness over standard variety. Positive and significant value was obtained in sixteen crosses for tallness over standard variety. Cross KS 262 x T 3 exhibited maximum negative heterosis followed by KS 219 x T 3, KS 227 x KS 224, KS 233 x T 3 and KS 228 x KS 224.

The inbreeding depression for this trait ranged from -10.76 (KS 227 x

DBR 8) to 16.40 (ACC 8207 x T 3) per cent. Out of 60 crosses, twenty two combinations were observed with significant and positive depression for dwarfness over F_1 hybrids. Crosses with maximum inbreeding depression for dwarfness were KS 227 x DBR 8, KS 247 x DBR 8, and KS 235 x AB 1 in order of merit.

4. Number of branches per plant :

The extent of heterosis over standard variety ranged from -44.06 (ACC 8207 x KS 224) to 34.89 (KS 247 x T 3) per cent. Out of 60 crosses, nine crosses showed significant and positive heterosis over standard variety. Cross KS 247 x T 3 was best hybrid followed by KS 235 x T 3, ACC 8204 x T 3, ACC 8206 x T 3 and KS 263 x AB 1 for more number of branches per plant.

Inbreeding depression ranged from -16.13 (KS 247 x KS 224) to 28.24 (KS 263 x AB 1) percent. The high inbreeding depression with positive value was recorded in KS 263 x AB 1 (28.24%) followed by KS 235 x T 3 (26.68%), KS 253 x KS 224 (26.30%), ACC 8204 x T 3 (25.38%) and ACC 2623 x T 3 (25.29%).

5. Number of fruits per plant :

The hybrid with positive heterosis was desirable for this trait. The heterosis over standard variety varied from -20.70 (ACC 8206 x KS 224) to 103.39 (KS 227 x AB 1) per cent. Out of 60 crosses, 25 combinations showed highly significant and positive heterosis over standard variety. Out of 25 combinations, the five desirable economic combinations in order of merit were KS 227 x AB 1 (103.39%), KS 233 x T 3 (85.29%), KS 219 x T 3 (81.84%), KS 228 x AB 1 (78.15%) and KS 263 x AB 1 (76.15%).

Inbreeding depression in F_2 populations, varied from -16.01 (ACC 8206 x DBR 8) to 25.06 (ACC 2623 x T 3) per cent for this trait. The highest depression 25.06 per cent was recorded in ACC 2623 x T 3 followed by Cross KS 262 x DBR 8 (24.80%), KS 233 x T 3 (24.73%) and KS 219 x T 3 (23.50%).

6. Length of fruit :

Since, all the genotypes in the study are round fruited. Hence, negative heterosis is considered desirable for round shape. The extent of heterosis varied from -15.51 (KS 262 x AB 1) to 33.55 (KS 235 x T 3) per cent. None of the crosses was found with significant negative heterosis for reduced length of fruit towards round shape. However, crosses KS 262 x AB 1, KS 233 x DBR 8, KS 262 x DBR 8, KS 233 x KS 224 and ACC 8206 x T 3 with non significant values were superior for this trait.

Inbreeding depression ranged from -19.40 (KS 262 x AB 1) to 20.85 (KS 247 x AB 1) per cent. Significant and positive inbreeding depression in F_2 population was observed for KS 247 x AB 1, ACC 5114 x DBR 8, KS 219 x T 3 and KS 219 x KS 224 indicating significant decreased length of fruit over their respective F_1 hybrids.

7. Width of fruit :

The magnitude of heterosis over standard variety, ranged from - 26.07 (ACC 2623 x DBR 8) to 21.67 (KS 263 x AB 1) per cent. Out of 60, the best crosses in the same order were KS 263 x AB 1 (21.67%) and KS 235 x T 3 (20.86%) for significant and positive heterosis over standard variety.

Inbreeding depression for this trait varied from -36.36 (AC 2623 x DBR 8) to 16.19 (ACC 5114 x DBR 8) per cent. The highest negative depression was recorded only in two crosses, namely, ACC 2623 x DBR 8 (-36.36%) and ACC 2623 x KS 224 (-33.43%) for this character.

8. Fruit weight :

The heterosis over standard variety varied from -22.22 (ACC 5114 x DBR 8) to 10.23 (ACC 8204 x T 3) per cent alongwith desirable and highly significant economic heterosis in cross ACC 8204 x T 3 over standard variety. The parents which exerted maximum heterotic response in their crosses were T 3 and ACC 8204. Out of 60 crosses, six crosses ACC 8204 x T 3, KS 263 x AB 1, KS 219 x AB 1, ACC 2623 x T 3, KS 233 x T 3 and ACC 8206 x T 3 showed significant positive heterosis over standard variety for bolder fruit size.

Among 60 F_2 population, inbreeding depression varied from -5.74 (ACC 2623 x KS 224) to 8.86 (ACC 6204 x T 3) per cent. Eight crosses were identified with significantly negative values expressing inbreeding depression for this traits. Maximum depression -5.67 was observed in cross KS 235 x KS 224 followed by -5.44 (KS 250 x KS 224), -5.31 (KS 235 x DBR 8), -4.76 (KS 228 x KS 224) and -4.52 (ACC 8207 x KS 224).

9. Plant Spread :

The pattern of desirable heterosis is same as days to flowering, days to marketable maturity, plant height and length of fruit. The heterosis ranged from -55.21 (KS 263 x AB 1) to 20.83 (KS 253 x T 3) per cent. Almost all the cross combinations exhibited highly significant and negative heterosis over standard variety for decreased area for spreading of plant.

For this traits, inbreeding depression ranged from -2.22 (KS 262 x AB 1) and (KS 262 x KS 224) to 24.69 (KS 227 x T 3) per cent. Among 60 crosses, positive and significant inbreeding depression was showed by 11 crosses in F_2 populations indicating inbreeding depression for the trait.

10. Yield per plant :

The extent of heterosis over standard variety for this most important trait varied from -22.56 (ACC 8204 x DBR 8) to 69.23 (KS 219 x T 3) per cent. Twenty one cross combinations showed significant and positive heterosis over standard variety for higher yield. The maximum heterotic values over standard variety were followed by KS 219 x T 3 (69.23%), KS 219 x AB 1 (68.72%), KS 233 x T 3 (66.15%), KS 235 x T 3 (60.00%), KS 247 x T 3 (56.41%), KS 228 x AB 1 (55.90%), KS 253 x T 3 (54.87%), KS 263 x AB 1 (54.36%), KS 227 x AB 1 (49.23%), ACC 2623 x T 3 (36.41%), ACC 8207 x T 3 (35.38%) and ACC 8206 x T 3 (31.28%).

The inbreeding depression for yield per plant ranged from -11.69 (ACC 2323 x AB 1) to 32.39 (KS 250 x AB 1) per cent. Among 60, none of the crosses showed significant negative inbreeding depression for reduced yield in F_2 generation.

ESTIMATES OF SELECTION PARAMETERS

HERITABILITY AND GENETIC ADVANCE

The magnitude of heritable variability is most important which showed close bearing on the response to selection **(panse, 1957)**. The estimates of heritability in narrow sense and genetic advance in per plant of mean for all the ten metric traits are presented in Table 5.

Heritability estimates (in narrow sense) have been classified according to **Robinson (1965)** as :

Low heritability	:	below 10 per cent
Medium habitability	:	10-30 per cent
High heritability	:	above 30 per cent

As evident from Table 5 heritability ranged from 31.20 (length of fruit) to 90.50 (plant spread) in F_1 and from 5.80 (width of fruit) to 83.90 (Plant height) in F_2. All the traits in both the generations had high estimates of heritability except length of fruit and width of fruit in F_2 population. The estimates of genetic advance (GA) in per cent of mean did not fluctuate much in F_1 and F_2 generations. The expected genetic advance as per cent of mean ranged from 0.59 (plant spread) to 106.16 (fruit weight) per cent in F_1 and 0.54 (plant spread) to 105.09 (fruit weight) per cent in F_2 generations. High estimates of genetic advance in both the generations were recorded in fruit weight, plant height, days to marketable maturity and days to flowering.

High heritability coupled with high genetic advance was recorded by days to flowering, days to marketable maturity, plant height and fruit weight. Rest of the characters showed high heritability with medium or low genetic.

CORRELATION COEFFICIENTS :

The genotypic and phenotypic correlation coefficients among characters studied are present in Table 11. In general, the magnitude of genotypic correlations was higher than that of phenotypic correlation coefficients.

GENOTYPIC CORRELATION :

In parent, F_1 and F_2, the strong positive association was observed between yield per plant and number of fruits per plant, width of fruit, plant

Table 11 : Estimates of genotypic and phenotypic correlations for 10 characters among parents, F_1s and F_2s in egg plant.

Character	Days to flowering	Days to marketable maturity	Plant height	Number of branches per plant	Number of fruits per plant	Length of fruit	Width of fruit	Fruit weight	Plant spread	Yield per plant
Days flowering	Parents	0.881	0.117	0.103	-0.269	-0.018	0.028	0.328	0.328	0.062
	F_1s	0.887	0.019	0.448	0.297	-0.034	0.269	0.248	0.382	0.324
	F_2s	0.902	0.011	0.303	0.220	0.148	0.318	-0.047	0.083	0.028
Days to marketable maturity	0.843**	Parents	0.337	0.158	-0.541	0.127	-0.080	0.262	0.302	-0.255
	0.782**	F_1s	0.053	0.400	0.205	-0.094	0.232	0.208	0.356	0.192
	0.827**	F_2s	0.101	0.459	0.283	0.286	0.402	0.034	0.190	0.082
Plant height	0.083	0.356	Parents	0.634	-0.346	0.739	0.293	0.151	0.213	-0.302
	0.013	0.030	F_1s	-0.032	-0.388	0.175	-0.144	0.061	-0.002	-0.304
	0.027	0.069	F_2s	-0.111	-0.308	-0.006	0.215	-0.080	-0.127	-0.375
No. of branches per plant	0.024	0.073	0.401	Parents	0.269	0.733	0.557	0.022	0.601	0.268
	0.327*	0.295*	-0.069	F_1s	0.940	0.614	0.938	0.614	0.505	0.965
	0.147	0.175	0.010	F_2s	0.863	0.400	0.393	0.389	0.452	0.864
No. of fruits per plant	-0.208	-0.449	-0.276	0.229	Parents	-0.510	0.254	-0.112	0.386	0.910
	0.217	0.194	-0.343**	0.730**	F_1s	0.433	0.737	0.395	0.261	0.912
	0.125	0.160	-0.206	0.620**	F_2s	0.323	0.353	0.138	0.250	0.939
Length of fruit	-0.003	0.022	0.336	0.120	-0.179	Parents	-0.181	0.575	-0.015	-0.200
	-0.041	-0.049	0.107	0.160	0.063	F_1s	0.676	0.574	0.419	0.483
	0.087	0.128	0.038	0.138	-0.031	F_2s	0.902	0.905	0.632	0.505
Width of fruit	0.050	0.010	0.178	-0.027	0.005	0.634**	Parents	0.490	0.535	0.754
	0.126	0.096	-0.053	0.270*	0.209	0.765**	F_1s	0.659	0.404	0.772
	0.079	0.106	0.093	0.097	-0.093	0.856**	F_2s	0.441	0.860	0.563
Fruit weight	0.316*	0.226	0.136	0.102	-0.046	0.351	0.293	Parents	0.276	0.340
	0.181	0.163	0.047	0.353**	0.199	0.443**	0.460**	F_1s	0.504	0.638
	-0.021	0.026	-0.051	0.053	-0.076	0.557**	0.507**	F_2s	0.383	0.419
Plant spread	0.324	0.275	0.193	0.366**	0.310*	0.023	0.141	0.241	Parents	0.563
	0.292*	0.308*	0.002	0.337**	0.221	0.238	0.237	0.425**	F_1s	0.431
	0.027	0.115	-0.109	0.228	0.165	0.291*	0.207	0.303*	F_2s	0.293
Yield per plant	0.056	-0.241	-0.285	0.251	0.813**	0.000	0.152	0.351	0.474**	Parents
	0.225	0.160	-0.282*	0.710**	0.622**	0.255*	0.381**	0.518**	0.389**	F_1s
	0.021	0.058	-0.301*	0.544**	0.768**	0.200	0.144	0.280*	0.232	F_2s

* Significant at 5 per cent level.
** Significant at 1 per cent level.

Upper diagonal indicated genotypic correlation coefficient.
Lower diagonal indicated phenotypic correlation coefficient

spread, fruit weight in parent, F_1 and F_2, and length of fruit in F_1 and F_2 and days to flowering only in F_1. Days to flowering had strong association with days to marketable maturity, number of branches per plant in parents, F_1s and F_2s; with plant spread, fruit weight in parents and F_1s; with width of fruit, number of fruits per plant in F_1s and F_2s and with yield per plant in F_1s. Days to marketable maturity was positively associated with number of branches per plant and plant spread in parents, F_1s and F_2s; with length of fruit in parents and F_2s ; with width of fruit, number of fruits per plant in F_1 and F_2 and with plant height in parents only. Plant height strongly associated with length of fruit, number of branches per plant and plant spread in parents and with width of fruit in parent and F_2. Number of branches per plant was positively associated with length of fruit, width of fruit, plant spread, number of fruits per plant in parents, F_1s and F_2s and with fruit weight in F_1 and F_2. Number of fruits per plant had strong association with width of fruit and plant spread in parent, F_1 and F_2 and with length of fruit and fruit weight in F_1 and F_2. Length of fruit positively associated with fruit weight in parent, F_1 and F_2 and with width of fruit and plant spread in F_1 and F_2. Width of fruit exhibited strong positive association with fruit weight and plant spread in parent, F_1 and F_2 Fruit weight was positively associated with plant spread in all the populations.

The strong negative association were observed between yield per plant and plant height in parent, F_1 and F_2; days to marketable maturity and length of fruit in parent. Days to flowering had negative association with number of fruits per plant in parents and with length of fruit in parent and F_1. Days to marketable maturity was negatively associated with number of fruits per plant and width of fruit in parent, while with length of fruit in F_1 generation. Plant height was negatively associated with number of fruits per plant in parent, F_1 and F_2; with plant spread in F_1 and F_2; with width of fruit in F_1, while, with length of fruit and fruit weight in F_2 generation. Number of fruits per plant exhibited negative association with length of fruit and fruit weight only in parents. Likewise length of fruit had negative association with width of fruit and plant spread in parents only.

PHENOTYPIC CORRELATION :

At phenotypic level yield per plant exhibited significant and positive association with number of fruits per plant and plant spread in parental population; with length of fruit and width of fruit in F_1 generation and with number of branches per plant, number of fruits per plant and fruit weight in both F_1 and F_2 generation. Yield had significant negative correlation only with plant height in all the populations. Days to flowering had significant positive relationship with days to marketable maturity in all the populations; with fruit weight in parental and with number of branches per plant and plant spread in F_1 generation. Days to marketable maturity had significant positive association with number of branches per plant and plant spread only in F_1. Positively significant correlation of number of branches per plant was observed with plant spread in parent and F_1; with fruit weight and width of fruit in F_1 and with number of fruits per plant in F_1 and F_2 generation. Number of fruits per plant had significant positive association with plant spread only in parental population. Length of fruit exhibited highly significant positive association with width of fruit in all the populations and with fruit weight in F_1 and F_2 generation. While, it had only significant positive relationship with plant spread in F_2. Width of fruit and fruit weight showed significant positive association with fruit weight and plant spread, respectively, in F_1 and F_2 generations. The negative and significant association of plant height and number of fruits per plant in F_1 was also observed.

PATH COEFFICIENTS :

The total genotypic and phenotypic correlation coefficients of yield were partitioned into direct and indirect effects of different traits on yield according to the method of **Dewey and Lu (1959).** The results obtained from ten character combinations towards yield per plant is presented in Table 12. Only high magnitude of genotypic correlation and significant phenotypic correlations were taken into consideration.

GENOTYPIC PATH COEFFICIENTS :

Genotypic path coefficient analysis in F_1 and F_2 generation revealed that number of fruits per plant, fruit weight and days to flowering in both the generations; plant height, width of fruit and plant spread in F_1 and number of branches per plant and length of fruit in F_2 generation exhibited high direct effect on yield per plant. Days to marketable maturity in both F_1 and F_2, length of fruit in F_1 and width of fruit in F_2 population had negative direct effect on yield per plant.

The highest positive indirect effect on yield per plant was observed by days to flowering *via* number of fruits per plant in both the generation; days to marketable maturity *via* number of fruits per plant and days to flowering in both F_1 and F_2 and *via* number of branches per plant only in F_2 generation. Number of fruits per plant in F_1 and F_2, fruit weight and width of fruit in F_1 generation showed strong positive indirect effect on yield per plant *via* number of branches per plant. The high positive indirect effect on yield per plant were recorded by number of fruits per plant *via* fruit weight and width of fruit in F_1 and number of branches per plant in F_2 generation; length of fruits *via* number of fruits per plant and fruit weight in both the generations and number of

Table 12 : Direct and indirect effect of different characters on yield per plant at genotypic and phenotypic level in egg plant.

Character			Days to flowering	Days to marketable maturity	Plant height	Number of branches per plant	Number of fruits per plant	Length of fruit	Width of fruit	Fruit weight	Plant spread	Yield per p
Days flowering	G	F_1	0.160	-0.211	0.002	-0.104	0.292	0.007	0.038	0.081	0.069	0.324
		F_2	0.193	-0.392	-0.001	0.095	0.153	0.029	-0.032	-0.010	-0.007	0.028
	P	F_1	0.060	-0.095	-0.001	0.031	0.141	0.000	0.008	0.054	0.027	0.225
		F_2	-0.047	-0.032	-0.004	0.013	0.091	0.000	0.007	-0.006	-0.001	0.021
Days to marketable maturity	G	F_1	0.142	-0.249	0.006	-0.093	0.202	0.019	0.032	0.068	0.064	0.192
		F_2	0.174	-0.434	-0.006	0.144	0.196	0.056	-0.040	0.007	-0.016	0.082
	P	F_1	0.047	-0.122	-0.002	0.028	0.127	0.000	0.006	0.049	0.028	0.160
		F_2	-0.039	-0.039	-0.010	0.016	0.116	0.000	0.009	0.008	-0.003	0.058
Plant height	G	F_1	0.003	-0.013	0.116	0.007	-0.382	-0.035	-0.020	0.020	0.000	-0.304
		F_2	0.002	-0.044	-0.055	-0.035	-0.214	-0.001	-0.022	-0.017	0.011	-0.375
	P	F_1	0.001	-0.004	-0.061	-0.006	-0.223	0.000	-0.003	0.014	0.000	-0.282*
		F_2	-0.001	-0.003	-0.144	0.001	-0.150	0.000	0.008	-0.015	0.002	-0.301**
Number of branches per plant	G	F_1	0.072	-0.100	-0.004	-0.232	0.926	-0.121	0.131	0.200	0.091	0.965
		F_2	0.058	-0.199	0.006	0.314	0.599	0.079	-0.039	0.085	-0.038	0.864
	P	F_1	0.020	-0.036	0.004	0.094	0.475	0.000	0.016	0.106	0.031	0.710**
		F_2	-0.007	-0.007	-0.001	0.089	0.452	0.000	0.006	0.015	-0.005	0.544**
Number of fruits per plant	G	F_1	0.048	-0.051	-0.045	-0.218	0.985	-0.085	0.103	0.129	0.047	0.912
		F_2	0.043	-0.123	0.017	0.271	0.694	0.063	-0.035	0.030	-0.021	0.939
	P	F_1	0.013	-0.024	0.021	0.068	0.651	0.000	0.012	0.060	0.020	0.822**
		F_2	0.006	-0.006	0.030	0.055	0.728	0.000	-0.008	-0.022	-0.004	0.768**
Length of fruit	G	F_1	-0.006	0.023	0.020	-0.142	0.427	-0.197	0.094	0.187	0.076	0.483
		F_2	0.029	-0.124	0.000	0.126	0.224	0.197	-0.090	0.198	-0.053	0.505
	P	F_1	-0.002	0.006	-0.007	0.015	0.041	0.002	0.046	0.133	0.022	0.255*
		F_2	-0.004	-0.005	-0.006	0.012	-0.023	0.000	0.071	0.160	-0.007	0.200
Width of fruit	G	F_1	0.043	-0.058	-0.017	-0.218	0.726	-0.132	0.140	0.215	0.073	0.772
		F_2	0.061	-0.175	-0.012	0.124	0.245	0.177	-0.100	0.315	-0.072	0.563
	P	F_1	0.008	-0.012	0.003	0.025	0.136	0.001	0.060	0.138	0.022	0.381**
		F_2	-0.004	-0.004	-0.013	0.009	-0.068	0.000	0.083	0.146	-0.005	0.144
Fruit weight	G	F_1	0.040	-0.052	0.007	-0.142	0.389	-0.113	0.092	0.326	0.091	0.638
		F_2	-0.009	-0.015	0.004	0.122	0.096	0.178	-0.145	0.219	-0.032	0.419
	P	F_1	0.011	-0.020	0.003	0.033	0.130	0.001	0.027	0.300	0.039	0.518**
		F_2	0.001	-0.001	0.007	0.005	-0.055	0.000	0.042	0.287	-0.007	0.280*
Plant spread	G	F_1	0.061	-0.089	0.000	-0.117	0.257	-0.082	0.056	0.164	0.180	0.431
		F_2	0.016	-0.082	0.007	0.142	0.173	0.124	-0.086	0.984	-0.084	0.293
	P	F_1	0.018	-0.038	0.000	0.032	0.144	0.000	0.014	0.127	0.092	0.389**
		F_2	-0.001	-0.004	0.016	0.020	0.120	0.000	0.017	0.087	-0.022	0.232

Residual effect (F_1) Genotypic = 0.057
Phenotypic = 0.173

Residual effect (F_2) Genotypic = -0.023
Phenotypic = 0.265

branches per plant in F_2 population. Number of fruits per plant and fruit weight in F_1 and F_2 and length of fruit and number of branches per plant in F_2 had strong positive and substantial indirect effects on yield per plant *via* width of fruit. The positive and indirect effect on yield per plant was recorded by fruit weight *via* number of fruits per plant in F_1 and length of fruit and number of branches per plant in F_2 generation; plant spread *via* number of fruits per plant in both F_1 and F_2 and fruit weight in F_1 and length of fruit in F_2 population.

The high negative indirect effect on yield per plant was exhibited by days to flowering *via* days to marketable maturity in F_1 and F_2 and number of branches per plant in F_1 generation; plant height *via* number of fruits per plant in both the generations; number of branches per plant *via* days to marketable maturity in F_1 and F_2 and *via* length of fruit in F_1 generation. Number of branches per plant in F_1 and days to marketable maturity in F_2 generation had strong positive indirect effect on yield *via* number of fruits per plant whereas negative indirect effect was exhibited by length of fruit *via* number of branches per plant in F_1 and days to marketable maturity in F_2 generation; width of fruit *via* number of branches per plant and length of fruit in F_1 and *via* days to marketable maturity in F_2 generation. Fruit weight had considerable negative indirect effect on yield *via* number of branches per plant and length of fruit in F_1 and *via* width of fruit in F_2 generation, while plant spread showed negative indirect effect *via* number of branches per plant in F_1 generation.

PHENOTYPIC PATH COEFFICIENT:

The highest positive and substantial direct effect on yield per plant was recorded by number of fruits per plant and fruit weight in both the generations, whereas days to marketable maturity in F_1 and plant height in F_2 generation exhibited negative direct effect on yield per plant.

The high order of indirect positively effect on yield per plant was recorded by days to marketable maturity and number of branches per plant *via* number of fruits per plant in both the generations; number of branches per plant *via* fruit weight in F_1 generation; length of fruit *via* fruit weight in both the generations. Width of fruit had substantial positive indirect effects on yield per plant *via* fruit weight in both the generations and *via* number fruits per plant in F_1 generations; fruit weight *via* number of fruits per plant. Plant spread showed positive indirect effect *via* number of fruits per plant in both F_1 and F_2 and *via* fruit weight in F_1 generation.

Plant height exhibited substantial negative indirect effects on yield per plant *via* number of fruits per plant in both the generations, Rest of the characters for genotypic and phenotypic path coefficients had negligible direct and indirect effects in both the generations. The recorded residual effects in F_1 was positive with low magnitude at both genotypic and phenotypic level, whereas residual effects was negative with low magnitude at genotypic and positive at phenotypic level in F_2.

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CHAPTER -V

DISCUSSION

Chapter-V

DISCUSSION

For increasing genetic potentialities of any crop, the most complex problem faced by the breeder, the judicious selection of the parents from the gene pool, because the yield is a complex character comprising a number of components each of which is polygenically controlled and, therefore, they are susceptible to environmental fluctuations. It is also desirable that selection of suitable parents involved in a hybridization programme should be based on ability of a line to nick well with other lines to produce superior segregants. For this purpose, breeders have utilized different biometrical techniques for assessing the breeding value of parents though estimation of the variances and effects. In this regard line x tester technique developed and advocated by **Kempthorne (1957)** has been useful in evaluating a large number of lines at a time.

Although the technique of line x tester analysis has been utilized by various workers **Singh and Joshi, 1966; Raghavaish and Joshi, 1982; Dahiya *et al.* 1985; Prakash *et al.* 1994a; Prasash *et al.* 2000; Babu and Thirumurugan, 2001** in the past for the improvement of egg plant. But it is still essential to assess the breeding value of newer lines of egg plant, a specific group of *Solanum melongena*. With these considerations, the present investigation was designed to get the precise information regarding the genetic architecture of various quantitative characters through the estimation of combining ability, heterosis and inbreeding depression, heritability, genetic advance, correlation and path coefficients in egg plant.

Analysis of variance for mean squares of different traits (Table3) revealed highly significant differences among parents, F_1s and F_2s indicating much variability in base material as well as hybrids and segregating population. Parents differed significantly for all the traits except width of fruit. Parents vs F_1s and F_1s *vs* F_2s also differed significantly for all the character except for number of branches per plant due to parents *vs* F_1s and for days to marketable maturity due to F_1s *vs* F_2s indicating significant heterosis in hybrids and inbreeding depression in segregating population.

VARIABILITY :

The study of genetic variability among the parents and their progenies is pre-requisite for planning successful breeding programme. The parents were selected on the basis of phenotypic differences. Considerable variability with substantial range (Table 4) was observed among parents and their progenies (F_1s and F_2s). The presence of wide range of variation among the parents was observed for days to flowering, days to marketable maturity, plant height and fruit weight, while among the F_1s maximum range of variation was observed for number of branches per plant, number of fruits per plant, length of fruit, width of fruit and yield per plant. Among the different populations, F_1s had maximum variability than parents and F_2s.

COMBINING ABILITY ANALYSIS :

Combining ability analysis through line x tester technique was done using methodology of Kempthorne (1957) which involves the study of Cov. (F.S.) and Cov. (H.S.) to get estimates to gca and sca variances and effects. This technique is based on the general structure of experiment with following speciations.

i. The individuals within a plot resulting from a given cross are full-sibs.

ii. The individuals in different replicates resulting from a particular cross are full-sibs.

iii. The individuals in the same or different replicates resulting from a common tester (sire) but different lines (dames) are half-sibs.

The estimates of combining ability variances are translated into genetic variance to understand the nature and magnitude of gene action and provide a guideline for selecting parents for hybridization.

Analysis of variance for combining ability revealed significant differences among female and male genotypes in respect of gca for all the characters in both the generation, except for width of fruit and fruit weight in both generations and length of fruit in F_1 generation. The significance of gca variances thus reflected the importance of additive gene action for the traits. Similar findings were also reported by **Dahiya *et al.* (1985), Das and Barua (2001) and Singh *et al.* (2002)** for all the characters except plant height. The differences among hybrids due to interaction between females and males in respect of sca were also found significant for all the characters, except length of fruit and width of fruit only in F_2 generation indicating the importance of non additive gene action. These findings are in agreement with that of **Dahiya *et al.* (1985) and Babu and Thirumuragan (2001)** for all the characters.

Additive genetic variance results mostly from additive gene action; whereas non-additive variance is madeup of dominance and epistasis. The dominance variance dimishes by half with each generation of selfing, and thus is un-exploitable in purelines. The epistatic variance also declines on selfing; but the additive x additive type is fixable.

The estimates of components of genetic variance due to δ^2g (pooled) and δ^2s indicated that the important role in the inheritance of fruit weight and plant spread was played by additive gene action in both the generations. Similar results of gene action for these traits were also reported by **Dixit *et al.* (1984), Gopinath and Mahalageri (1986), Nualsri *et al.* (1986), Vadivel and Babu (1993), Ingale and Patil (1997) and Singh *et al.* (2002).**

The predominant role of non-additive gene action in F_1 and additive gene action in F_2 was observed for plant height and length of fruit. The difference in estimates obtained in F_1 and F_2 generations grown in the same environment may be attributed to the restricted sampling in the total variability to be expected in the F_2 generation and it may be due to coupling phase of linkage. **Robinson *et al.* (1960)** stated that if there was preponderance of repulsion phase linkage, additive genetic variance could increase, as the generations advanced; and if the linkage phase was predominantly coupling, additive genetic variance could decrease. **Gopinath and Mahalageri (1986), Nualsri *et al.* (1986) and Vadival and Babu (1993)** have also reported additive gene action for plant height and length of fruit. Contrary to this non-additive gene action for these traits were also reported by **Dixit *et al.* (1984), Singh and Mital (1988) and Das and Barua (2001).**

For days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant, width of fruit and yield per plant the ratio ($\delta^2 g/\delta^2 s$) value less than one indicated the predominance of non-additive gene action in the inheritance of these traits. **Sidhu *et al.* (1980)** and **Singh and Mital (1988)** for days to flowering and yield per plant; **Dixit *et al.* (1984)** for number of fruits per plant and yield per plant; **Ingale and Patil (1997)** for width of fruit and yield per plant and **Patil *et al.* (2000)** for number of fruits per plant have also reported the similar results.

We might briefly consider the implication of information gathered from this study on breeding procedures. The characters, plant height, length of fruit, fruit weight and plant spread were predominated by additive gene action. To exploit additive genetic variance in the improvement of such characters, pedigree method involving selection based on progeny performance can be used. However, it has been a general observation in self-pollinated crop that additive genetic variance fix rapidly after F_2 generation resulting in restricted recombination. Linkage may also cause bias in the estimates derived from early generations, since linkage equillibrium is improbable **(Mather, 1949; Comstock and Robinson 1952).** The dominance of additive effects for all yield components suggested that single plant selection in the early segregating generations of cross would be highly effective in aubergine **(Singh *et al.* 2002).**

Days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant, width of fruit and yield per plant have been shown preponderance of non-additive gene action. Conventional breeding methods exploit only that portion of genetic variability which is due to additive and additive x additive type of gene action. The presence of predominantly large amount of non-additive gene action due to dominance, additive x dominance and dominance x dominance, would necessiate the maintenance of heterozygosity in the population. These type of gene action are non fixable. Therefore, breeding methods such as biparental mating followed by recurrent selection may hasten the rate of genetic improvement for these characters. These procedures, though difficult to be followed in self-pollinated crops, have the promise to give encouraging results **(Andrus, 1963; Singh, 1974).**

DEGREE OF DOMINANCE :

In addition to other genetic parameters, the average degree of dominance is also of interest to plant breeders **(Gardner, 1963)**. The degree of dominance in the present investigation has been estimated as $(\bar{\sigma}^2_s/\bar{\sigma}^2_g)^{0.5}$. This formula is based on the assumptions that the genes are isodirectionally distributed among the parents and all the increments have the same sign **(Kempthorne and Curnow, 1961)**. This procedure, thus measures only the degree of dominance regardless of direction. If the dominance effect is in the plus and minus directions, the trend to cancel each other, then F_1 may be equal to the mean of its better parent.

It was seen that out of ten characters, fruit weight and plant spread with ratio $(\delta^2 s/\delta^2 g)^{0.5}$ value less than one in both the generations reflected partial dominance. These results are in accordance with the findings of **Dixit *et al.* (1984)** for fruit weight and plant spread. The characters plant height and length of fruit showed change of over dominance to partial dominance from F_1 to F_2 generation. It is in agreement with the genetic analysis, which indicated non-additive gene action in F_1 and additive gene action in F_2 for these traits. **Comstock and Robinson (1952)** reported that the degree of dominance might be biased upward either by linkage or epistasis or both. Experimental evidence indicating linkage bias was also provided by **Comstock *et al.* (1957), Gardner and Lonnquist (1959), Robinson *et al.* (1960), Robinson and Moll (1963), Moll *et al.* (1964) and Williams *et al.* (1965).** Partial dominance was also reported by **Singh *et al.* (1982)** for length of fruit and Dixit *et al.* (1984) for plant height.

Major role of over dominance was observed for days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant, length of fruit, width of fruit and yield per plant in both the generations. These findings are in agreement with those of **Singh *et al.* (1982)** for all the characters except length of fruit and **Dixit *et al.* (1984)** for yield per plant.

GENERAL COMBINING ABILITY EFFECTS :

The knowledge of combining ability effects alongwith the mean performance is of paramount importance to the breeders, because it assists him in the isolation of suitable germplasm base for their utilization in the subsequent breeding programme. Ranking of the good general combiners in

F_1, F_2 and over the generations for different metric traits is furnished in Table13.

In present investigation the parents differed significantly in their gca effects and none of them exhibited high general combining ability for all the characters. Among the female lines, KS 253 and KS 244 for days to flowering; KS 247, KS 253 and KS 228 for days to marketable maturity; KS 262, KS 233, KS 219, ACC 8207, KS 250 and KS 253 for plant height; ACC 2623 for number of branches per plant; KS 228, KS 227 and KS 219 for number of fruits per plant; KS 262, KS 247 and KS 263 for plant spread and KS 219, KS 228, KS 263, KS 227 and KS 247 for yield per plant were good general combiners in both the generations. Further, it was observed that the female line KS 247, beside being good general combiner for yield per plant was also good combiner for days to flowering, days to marketable maturity and plant spead.

Among the male parents, KS 224 for days to flowering and days to marketable maturity; KS 224 and T 3 for plant height; T 3 for number of branches per plant, number of fruits per plant, width of fruit and yield per plant; DBR 8 for length of fruit ; T 3 and AB 1 for fruit weight and AB 1 and DBR 8 for plant spread were superior general combiners in both the generations. **Kumar and Ram (1987)** also reported that T 3 was best general combiner among the parents.

Overall, among females, KS 219, KS 247 and KS 228 and among males, T 3 and KS 224 were good general combiners for one or more characters in desirable direction . The ranking of the parents on the basis of gca and *per se* performance was almost the same for most of the characters. This finding indicated that the mean performance might have predicted value for gca effects. **Bhutani *et al.* (1980) Dixit *et al.* (1982), Mishra and Mishra**

Table 13. : Desirable parents on the basis of *per se* performance and gca effects for ten characters in egg plant.

Character		Superior parent based on *per se* performance	Good general combiners		Common parents based on *per se* performance and gca effects in F_1 an
			F_1	F_2	
Days to flowering	F	KS 219, KS 253, KS 247, ACC 8206, KS 227, KS 228	KS 253, KS 247	KS 219, KS 247, KS 253	KS 253, KS 247
	M	KS 224, DBR 8	KS 224	KS 224	KS 224
Days to marketable maturity	F	KS 219, KS 247, KS 253, KS 228	KS 247, KS 253, KS 228, KS 219	KS 247, KS 253, KS 228	KS 247, KS 253, KS 228
	M	KS 224, DBR 8	KS 224	KS 224	KS 224
Plant height	F	KS 219, KS 233, KS 262, KS 227, ACC 8207, KS 250	KS 262, KS 233, KS 227, KS 228, KS 219, ACC 8207, KS 250, KS 253, KS 235	KS 262, KS 253, KS 233, KS 250, KS 219, ACC 8307	KS 262, KS 233, KS 219, ACC 8207, KS 250, KS 253
	M	KS 224, DBR 8	KS 224, T 3	T 3, KS 224	T 3, KS 224
Number of branches per plant	F	KS 2623, KS 228, KS 247,	ACC 2623, KS 219, KS 247	ACC 2623	ACC 2623
	M	T 3 DBR 8	T 3	T 3	T 3
Number of fruits per plant	F	KS 253, KS 247, KS 219, KS 227	KS 228, KS 227, KS 263, KS 219 KS 235	KS 227, KS 228, KS 219 KS 247	KS 228, KS 227, KS 219
	M	DBR 8 T 3, AB 1	T 3	T 3	T 3
Length of fruit	F	KS 235, KS 227, KS 250	KS 262, KS 233	-	-
	M	DBR 8, T 3	DBR 8	DBR 8	DBR 8
Width fruit	F	ACC 5114, KS 262, KS 247, KS 253, KS 233	KS 263, KS 235	-	-
	M	AB 1, T 3	T 3	T 3	T 3
Fruit weight	F	KS 250, ACC 2623, KS 263	-	ACC 8207	-
	M	AB 1 T 3, KS 224	T 3, AB 1	T 3, AB 1	T 3, AB 1
Plant spread	F	KS 262, KS 233, KS 263, KS 228, KS 235, KS 247, KS 253, KS 250, KS 227	KS 262, KS 233, KS 247, KS 263, KS 235	KS 247, KS 262, KS 263	KS 262, KS 247, KS 263
	M	-	AB 1, KS 224, DBR 8	AB 1, KS 224, DBR 8	AB 1, KS 224, DBR 8
Yield per plant	F	-	KS 219, KS 228, KS 235, KS 263, KS 227, KS 247	KS 219, KS 247, KS 228, KS 263, KS 227	KS 219, KS 228, KS 263, KS 227, KS 247
	M	T 3, AB 1, KS 224, DBR 8	T 3	T 3	T 3

(1990), Prakash *et al.* **(1994),** Kumar *et al.* **(1996), Babu and Thirumurugan (2001) and Das and Barua (2001)** also observed similar trend between gca effect and *per se* performance.

High general combining ability effects observed for different characters of economic importance may be useful for sorting out outstanding parents with favourable alleles for the different components of yield. The effect includes additive and additive x additive components of gene action which represent fixable genetic effect. **(Griffing, 1956a, 1956b; Sprague, 1966; Gilbert,1967)** also stated that the additive parental effects as measured by gca effects are of practical use to plant breeders, since non-allelic interaction are unpredictable. As aforesaid parents having good gca effects are superior to the rest for many characters, a multiple crossing programme or an intermating population involving all possible crosses among them subjected to biparental mating may be expected to offer the maximum promise in breeding for high yield. Selection for economic traits in such a population is likely to result worthwhile gain the yield potential. The scheme of diallel selective mating system proposed by **Jensen (1970)** for cereal breeding can also be employed successfully for the present material. This method provides to combine the favourable gene or gene complexes by the use of series of multiple crosses which would supplement speedy recombination and also break genetic barriers, if present.

SPECIFIC COMBINING ABILITY EFFECTS :

The sca effects normally did not contribute considerably in the improvement of self-pollinated crops, except where commercial utilization of heterosis is feasible. However, in the production of homozygious lines breeders interest is usually confined upon transgressive segregation shown in the crosses. The good specific combiners are presented in Table 14. In order to select out best specific combiners which may result desirable segregants in

Table 14. Good specific combiners in F_1, F_2 and over the generations in egg plant.

Characters	F_1	F_2	Common in F_1 and F_2
Days flowering	KS 247 x DBR 8, KS 253 x KS 224 x KS 5233 x T 3, ACC 2623 x KS 224, KS 262 x T 3, KS 227 x T 3	ACC8206 x KS224, KS227 x DBR8, KS263 x T3	ACC 5114 x AB 1, KS 250 x T 3
Days to marketable maturity	KS 227 x T 3, KS 247 x DBR 8, KS 250 x T 3, KS 235 x KS 224, KS 247 x AB 1	ACC8206 x KS224, KS253 x AB1, KS263 x T3, KS227 x DBR8, ACC8207 x KS224	ACC 2623 x KS 224, ACC 5114 x AB 1
Plant height	KS 247 x DBR 8, ACC 8206 x DBR 8, KS 235 x KS 224, KS 219 x KS 224, KS 263 x DBR 8	ACC5114 x DBR8, KS235 x DBR8, KS227 x KS224	ACC 8204 x AB 1, ACC 2623 x T 3, KS 219 x T ACC 8207 x KS 224, KS 253 x DBR 8
Number of branches per plant	KS 263 x AB 1, ACC 8204 x T 3, KS 228 x AB 1, ACC 8207 x T 3, KS 253 x T 3	KS250 x KS224, ACC8206 x T3	KS 253 x T 3
Number of fruits per plant	KS 233 x T 3, KS 262 x DBR 8	ACC 2623 x T 3 ACC 5114 x KS 224	KS 227 x AB 1, ACC 8206 x T 3, KS 228 x AE KS 263 x AB 1, KS 250 x KS 224
Length of fruit	KS 263 x T 3, ACC 5114 x KS 224 KS 262 x AB 1	-	-
Width of fruit	ACC 2623 x T 3, KS 263 x AB 1, KS 233 x T 3, KS 235 x T 3, ACC 8207 x DBR 8,	-	-
Fruit weight	KS 263 x AB 1, KS 219 x AB 1, ACC 8204 x T 3, KS 253 x KS 224, KS 228 x AB 1	KS 233 x T 3, KS 250 x DBR 8	KS 247 x KS 224
Plant spread	KS 227 x AB 1, KS 247 x T 3, KS 219 x DBR 8, KS 263 x AB 1, KS 219 x KS 224	KS 235 x KS 224	-
Yield per plant	KS 219 x T 3, KS 263 x AB 1, ACC 2623 x T 3, KS 250 x AB 1, ACC 8207 x T 3	ACC 8204 x T 3	KS 219 x AB 1, KS 263 x AB 1, KS 233 x T KS 228 x AB 1, KS 227 x AB 1

segregating generations it becomes necessary to select such derivatives as are desirable from F_1 to F_2 generation. The cross combinations exhibiting higher estimates of significant and desirable sca effects common in both the populations were ACC 5114 x AB 1 and KS 250 x T 3 for days to flowering; ACC 2623 x KS 224 and ACC 5114 x AB 1 for days to marketable maturity; ACC 8204 x AB 1, ACC 2623 x T 3, KS 219 x T 3, ACC 8207 x KS 224 and KS 253 x DBR 8 for plant height; KS 253 x T 3 for number of branches per plant; KS 227 x AB 1, ACC 8206 x T 3, KS 228 x AB 1, KS 263 x AB 1 and KS250 x KS 224 for number of fruits per plant; KS 247 x KS 224 for fruits weight and KS 219 x AB 1, KS 263 x AB 1, KS 233 x T 3, KS 228 x AB 1 and KS 227 x AB 1 for yield per plant. All these common crosses over the generations are indicative of additive x additive type of gene interactions for the expression of different traits. Crosses KS 263 x AB 1, KS 228 x AB 1 and KS 227 x AB 1 besides being good specific combiners for yield per plant were superior over the generations for most important yield trait, i.e., number of fruits per plant. Rest of the crosses for different characters, having high sca in F_1, failed to repeat its performance in F_2 reflecting the presence of dominance and epistatic types of gene action.

HETEROSIS AND INBREEDING DEPRESSION :

The magnitude of heterosis has been measured by different workers in different ways, such as the superiority of F_1s over the mid-parent, better parent and standard variety. Heterosis which is measured as mean superiority of F_1s over the standard variety is thus, an important and desirable parameter in such studies and would be deciding factor for practical purposes. Keeping in view, the present study was carried out to workout the mean superiority of F_1s over the standard variety (T 3). It may however, be in mind that the *per se* performance, being the realized value and the heterotic response being an estimate the former should also be given due consideration than latter while making the selection on cross combinations.

In general, considerable amount of desirable heterosis was observed for most of the characters, namely, days to flowering, days to marketable maturity, plant height, number of branches per plant, number of fruits per plant, length of fruit, width of fruit, fruit weight, plant spread and yield per plant in present study, but none of the crosses exhibited significant desirable heterosis for all the characters. Crosses, KS 219 x T 3, KS 219 x AB 1, KS 223 x T 3, KS 247 x T 3, KS 228 x AB 1, KS 253 x T 3, KS 263 x AB 1, KS 227 x AB 1, ACC 2623 x T 3, ACC 8207 x T 3, ACC 8206 x T 3, KS 235 x KS 224, KS 250 x AB 1, ACC 8204 x T 3 and KS 262 x DBR 8 showed significant heterosis for yield per plant. An insight over the superior heterotic crosses for yield per plant in relation to other genetic parameters (Table 15) indicated that all the superior crosses exhibited significant inbreeding depression in F_2 generation. Thus to exploit heterotic effect in F_1 generation and to avoid the deterioration in yield performance in F_2, the development of hybrids at commercial scale in egg plant is suggested. **Singh (1984)** also advocated the exploitation of heterosis in F_1 hybrids. Further it is evident that superior crosses for yield per plan. involved high x high, high x low and low x low general combiners and have a positive correlation with sca effects. Besides yield, superior crosses also showed desirable and significant heterosis for one or more yield components. Among the yield components, crosses KS 247 x DBR 8, KS 235 x KS 224, KS 227 x T 3, KS 253 x T 3 and KS 227 x AB 1 for days to flowering; KS 235 x KS 224, KS 247 x DBR 8, KS 227 x T 3, KS 228 x DBR 8 and KS 253 x T 3 for days to marketable maturity; KS 233 x T 3, KS 227 x T 3, KS 235 x KS 224, KS 262 x DBR 8 and KS 228 x DBR 8 for plant height; KS 247 x T 3, KS 235 x T 3, ACC 8206 x T 3, KS 263 x AB 1 and KS 227 x AB 1 for number of branches per plant;

Table 15. Superior heterotic crosses for yield per plant in relation to other genetic parameters in egg plant.

Superior heterotic crosses for yield per plant	Inbreedig depression	gca of parents		Sca effects	Heterosis for related traits
		P_1	P_2		
KS 219 x T 3 (69.23**)	30.96**	0.43**	0.43**	0.28**	I(-18.31**), II(-14.12**), IX(-13.54**)
KS 219 x AB 1 (68.72**)	26.44**	0.43**	0.04	0.67**	I(-17.32**), II(-12.21**), VIII(8.82*), IX(-32.29**)
KS 233 x T 3 (66.15**)	30.25**	0.09	0.43**	0.56**	I(-15.34**), II(-13.35**), III(-15.29**), V(85.29**), VIII(8.33*), IX(-28.13**)
KS 247 x T 3 (56.41**)	16.72**	0.15**	0.43**	0.31**	I(-17.32**), II(-16.41**), IV(34.89**), V(72.34**), IX(-30.21**)
KS 228 x AB 1 (55.90**)	25.99**	0.26**	0.04	0.59**	I(-17.32**), II(-16.79**), V(78.15**), IX(-45.83**)
KS 253 x T 3 (54.87**)	25.85**	0.02	0.43**	0.41**	I(-20.79**), II(-19.08**), V(73.12**)
KS 263 x AB 1 (54.36**)	24.25**	0.21**	0.04	0.61**	I(-15.83**), II(-14.12**), IV(28.75*), V(76.15**), VII(21.67**), VIII(9.70*), IX(-55.21**)
KS 227 x AB 1 (49.23**)	22.68**	0.20**	0.04	0.51**	I(-20.79**), II(-111.89**), IV(27.27**) V(16.82**), IX(-53.13**),
ACC 2623 x T 3 (36.41**)	31.95**	-0.30**	0.43**	0.37**	I(-8.91**), II(-6.48**), IV(25.80**), V(47.82**), VIII(8.82*), IX(-17.71**)
ACC 8207 x T 3 (35.38**)	25.38**	-0.21**	0.43**	0.26**	I(-13.37**), II(11.06**) V(45.28**), IX(-17.71**)
ACC 8206 x T 3 (31.28**)	14.06**	-0.24**	0.43**	0.21**	I(-9.40**), II(-5.34*), IV(13.82*), V(73.49**), (8.29*), IX(-11.46**)
KS 235 x KS 224 (27.69**)	18.88**	0.25**	-0.25**	0.32**	I(-23.26**), II(-27.09**), III(-11.73**), V(32.51*), IX(-46.88**)
KS 250 x AB 1 (26.67**)	32.39**	-0.00	0.04	0.36**	I(-14.35**), II(-15.26**), IX(-50.00**)
ACC 8204 x T 3 (26.67**)	11.74**	-0.28**	0.43**	0.16	I(-9.40**), II(-5.73*), IV(33.30**), V(56.60**), VIII(10.23**), IX(-16.67**)
KS 262 x DBR 8 (17.44**)	20.09**	-0.10*	0.21**	0.45**	I(-13.37**), II(-11.45**), III(-11.29**), V(55.15**), IX(-51.04**)

* Significant at 5 per cent level of significance. ** Significant at 1 per cent level of significance
I = Days to flowering, II= Days to marketable maturity, III= Plant height (cm), IV= Number of branches per plant, V=Number of fruits per plant
VI= Length of fruit (cm), VII=Width of fruit (cm), VIII=fruit weight (g), IX=Plant spread (m^2), X= yield per plant

KS 233 x T 3, KS 228 x AB 1, KS 263 x AB 1, ACC 8206 x T 3 and KS 253 x T 3 for number of fruits per plant; KS 263 x AB 1 and KS 235 x T 3 for width of fruit; ACC 8204 x T3, KS 263 x AB 1, KS 219 x AB 1, ACC 2623 x T 3 and KS 233 x T 3 for fruit weight; KS 263 x AB 1, KS 227 x AB 1, KS 262 x DBR 8, KS 228 x DBR 8 and KS 250 x AB 1 for plant spread showed significant desirable heterosis over standard variety. Crosses, KS 262 x DBR 8 and KS 263 x T 3 for length of fruit had relatively good position with non-significant heterotic value. **Komochi (1966)** for plant height; **Ingale and Patil (1997)** for days to flowering, fruit yield, plant height, plant spread and fruits per plant; **Prasath *et al.* (2000)** for all the characters under study have also reported highly significant heterotic values in egg plant.

The superior combinations showing significant heterotic effect for different traits in F_1 generation also exhibited considerable inbreeding depression in F_2 generation. Crosses, KS 253 x T 3, KS 263 x KS 224 and KS 263 x DBR 8 for days to flowering; KS 247 x DBR 8, KS 253 x KS 224, KS 235 x KS 224 and KS 263 x KS 224 for days to marketable maturity; KS 247 x DBR 8 and KS 224 x DBR 8 for plant height; KS 227 x T 3, KS 235 x T 3, ACC 8204 x T 3 and KS 263 x AB 1 for number of branches per plant; KS 227 x AB 1, KS 233 x T 3, KS 219 x T 3, KS 262 x DBR 8 and ACC 2623 x T 3 for number of fruits per plant; ACC 8204 x T 3, KS 263 x AB 1, KS 219 x AB 1, ACC 2623 x T 3 and ACC 8206 x T 3 for fruit weight and KS 219 x T 3, KS 219 x AB 1, KS 233 x T 3, KS 235 x T 3 and KS 227 x T 3 for yield per plant showed significant inbreeding depression in F_2 indicating deterioration in performance in segregating generation. The crosses having heterotic effect in F_1 and significant inbreeding depression in F_2 reflected the role of non-additive gene action. The results are in the conformity with those of **Peter and Singh (1974),** for days to flowering and number of branches per plant; **Hani *et al.* (1977)** for yield per plant and **Singh (1984)** for all the characters.

HERITABILITY AND GENETIC ADVANCE :

Heritability is one of the most important selection parameter for the breeders, because it indicates the extent to which the improvement of a population is possible through selection (**Robinson, 1949**). The heritability estimate in the population, influence the gains to be achieved from the selection. The genetic advance is yet another important selection parameter, which is not independent, and represents the expectation of genetic gain under selection. It has an added advantage over heritability as guiding factor to breeders in selection programmes where the improvement of character(s) is desired through segregating generations.

In order to streamline the coherent selection breeding programme, **Johnson *et al.* (1955)** pointed out that genetic gain should be considered along with heritability, since the estimates of heritability alone would not be of practical utility in selection based on phenotypic appearance.

In the present study heritability was high for plant spread, plant height, yield per plant, fruit weight, days to marketable maturity, number of fruits per plant, days to flowering and number of branches per plant in both the generations, indicating that these characters were largely influenced by additive gene action. High heritability estimates were also exhibited by length of fruit and width of fruit only in F_1 generation. This indicated the primary control of additive gene action. These results are in conformity, with those of **Dheshi *et al.* (1964), Mehrotra and Dixit (1977), Vadivel and Babu (1989), Mohanty (1999), Patel *et al.* (1999), Rai *et al.* (1999), Singh and Gopalakrishnan (1999), Negi *et al.* (2000) and Sharma *et al.* (2002)** for days flowering, days to first harvest or picking, plant height, number of branches per plant, number of fruits per plant, fruit length, fruit diameter, fruit weight, plant spread and yield.

The estimate value of expected genetic advance in percentage of mean was high for fruit weight, plant height, days to marketable maturity and days to flowering in both the generations. Similar results were also reported for days to flower, days to first harvest, plant height, number of branches per plant, number of fruits per plant, fruit length, fruit weight and yield by **Singh *et al.* (1974), Vadivel and Babu (1994), Mohanty (1999), Patel *et al.* (1999), Rai *et al.* (1999), Singh and Gopala Krishnan (1999), Negi *et al.* (2000) and Sharma *et al.* (2002).**

High heritability coupled with high genetic advance was exhibited by characters days to flowering, days to marketable maturity, plant height and fruit weight and thus improvement can be done through selection for these traits. Rest of the traits showed either high heritability and low genetic advance or vice versa indicating that improvement could not be achieved through selection. These results are in accordance with the previous findings of **Mishra and Roy (1976), Mehrotra and Dixit (1977), Gopimony *et al.* (1986), Nainar *et al.* (1991), Vadivel and Babu (1994), Mohanty (1999), Patel *et al.* (1999) and Singh and Gopalakrishnan (1999).**

CORRELATION COEFFICIENTS :

The knowledge of correlation between yield and its components may give valuable indications regarding the components on which selection pressure could most profitably be exercised in order to obtain an increase in yielding ability **(Grafius, 1964).**

Understanding of the genotypic correlation between characters is of theoretical interest because a genotypic correlation may derive from genetic linkage, pleiotropy or developmentally induced relationship between components that are indirectly the consequence of gene interaction. The significance of genotypic associations could not be tested as no suitable statistical test is available **(Nasar *et al.* 1973),** yet their magnitude is considered in relation to the corresponding phenotypic estimates.

In the present study, in general, genotypic correlation coefficients were higher than phenotypic correlation coefficients suggesting inherent relationship in different genotypes. This is not unusual in egg plant and has earlier been reported by **Prabhu (1974), Singh and Khanna (1978)** and **Sharma *et al.* (2002).**

At genotypic level, the coefficient of correlations of yield per plant were consistently strong and positive with number of fruits per plant, number of branches per plant, width of fruit, plant spread and fruit weight in parents, F_1s and F_2s; length of fruit in F_1 and F_2; and days to flowering and days to marketable maturity in F_1 only. It is interesting to note that yield per plant had either weak or negative association with plant height in all the populations; and days to flowering and length of fruit in parents only. Further, the significant and positive association of yield per plant with number of fruits per plant in all the populations; plant spread in parents and F_1s; number of branches per plant and fruit weight in F_1 and F_2; and width of fruit and length of fruit only in F_1 progenies while plant height in F_1 and F_2 exhibited negative and significant correlation with yield at phenotypic level indicated the role of environment for these associations. Significant and negative association of yield with plant height indicated better yield from dwarf plant type. These findings concorded well with the earlier results of **Hiremath and Rao (1974), Singh and Nandpuri (1974), Sinha (1983), Chadha *et al.* (1984), Krusteva (1985), Sharma *et al.* (1985), Nualsri *et al.* (1986), Khurana *et al.* (1988), Randhawa *et al.* (1989), Kumar *et al.* (1990), Mishra and Mishra (1990), Vadivel and Babu (1990), Guatam and Srinivas (1992), Usha Kumari and Subramanian (1993), Kumar (1995), Sanwal *et al.* (1998), Mohanty (1999), Negi *et al.* (1999), Singh and Singh (2001)** and **Sharma *et al.* (2002)** for different traits. Due to weak or negative correlation of yield per plant with plant height and days to marketable maturity it is expected that early maturing types will favour the higher production but it would be contrary to said notions of better production by late maturing types. Thus, results indicated that high yield is not favoured by earliness but it was due to strong association of days to maturity with other yield components. Therefore, selection pressure should be exercised in favour of medium plant height, number of branches per plant, number of fruits per plant and fruit weight which could ultimately result in higher yield per plant.

When relationship among the component traits were reviewed, it was found that at genotypic level days to flowering had strong positive association with days to marketable maturity and number of branches per plant in all the three populations; fruit weight and plant spread in parents and F_1s; number of branches per plant and width of fruit in F_1 and F_2; plant height in parent; and length of fruit in F_2 population. Days to marketable maturity showed high positive association with number of branches per plant and plant spread in parents, F_1s and F_2s; fruit weight in parent and F_1; width of fruit and number of fruits per plant in F_1s and F_2s; plant height and length of fruit in parents and F_2 generation. Plant height exhibited positive relationship with number of branches per plant, plant spread and fruit weight in parents; length of fruit in parents and F_1; and width of fruit in parent and F_2. Number of branches per plant showed positive and high magnitude of association with number of fruits per plant, width of fruit, length of fruit and plant spread in all the three populations; and with fruit weight in F_1 and F_2. Width of fruit and plant spread in parents, F_1s and F_2s and length of fruit and fruit weight in F_1 and F_2 exhibited comparatively strong and positive association with number of fruits per plant. The length of fruit had positive correlations with fruit weight in parent, F_1 and F_2 and with width of fruit and plant spread in F_1s and F_2s. The strong positive association was also observed between width of fruit and plant spread, fruit weight; fruit weight and plant spread in all the populations. At phenotypic level, positive and significant associations were recorded by days to flowering with days to marketable maturity in all the three populations; with number of branches per plant and plant spread in F_1s and with fruit weight in parents. Days to marketable maturity showed significant positive association with plant spread and number of branches per plant only in F_1s. Number of branches per plant exhibited significant positive relationship with plant spread in parent and F_1; with number of fruits per plant in F_1 and F_2; with fruit weight and width of fruit in F_1, while number of branches per plant had positive and significant association with plant spread in parents. Length of fruit showed positive and significant association with width of fruit in all the three population; with fruit weight in F_1 and F_2; and with plant spread only in F_2. Width of fruit had significant positive association with fruit weight in F_1 and F_2, while fruit weight also showed positive and significant association with plant spread. Such associations of days to flowering and days to marketable maturity with different traits confirmed the said notions as it is expected that late maturing types would get more period for vegetative development resulting in taller plant height and more number of branches per plant towards higher yield. Similar findings on associationship with different traits were also reported by **Singh and Nandpuri (1974), Singh and Khanna (1978), Khurana *et al.* (1988), Nainar *et al.* (1990), Guatam and Srinivas (1992), Usha Kumari and Subramanian (1993), Negi *et al.* (1999) and Sharma *et al.* (2002).**

Among component traits, plant height with number of fruits per plant in parent, F_1 and F_2; with width of fruit in F_1 and with plant spread in F_2 reflected strong and negative association at genotypic level, while at phenotypic level, plant height also exhibited significant and negative correlation with number of fruits per plant in F_2 population. The strong and negative correlations were observed for days to flowering and days to marketable maturity with number of fruits per plant; number of fruits per plant with length of fruit and fruit weight; and length of fruit with width of fruit in parents at genotypic level. Similar findings were reported by **Hiremath and Rao (1974), Khurana *et al.* (1988), Mishra and Mishra (1990) and Negi *et al.* (1999).**

Over all, it is concluded that for getting higher yield, selection should be emphasized on dwarf plant height, more number of branches per plant, number of fruits per plant and fruit weight in this crop. However, as regards to character plant height, medium tall plant height should be taken into consideration rather than much more tall or dwarf.

PATH COEFFICIENT ANALYSIS :

Yield is a complex character controlled by many factors. Selection for desirable types should not only be restricted to yield alone, but component traits related to yield should also be considered. Since association measures the relationship between any two characters and does not indicate the relative importance of each character, a study was conducted to find out the efficiency of selections for yield improvement based on yield components. Under such situation, path coefficient analysis provides a means of measuring the direct as well as indirect effects of a variable *via* other variables on the end product.

The result of path coefficient analysis (Table 12) revealed that having higher positive direct effect, number of fruits per plant was the most important character followed by fruit weight in F_1 and F_2 at both genotypic and phenotypic level, while at genotypic level, days to flowering in F_1 and F_2; width of fruit and plant height in parents; and number of branches per plant and length of fruit in F_2 generation exhibited high positive direct effect on yield per plant. Days to marketable maturity in F_1 and F_2; number of branches per plant and length of fruit in F_1; and width of fruit in F_2 had direct negative effect on yield per plant at genotypic level, wheras days to marketable maturity in F_1 and plant height in F_2 population also showed negative direct effect on yield per plant at phenotypic level. The negative direct effect of plant height and negative indirect effects *via* other traits contributed to negative correlation of plant height with yield per plant and this resulted higher yield from dwarf plant types. The earlier workers, viz., **Singh (1983), Randhawa *et al.* (1989), Mishra and Mishra (1990), Vadivel and Babu (1990), Usha Kumari and Subramaniam (1993), Mohanty (1999) and Mohanty (2001)** reported similar results with respect to different traits.

The genotypic and phenotypic path revealed that the highest positive indirect effects on yield per plant were recorded by days to flowering *via* number of fruits per plant (except F_2 at phenotypic level), by days to marketable maturity and number of branches per plant *via* number of fruits per plant, by length of fruit *via* fruit weight in F_1 and F_2 generations. Width of fruit contributed *via* number of fruits per plant (except F_2 at phenotypic level) and fruit weight, and plant spread exerted its effect *via* number of fruits per plant and fruit weight (except F_2 at phenotypic level) in F_1 and F_2 populations. Besides, genotypic path revealed that indirect effect in positive direction on yield per plant was shown by days to marketable maturity *via* days to flowering in F_1 and F_2 and *via* number of branches per plant in F_2. Number of branches per plant exhibited positive indirect effect *via* fruit weight and width of fruit in F_1 progenies. Number of fruits per plant had positive indirect effect *via* fruit weight and width of fruit in F_1 and *via* number of branches per plant in F_2. Length of fruit contributed positively *via* number of fruits per plant in F_1 and F_2 and *via* number of branches per plant only in F_2. The high order of indirect positive effect on yield per plant was recorded by width of fruit, fruit weight and plant spread *via* number of branches per plant and length of fruit in F_2

populations. At phenotypic level, number of branches per plant contributed *via* fruit weight in F_2. Fruit weight also had positive indirect effect *via* number of fruits per plant on yield per plant. **Mishra and Mishra (1990)** also reported high indirect effect of number of fruits per plant, fruit weight and branches per plant on yield per plant. Contribution of number of fruits per plant *via* number of branches per plant, plant height and length of fruit were also reported.

The strong negative indirect effect were recorded by days to flowering *via* days to marketable maturity in both the generations, *via* number of branches per plant in F_1 progenies. Number of branches per plant showed negative effect *via* days to marketable maturity in both F_1 and F_2 and *via* length of fruit in F_1. Number of fruits per plant and length of fruits negatively contributed to yield per plant *via* days to marketable maturity in F_2 and *via* number of branches per plant in F_1 generation at genotypic level. Width of fruit had negative indirect effect on yield per plant *via* days to marketable maturity in F_2 and *via* number of branches per plant and length of fruit in F_1 generation at genotypic level. Negative and indirect effect on yield per plant was also reported by fruit weight *via* number of branches per plant and length of fruit in F_1 and *via* width of fruit in F_2 populations. Plant spread contributed negatively *via* number of branches per plant in F_1 at genotypic level. Thus on the basis of path analysis it was observed that character number of branches per plant, number of fruits per plant, plant height and fruit weight were major contributors resulting desirable correlations with yield per plant.

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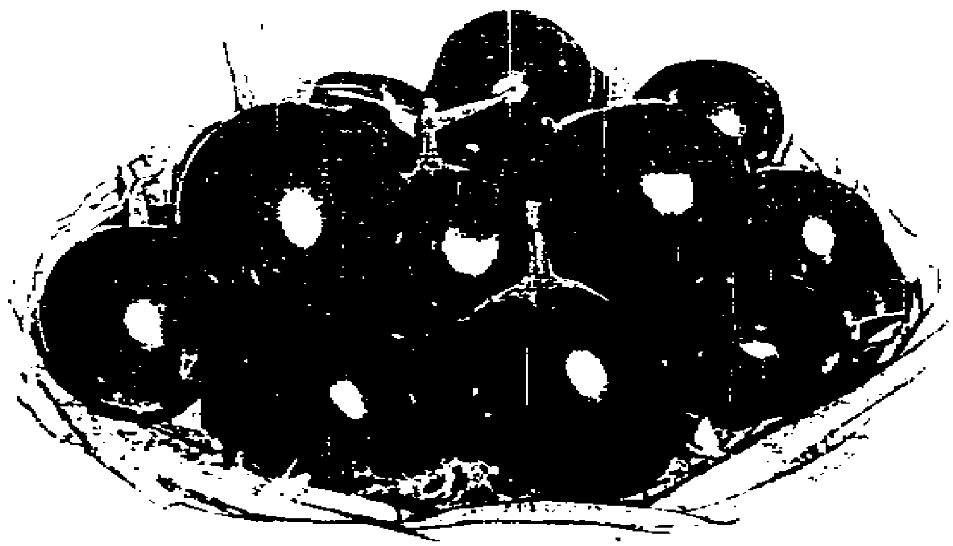
CHAPTER -VI

SUMMARY



Chapter-VI

SUMMARY

The present investigation, "Line x tester analysis for combining ability in egg plant (*Solanum melongena* L.)" was carried out to know the genetic architecture of yield contributing traits by computing variability, combining ability variances and effects, degree of dominance, heterosis and inbreeding depression, heritability and genetic advance and correlation and path coefficients involving fifteen lines (females) and four testers (males), as per procedure of **Kempthorne, (1957).**

The experiment, comprising 19 parents (15 lines and 4 testers), 60 F_1s and 60F_2s, was laid out during *Kharif*, 2003-04 in a randomized block design with three replications at Vegetable Researh Station, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The observations were recorded for 10 characters, viz., days to flowering, days to marketable maturity, plant height, number of branches per plant, number of fruits per plant, length of fruit, width of fruit, fruit weight, plant spread and yield per plant. The data recorded on these characters were subjected to different biometrical analyses as mentioned above. The results obtained on related aspects are summarized here under :

The anlaysis of variance showed that variances due to parents, F_1s and F_2s were significant for all the characters except width of fruit offering reasonable variability to carry out genetic studies. The effect related to parents vs F_1s and F_1s *vs.* F_2s were also significant for all the characters except number of branches per plant.

High magnitude of variability was observed in the mean performance of parents, F_1s and F_2s for number of branches per plant, number of fruits per plant, length of fruit, width of fruit and yield per plant.

The analysis of variance for combining ability revealed significant differences among female and male genotypes in respect of gca for all the characters except width of fruit and fruit weight in F_1 and F_2 and length of fruit in F_2 generation among females. The differences among hybrids due to interaction between females and males in respect of sca were also found significant for all the characters. The estimated components of variance showed that additive gene action was predominant in the inheritance of fruit weight and plant spread in both the generations, while non-additive gene action played a major role for days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant, width of fruit and yield per plant. For plant height and length of fruit non-additive and additive gene action was observed in F_1 and F_2 generations, respectively.

Average degree of dominance showed partial dominance for fruit weight and plant spread in both the generations. Over dominance was observed for days to flowering, days to marketable maturity, number of branches per plant, number of fruits per plant and yield per plant in both the generations and for width of fruit in F_1 generation. Plant height and length of fruit showed change of over dominance to partial dominance from F_1 to F_2 generations.

None of the parents was found to be a good general combiner for all the characters. Among female lines, KS 253 and KS 247 for early flowering; KS 247, KS 253 and KS 228 for early marketable maturity; KS 262, KS 233, KS 219, ACC 8207, KS 5250 and KS 253 for dwarf plant height; KS 228, KS 227 and KS 219 for more number of branches per plant; KS 262, KS 247 and KS 263 for compact plant type; KS 219, KS 228, KS 263, KS 247 and KS 297 for higher yield were good general combiners in both the generations. Among males, KS 224 for early flowering; KS 224 for early marketable maturity; KS 224 and T 3 for dwarf plant type; T 3 for more number of branches per plant; T 3 for more number of fruits per plant; DBR 8 for less fruit length; T 3 for wide fruit width; T 3 and AB 1 for fruit weight; AB 1, KS 224 and DBR 8 for compact plant spread and T 3 for high yield, were superior general combiners over the generations.

The study of sca effects also revealed that none of the crosses were good specific combiners for all the characters in both the generations. Most of the crosses which did well in F_1 failed to do so in F_2 and vice versa. The cross combinations exhibiting comparatively higher estimates of significant and desirable sca effects, common in both the generations, were ACC 5114 x AB 1 and KS 250 x T 3 for early flowering; KS 227 x KS 224 for late flowering; ACC 2623 x KS 224 and ACC 5114 x AB 1 for early marketable maturity; ACC 8204 x AB 1, ACC 2623 x T 3, KS 219 x T 3, ACC 5114 x ABR 8, ACC 8207 x KS 224 and KS 253 x DBR 8 for dwarf plant height; KS 227 x AB 1 and KS 219 x AB 1 for more number of branches per plant; KS 227 x AB 1, KS 228 x AB 1, KS 263 x AB 1, ACC 8206 x T 3, KS 253 x T 3, KS 247 x T 3, KS 219 x AB 1, ACC 8204 x T 3 and KS 250 x KS 224 for more number of fruits per plant; KS 247 x KS 224 for desirable fruit weight; KS 247 x T 3 for compact plant spread and KS 219 x AB 1, KS 233 x T 3, KS 247 x T 3, KS 228 x AB 1, KS 253 x T 3, KS 263 x AB 1, KS 227 x AB 1, ACC 8206 x T 3, KS 235 x KS 224, KS 262 x DBR 8, KS 250 x KS 224 and ACC 5114 x KS 224 for high yield.

The males contributed maximum in comparison to females for plant spread, fruit weight and width of fruit in both the generations. For plant height, days to marketable maturity, number of fruits per plant and days to flowering maximum contribution were showed by females than males in both the generations.

In general, considerable amount of desirable heterosis was observed for all the characters but none of the crosses exhibited heterosis for most of the characters. However, crosses, KS 247 x DBR 8, KS 235 x KS 224, KS 227 x T 3, KS 253 x T 3 and KS 227 x AB 1 for earliners; KS 235 x KS 224, KS 247 X DBR 8, KS 263 X DBR 8, KS 228 X DBR 8 and K S253 x T 3 for early days to marketable maturity; KS 233 x T 3, KS 227 x T 3, KS 235 x KS 224, KS 262 x DBR 8 and KS 247 x DBR 8 for dwarf plant height; KS 247 x T 3, KS 235 x T 3, KS 235 x KS 224, KS 263 x AB 1 and KS 227 x AB 1 for number of branches per plant; KS 233 x T 3, KS 228 x AB 1, KS 263 x AB 1, ACC 8206 x T 3 and KS 253 x T 3 for number of fruit per plant; KS263 x AB 1 and KS 235 x T 3 for width of fruit; ACC 8204 x T3, KS 263 x AB 1, KS 219 x AB 1, ACC 2623 x T 3 and KS 233 x T 3 for fruit weight; KS 263 x AB 1, KS 227 x AB 1, KS 262 x DBR 8, KS 228 x DBR 8 and KS 250 x AB 1 for plant spread and KS 219 x T 3, KS 219 x AB 1, KS 233 x T 3, KS 247 x T 3 and KS 228 x AB 1 for yield per plant exhibiting significant heterotic effects, were in order of merit.

Study revealed high heritability coupled with high genetic advance for days to flowering, days to marketable maturity, plant height and fruit weight both in F_1 and F_2 generations. Either low or medium heritability and genetic advance were observed for rest of the characters in either of the generations.

On the basis of gene actions, it is felt that improvement in egg plant may be made by adopting pedigree selection with intermating in early segregating populations; and biparental mating followed by recurrent selection procedure.

In general, genotypic correlation coefficients were higher than phenotypic correlation coefficients. Studies on associationship at genotypic level revealed positive and strong correlation of yield per plant with number of fruits per plant, number of branches per plant, width of fruit, plant spread and fruit weight in all the three populations; with length of fruit in F_1 and F_2 and with days to flowering and days to marketable maturity only in F_1 generations.

Negative association of plant height in all the three populations; and days to flowering and length of fruit in parents only with yield per plant was also observed. At phenotypic level, significant and positive association of yield per plant with number of fruits per plant in all the populations; plant spread in parent and F_1; number of branches per plant and fruit weight in F_1 and F_2; width of fruit and length of fruit in F_1 was observed. Plant height in F_1 and F_2 showed negative and significant correlation with yield per plant. Positive and significant association was found between yield per plant and number of fruits per plant, days to flowering and days to marketable maturity, and length of fruit and width of fruit in all the three populations.

Path coefficient analysis indicated that number of fruits per plant had highest direct / desirable effect on yield per plant followed by fruit weight in both F_1 and F_2 at genotypic and phenotypic levels, and days to flowering in F_1 and F_2 only at genotypic level. Hence, these traits could be considered as the most important yield contributing characters for direct selection in order to improve the yield. Traits, days to marketable maturity, number of branches per plant and plant spread *via* number of fruits per plant; length of fruit and width of fruit *via* fruit weight in F_1 and F_2 at genotypic and phenotypic level had high indirect effect on yield per plant. The higher magnitude of indirect effect on yield per plant was recorded by days to flowering *via* number of fruits per plant; days to marketable maturity *via* days to flowering; length of fruit and width of fruit *via* number of fruits per plant and plant spread *via* fruit weight in F_1 and F_2 only at genotypic level. This information may be utilized to improve the yield in egg plant through indirect selection for these traits.

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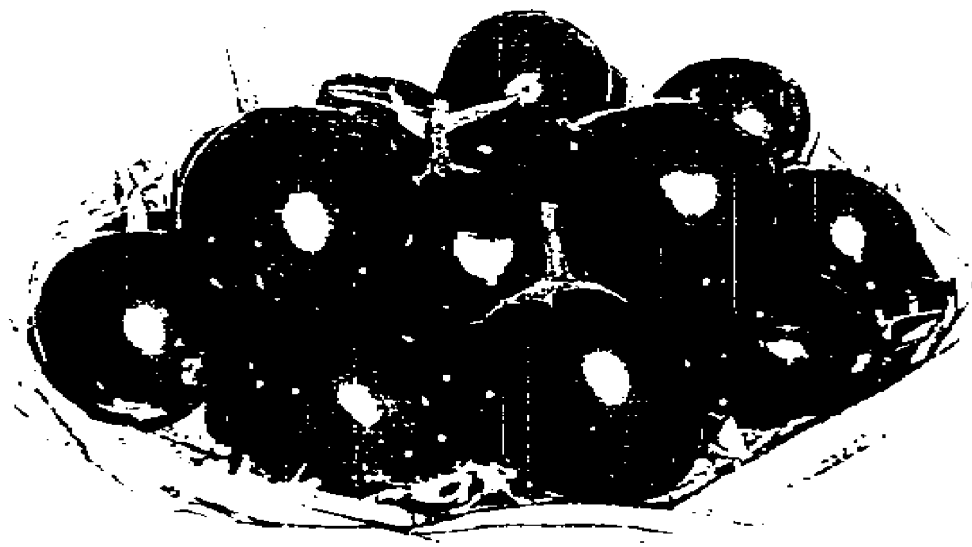

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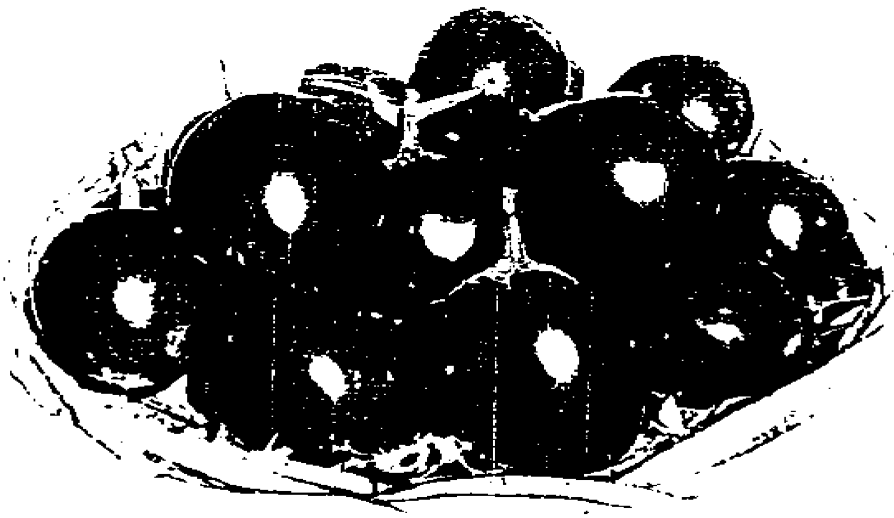
APPEDNDICES



Appendix I- Mean performance of parents for various characters in egg plant.

Parent	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m^2)	Yield per plant (kg)
Females										
KS 219	**38.67**	**51.33**	**59.73**	6.53	14.64	9.23	7.95	100.53	0.57	1.39
KS 247	40.67	54.33	94.10	8.37	15.30	9.55	8.33	94.17	0.48	1.20
KS 253	39.67	55.00	78.00	7.27	15.37	9.34	8.13	92.20	0.49	1.25
KS 262	59.33	75.67	65.60	6.27	11.12	9.21	8.24	100.67	**0.36**	1.05
KS 228	52.67	68.00	75.20	8.53	10.88	9.92	7.85	94.73	0.45	0.98
KS 233	53.00	71.33	63.33	5.93	9.60	10.14	8.01	95.40	038	0.87
KS 250	55.33	73.33	72.87	7.07	9.53	8.96	7.76	113.93	0.49	1.03
KS 263	55.00	76.33	77.67	6.07	8.69	9.11	7.41	106.40	0.43	0.93
KS 235	56.00	75.67	77.40	6.53	11.61	8.49	7.35	93.73	0.47	1.04
KS 227	51.67	70.33	66.73	7.27	14.49	8.54	**6.77**	90.13	0.49	1.27
ACC 5114	55.00	77.00	93.93	7.27	7.88	10.93	8.82	94.87	0.56	0.73
ACC 8204	58.00	83.67	94.67	**5.87**	8.90	9.22	7.98	95.00	0.53	0.75
ACC 8206	46.67	73.33	86.60	7.13	**7.47**	9.51	7.73	98.13	0.56	**0.65**
ACC 8207	53.00	82.67	71.60	6.83	10.20	9.03	7.45	92.60	0.50	0.93
ACC 2623	55.67	85.67	**110.47**	**10.87**	9.35	**11.38**	7.70	110.40	0.59	1.01
Males										
T 3	**67.33**	**87.33**	76.73	8.80	**16.52**	9.09	8.63	113.40	**0.96**	**1.95**
AB 1	53.67	71.00	83.03	7.00	15.13	10.29	**9.21**	**119.33**	0.50	1.75
KS 224	49.67	59.00	66.47	6.93	13.55	10.63	7.61	109.20	0.53	1.61
DBR 8	51.33	65.33	71.40	8.60	16.40	**8.36**	7.55	**75.33**	0.56	1.41
SEm±	2.26	2.28	2.46	1.06	2.27	0.86	0.86	4.85	0.04	0.22
C.D. at(5%)	4.41	4.45	4.80	2.07	4.43	1.68	1.68	9.46	0.08	0.43
C.D. at(1%)	5.80	5.85	6.29	2.72	5.83	2.21	2.21	12.45	0.10	0.56

Appendix II - Mean performance of F_1 generation for ten characters in egg plant.

Cross	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m^2)	Yield per plan (kg)
KS 219 x T 3	55.00	75.00	62.87	9.87	30.04	11.20	9.02	116.48	0.83	3.30
KS 219 x AB 1	55.67	76.67	77.53	11.13	26.33	9.82	8.60	123.40	0.65	3.29
KS 219 x KS 224	52.33	72.00	65.60	7.73	18.37	11.04	8.22	99.00	0.54	1.82
KS 219 x DBR 8	52.67	75.00	84.20	9.47	19.90	9.44	7.85	89.87	0.53	1.94
KS 247 x T 3	55.67	73.00	74.40	**11.87**	28.47	10.22	8.64	112.20	0.67	3.05
KS 247 x AB 1	52.00	61.67	84.80	7.53	17.57	10.31	7.95	110.40	0.50	2.01
KS 247 x KS 224	48.67	67.67	81.33	8.43	16.17	10.51	8.51	113.07	0.53	1.94
KS 247 x DBR 8	45.33	**61.67**	70.67	9.17	25.46	9.88	8.40	91.93	0.53	2.23
KS 253 x T 3	53.33	70.67	72.73	10.43	28.60	10.78	9.24	117.20	0.76	3.02
KS 253 x AB 1	52.67	66.67	81.20	7.73	19.40	9.54	7.83	106.00	0.48	1.85
KS 253 x KS 224	**43.00**	62.00	72.07	7.87	16.87	10.29	7.55	110.67	0.54	1.97
KS 253 x DBR 8	50.67	67.67	71.07	8.07	22.52	8.77	7.35	91.67	0.54	1.88
KS 262 x T 3	56.33	74.67	**62.53**	7.53	18.93	9.81	8.73	111.67	0.69	1.93
KS 262 x AB 1	57.00	75.33	76.60	7.40	17.47	**7.68**	7.02	106.73	0.45	2.03
KS 262 x KS 224	57.33	73.67	65.00	7.33	19.53	9.97	8.16	102.40	0.45	1.99
KS 262 x DBR 8	58.33	77.33	68.07	9.13	23.63	8.31	7.27	92.47	0.47	2.29
KS 228 x T 3	53.00	71.33	70.27	7.80	19.27	9.56	7.96	115.03	0.70	2.16
KS 228 x AB 1	55.67	72.67	74.27	10.73	29.43	9.57	8.03	118.20	0.52	3.04
KS 228 x KS 224	48.67	65.00	65.07	8.13	22.12	8.61	7.68	93.93	0.56	2.14

Cont……

Cross	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m2)	Yield per plai (kg)
KS 228 x DBR 8	56.33	70.00	74.73	9.67	25.17	9.28	7.37	93.73	0.48	2.34
KS 233 x T 3	57.00	75.67	65.00	11.20	30.61	10.56	9.52	122.87	0.69	3.24
KS 233 x AB 1	56.33	79.33	74.93	6.87	16.11	8.99	7.35	112.53	0.51	1.90
KS 233 x KS 224	56.67	75.00	66.40	7.33	17.60	8.40	7.21	100.20	0.47	1.86
KS 233 x DBR 8	**62.67**	78.33	72.33	7.93	21.97	7.87	6.62	92.80	0.53	2.00
KS 250 x T 3	55.33	74.67	73.00	7.47	16.30	8.54	7.62	108.93	0.74	1.74
KS 250 x AB 1	57.67	74.00	76.27	8.53	20.22	9.20	8.65	112.93	0.48	2.47
KS 250 x KS 224	56.33	73.67	69.87	8.07	22.85	9.26	8.29	90.73	0.47	2.09
KS 250 x DBR 8	56.33	72.67	75.87	8.07	20.43	9.42	8.10	96.53	0.56	2.02
KS 263 x T 3	57.67	76.33	76.93	8.93	22.73	8.48	7 51	106.53	0.78	2.48
KS 263 x AB 1	56.67	75.00	80.80	11.33	29.10	10 92	10.25	124.40	**0.43**	3 01
KS 263 x KS 224	5067	67.33	74.20	6.33	17.43	9.67	8.76	109 47	0.49	1.84
KS 263 x DBR 8	53.67	75.00	72.80	8.60	25.47	9.73	8.59	90.20	0.55	2.14
KS 235 x T 3	62.33	77.00	76.33	11.73	26.50	**12.14**	**10.43**	121.33	0.80	3.12
KS 235 x AB 1	56.00	73.67	75.07	7.53	17.57	8.96	8.04	112.40	0.48	1.83
KS 235 x KS 224	51.67	63.67	67.73	8.87	21.89	9.47	8.53	101.07	0.51	2.49
KS 235 x DBR 8	52.67	71.00	78.33	7.20	23.37	8.83	7.50	89.13	0.55	2.21
KS 227 x T 3	53.00	69.00	67.20	7.67	19.50	8.77	6.97	113 27	0.81	2.50
KS 227 x AB 1	53.33	74.33	75.53	11.20	**33.60**	9.65	7.86	119.33	0.45	2.91
KS 227 x KS 224	57.33	77.00	64.13	8.53	19.80	9.47	7.54	101 60	0.59	1.93
KS 227 x DBR 8	51.00	73.33	71.93	8.33	22.06	8.88	7.91	95 93	0.55	2.11

Cont......

Cross	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m2)	Yie per p (kg
KS 5114 x T 3	57.67	73.00	85.90	7.60	**12.21**	9.85	7.68	110.27	0.80	1.9
KS 5114 x AB 1	50.33	68.33	85.27	6.27	12.70	10.86	8.66	113.13	0.53	1.8
KS 5114xKS 224	52.33	70.33	85.60	7.67	15.30	8.46	7.81	106.13	0.55	1.7
KS 5114xDBR 8	57.33	75.33	80.87	7.40	15.80	9.47	8.03	**88.20**	0.59	1.5
KS 8204 x T 3	61.00	82.33	85.93	11.73	25.87	10.88	9.96	**125.00**	0.80	2.4
KS 8204 x AB 1	55.67	78.00	74.47	7 40	14.77	8.96	8.17	105.20	0.53	1.7
KS 8204xKS 224	54.67	77.00	86.20	7 73	15.77	9.73	8.37	102.33	0.55	1.7
KS 8204xDBR 8	57.33	77.67	84.07	7 20	14.83	8.41	7.07	95.60	0.53	**1.5**
KS 8206 x T 3	61.00	**82.67**	81.53	11.60	28.66	10.54	8.64	122.80	**0.85**	2.5
KS 8206 x AB 1	54.33	74.00	86.20	7 47	13.53	9.27	7.80	108.47	0.58	1.7
KS 8206xKS 224	50.00	71.00	78 40	6 20	13.10	10.11	8.31	105.53	0.55	1.6
KS 8206xDBR 8	55.00	77 33	76 47	8 47	16 43	8 33	7.35	90.60	0.59	1.7
ACC8207 x T 3	58.33	77.67	75.60	10 33	24.00	9 03	7.71	121.53	0.79	2.6
ACC 8207 x AB 1	52.33	73.00	77.47	6.80	16.57	9.14	6.86	109.53	0.54	1.70
ACC 8207 x KS 224	51.33	67.33	65.40	**4.87**	17.42	10.54	7.98	106.13	0.51	1.7
ACC 8207 x DBR 8	55.00	74.33	74.20	7.27	17.62	10.13	8.41	95.13	0.55	1.6
ACC 2623 x T 3	61.33	81.67	81.47	11.07	24.42	11.26	9.79	123.40	0.79	2.6
ACC 2623 x AB 1	52.67	71.00	**101.07**	7.47	13.90	10.58	7.68	103.53	0.56	1.5
ACC 2623 x KS 224	48.67	62.33	95.67	7 60	15.87	10.19	6.94	105.73	0.57	1.7
ACC 2623 x DBR 8	57.00	77.33	94.93	6 87	14.46	9.82	**6.38**	93.07	0.57	1.5
SEm±	2.26	2.28	2.46	1 06	2 27	0 86	0.86	4.85	0.04	0.2
C.D. at(5%)	4.41	4.45	4.80	2.07	4 43	1.68	1.68	9.46	0.08	0.4
C.D. at(1%)	5.80	5.85	6.29	2 72	5 83	2 21	2.21	12.45	0.10	0.56

Appendix III - Mean performance of F_2 generation for ten characters in egg plant.

Cross	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m^2)	Yiel per pl (kg
KS 219 x T 3	49.00	72.00	59.40	7.87	22.98	9.21	7.85	108.60	0.70	2.2
KS 219 x AB 1	50.67	75.00	73.80	9.20	25.32	9.33	7.52	113.73	0.53	2.4
KS 219 x KS 224	52.00	71.00	67.93	6.20	15.15	9.35	8.26	100.80	0.51	1.6
KS 219 x DBR 8	53.00	73.00	72.53	7.67	20.40	8.79	6.84	91.13	0.50	1.7
KS 247 x T 3	54.33	71.00	68.07	9.47	29.12	9.47	8.39	104.33	0.55	**2.5**
KS 247 x AB 1	52.00	65.67	84.07	6.20	16.16	8.16	7.72	107.73	0.47	1.7
KS 247 x KS 224	48.33	66.00	76.00	7.07	15.52	9.69	8.39	112.13	0.48	1.8
KS 247 x DBR 8	50.33	69.00	78.13	7.17	21.08	8.48	7.65	89.93	0.50	1.9
KS 253 x T 3	51.67	70.67	64.40	8.40	25.40	9.71	9.04	114.87	0.61	2.2
KS 253 x AB 1	49.33	63.67	75.13	6.83	15.43	8.92	8.54	105.13	0.47	1.6
KS 253 x KS 224	50.67	68.00	65.33	5.80	15.24	9.44	8.28	109.15	0.46	1.7
KS 253 x DBR 8	53.33	72.33	**62.93**	6.73	20.12	9.32	7.89	**87.47**	0.51	1.7
KS 262 x T 3	55.00	72.00	61.53	6.73	15.35	10.41	9.67	109.27	0.64	1.7
KS 262 x AB 1	52.33	71.33	69.47	6.87	15.17	9.17	8.34	110.80	0.46	1.7
KS 262 x KS 224	53.33	73.67	63.47	6.40	17.55	8.40	7.52	106.87	0.46	1.7
KS 262 x DBR 8	55.00	70.33	64.47	7.53	17.77	8.60	7.46	94.93	0.44	1.8
KS 228 x T 3	58.33	73.00	66.00	7.13	16.93	8.48	7.69	112.47	0.65	1.8
KS 228 x AB 1	55.00	75.00	74.07	8.20	25.80	10.90	9.11	109.15	0.48	2.2
KS 228 x KS 224	47.33	63.33	66.33	6.20	22.68	7.56	7.15	98.40	0.52	1.9
KS 228 x DBR 8	52.33	67.67	73.93	8.67	22.52	8.70	**6.66**	91.07	0.46	2.02

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Cross	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m2)	Yiel per pl (kg)
KS 233 x T 3	57.00	74.67	64.00	9.80	23.04	10.44	8.99	**123.80**	0.67	2.2
KS 233 x AB 1	59.67	**80.67**	68.13	6.67	15.93	9.65	7.87	111.60	0.47	1.6
KS 233 x KS 224	52.33	70.67	63.27	6.47	17.49	8.46	7.77	97.20	0.44	1.7
KS 233 x DBR 8	59.67	79.67	74.00	8.20	20.00	8.52	7.99	90.87	0.49	1.81
KS 250 x T 3	50.33	68.00	67.03	7.07	16.58	10.01	7.67	107.07	0.65	1.66
KS 250 x AB 1	59.67	77.33	71.47	8.27	16.55	9.68	9.14	109.27	0.46	1.67
KS 250 x KS 224	52.00	71.00	65.47	9.27	20.18	8.15	7.14	95.67	0.45	1.85
KS 250 x DBR 8	52.67	71.00	69.67	6.53	21.87	9.29	8.40	96.53	0.52	1.91
KS 263 x T 3	53.67	74.67	75.53	8.60	17.75	9.73	8.71	108.87	0.65	1.99
KS 263 x AB 1	60.67	80.33	76.13	8.13	24.09	9.97	8.64	115.53	**0.39**	2.28
KS 263 x KS 224	58.33	77.67	70.60	6.23	16.82	10.50	9.10	109.33	0.45	1.81
KS 263 x DBR 8	62.77	82.67	77.00	8.53	20.28	8.69	7.52	94.00	0.48	1.90
KS 235 x T 3	56.33	75.67	73.67	8.60	21.95	10.74	9.40	120.53	0.74	2.12
KS 235 x AB 1	51.33	72.00	80.47	7.20	14.07	9.69	8.35	113.33	0.48	1.55
KS 235 x KS 224	51.00	72.33	70.53	7.07	17.77	8.91	8.59	106.80	0.42	2.02
KS 235 x DBR 8	52.33	71.00	72.73	8.27	19.81	8.51	7.70	93.87	0.52	1.85
KS 227 x T 3	52.67	71.67	63.53	7.93	19.23	9.58	8.41	110.73	0.61	2.01
KS 227 x AB 1	56.00	75.33	73.47	9.53	**27.95**	10.02	8.90	115.53	0.41	2.25
KS 227 x KS 224	60.67	78.33	64.10	6.20	19.35	8.75	7.45	97.80	0.53	1.78
KS 227 x DBR 8	49.33	70.33	79.67	7.87	21.26	8.38	7.32	94.76	0.51	1.90
KS 5114 x T 3	50.00	73.33	81.07	5.73	14.19	9.72	8.34	107.33	0.69	1.70

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Cross	Days to flowering	Days to marketable maturity	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Length of fruit (cm)	Width of fruit (cm)	Fruit weight (g)	Plant spread (m2)	Yiel per p (kg
KS 5114 x AB 1	50.33	67.33	85.20	6.33	13.13	9.33	8.58	113.60	0.49	1.5[illegible]
KS 5114xKS 224	53.67	74.33	80.60	6.20	14.65	9.29	8.04	105.73	0.50	1.6[illegible]
KS 5114xDBR 8	55.33	72.33	74.53	7.47	15.83	**7.52**	6.73	91.13	0.59	1.3[illegible]
KS 8204 x T 3	54.67	77.33	77.53	8.73	25.30	10.65	9.36	113.93	0.79	2.1[illegible]
KS 8204 x AB 1	54.67	75.00	75.47	**6.00**	**12.52**	10.21	8.95	110.73	0.49	1.41
KS 8204xKS 224	57.67	80.00	78.73	7.27	16.25	8.26	7.78	93.60	0.49	1.39
KS 8204xDBR 8	55.67	77.33	85.07	7.00	13.07	8.19	7.58	97.00	0.49	**1.31**
KS 8206 x T 3	56.33	77.33	71.07	**9.83**	24.91	9.99	8.82	112.47	**0.81**	2.20
KS 8206 x AB 1	54.67	75.33	83.13	6.80	13.61	9.20	8.17	108.87	0.51	1.44
KS 8206xKS 224	**45.00**	**63.00**	70.60	7.00	12.66	9.45	7.75	104.27	0.51	1.61
KS 8206xDBR 8	58.33	79.33	77.87	7.13	21.38	8.72	7.37	91.07	0.56	1.56
ACC 8207 x T 3	54.00	77.33	63.20	8.33	19.28	9.75	8.63	123.07	0.71	1.97
ACC 8207 x AB 1	53.00	73.67	75.53	7.00	18.13	9.16	8.35	114.27	0.51	1.72
ACC 8207 x KS 224	49.00	65.67	61.87	6.07	14.53	9.63	8.14	110.93	0.49	1.69
ACC 8207 x DBR 8	53.67	72.67	73.73	6.33	15.14	9.20	7.82	88.93	0.51	1.52
ACC 2623 x T 3	55.33	77.00	77.53	8.27	18.30	**11.40**	**9.20**	116.73	0.73	1.81
ACC 2623 x AB 1	52.00	74.67	91.07	8.00	17.02	9.46	8.58	110.60	0.52	1.72
ACC 2623 x KS 224	48.67	63.67	**91.13**	7.07	13.64	10.32	9.26	111.80	0.51	1.59
ACC 2623 x DBR 8	56.00	77.00	87.93	7.07	15.35	9.36	8.70	88.27	0.55	1.48
SEm±	2.26	2.28	2.46	1.06	2.27	0.86	0.86	4.58	0.04	0.22
C.D. at(5%)	4.41	4.45	4.80	2.07	4.43	1.68	1.68	9.46	0.08	0.43
C.D. at(1%)	5.80	5.85	6.29	2.72	5.83	2.21	2.21	12.45	0.10	0.56