DIVERSITY, HETEROSIS AND GENETICS OF YIELD AND QUALITY PARAMETERS IN BRINJAL (*Solanum melongena* L.)

BABRUWAHAN V. INGALE

DEPARTMENT OF GENETICS AND PLANT BREEDING
UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD-5

MARCH, 1993

DIVERSITY, HETEROSIS AND GENETICS OF YIELD AND QUALITY PARAMETERS IN BRINJAL (*Solanum melongena* L.)

Thesis Submitted to the
University of Agricultural Sciences, Dharwad
in partial fulfilment of the requirements for the
Degree of

Doctor of Philosophy

in

GENETICS AND PLANT BREEDING

By

BABRUWAHAN V. INGALE

DEPARTMENT OF GENETICS AND PLANT BREEDING
UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD-5

MARCH, 1993

DEPARTMENT OF GENETICS AND PLANT BREEDING

COLLEGE OF AGRICULTURE

UNIVERSITY OF AGRICULTRUAL SCIENCES, DHARWAD

CERTIFICATE

This is to certify that the thesis entitled **"DIVERSITY, HETEROSIS AND GENETICS OF YIELD AND QUALITY PARAMETERS IN BRINJAL (Solanum melongena L.)"**, submitted by **Mr.BABRUWAHAN VITTHALRAO INGALE**, for the degree of **DOCTOR OF PHILOSOPHY** in **GENETICS AND PLANT BREEDING**, of the University of Agricultural Sciences, Dharwad is a record of research work done by him during the period of his study in this University under my guidance and supervision and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar titles.

Dharwad

Date : 26th March 1993

(S.J. PATIL)

(MAJOR ADVISOR)

PROFESSOR OF GENETICS AND PLANT BREEDING AND CHIEF SCIENTIFIC OFFICER, COLLEGE OF AGRICULTURE, UAS, DHARWAD.

Approved by :

Chairman : (S.J.PATIL)

Members : 1. (M.S.K. SHETTY) 14/9/93

2. (K. GIRIRAJ)

3. (N.C.HULAMANI) 14/9/93

4. (P.W.BASARKAR)

At the Lotus Feet
of my Master
Sarvashri
BENDOJI MAHARAJ

ACKNOWLEDGEMENT

It gives me immense pleasure to express my deep sense of gratitude to **Dr.S.J.Patil**, Chief Scientific Officer (Plant Sciences), and Professor, Division of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad and esteemed Chairman of my Advisory Committee for his inspiring guidance, persistent encouragement, thought-provoking suggestions and keen interests snown during the course of this investigation and preparation of the manuscript.

I avail this opportunity to express my heartfelt thanks and gratitude to the members of my Advisory Committee, **Dr.M.S.K. Shetty**, Associate Professor, Division of Genetics and Plant Breeding; **Dr.K.Giriraj**, Senior Scientist (Oil seeds); **Dr.N.C.Hulamani**, Associate Director of Research and **Dr.P.W.Basarkar**, Assistant Professor of Biochemistry, University of Agricultural Sciences, Dharwad, who have taken great pains and rendered worthy suggestions during the course of investigation and for their constructive criticism which improved the text substantially.

This thesis must surely bear the imprint of the insightful ideas of **Dr.R.Parameshwarappa**, Director of Instruction (Agri.), College of Raichur, who provided me with a continuing stream of meaningful feedback during early phase of my research. I gratefully venerate his unceasing help.

A word of sincere appreciation flows spontaneously from my inward heart to **Dr.S.K.Nadaf**, Maize Breeder, ARS, Arabhavi; **Dr.M.V.C.Gouda**, Associate Professor and all staff members of the Division of Genetics and Plant Breeding for their keen interest, valuable suggestions, unreserved help and sustained cooperation during the course of investigation.

My thanks are also due to **Dr.M.B.Madalageri**, Associate Professor of Horticulture, College of Agriculture, Dharwad; **Dr.K.E. Lawande**, Vegetable Breeder M.P.A.U., Rahuri; **Dr.P.P.Deshmukh**, Head, Department of Horticulture, P.K.V., Akola and **Shri.S.B.Palve**, Vegetable Breeder, K.K.V., Dapoli, who spared the seed material of local collections for investigation.

I take this opportunity to extend my sincere thanks to **Dr.C.N.Srinivasan**, Professor of Biochemistry, U.A.S., Dharwad, for providing me necessary facilities for biochemical analysis during the course of investigation.

I feel strongly beholden to all my affectionate friends, Dangaria, Dobariya, Deoghare, Raut and Ghuguskar for their whole-hearted cooperation and help throughout the study.

Indeed, the words at my command are inadequate either in form or spirit to convey my deep sense of appreciation to my wife, Sau.Jayashree and Son, Chi.Abhijit for shouldering the family responsibility and also for their constant encouragement for my educational pursuit.

I am overwhelmed with sincere feelings of indebtedness to my revered father, Shri.Vitthalrao; mother Sau.Mathurabai; father-in-law, Shri Ramrao and mother-in-law, Sau.Shakuntalabai, who blessings, wishes and predilections motivated me to work towards this cherished goal.

I am grateful to the Konkan Krishi Vidyapeeth, Dapoli (Maharashtra) for the deputation which helped me to complete this study while in service.

Lastly, I take pleasure in thaking Mr.P.Aswathanarayana Rao, for nicely typing the manuscript.

B Ingale 26/3/1993

DHARWAD

26th MARCH, 1993

(BABRUWAHAN VITTHALRAO INGALE)

CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF FIGURES

CHAPTER - I

INTRODUCTION

I. INTRODUCTION

Brinjal (*Solanum melongena* L.), an important vegetable crop of India, is grown throughout the year in one or the other part of the country. Its fruits are widely consumed in various culinary preparations and are a rich source of protective nutrients. The common names of this crop are egg plant (English), Baingan (Hindi), Badanekayi (Kannada), Vange (Marathi), Vengan (Gujarati), Vankaya (Telugu), Bangena (Assamese), Begun (Bengali), Baigan (Oriya), Katharikal(Tamil), Kazhuthana (Malayalam), Bengan (Punjabi) etc.

It is cultivated throughout the tropical and subtropical regions of the world in an area of 4.32 lakh hectares with a production of 57.46 lakh tonnes. About 88 per cent of the area (3.79 lakh ha) is restricted to Asia which contributes about 80 per cent (45.13 lakh tonnes) of the total production in the world (Anon., 1991).

Brinjal is said to be the native of India (Thompson and Kelly, 1957). A great genetic variation with regard to colour, maturity, shape, vegetative growth and presence or absence of spines exists among the indigenous material. The average yield (15 tonnes/ha) is low in India because of the low yielding local cultivars grown for local preferences (Grubben, 1977).

Brinjal (*Solanum melongena* L.) belongs to the family solanaceae. Over 50 species have been recorded in

India belonging to the genus, Solanum. More than 16 species, many of which, closely related to cultivated brinjal are found to grow wild in various parts of India. However, it is difficult to fix the ancestry of cultivated egg plants. Continuous selection must have played a major role in the evolution and development of the various cultivated types. Ancient records suggest that it was first cultivated in India.

There are regional preferences for colour of fruit. Purple fruits are most esteemed in the northern parts of the country, but long and green types are preferred in Bihar and Southern Karnataka and round and green in Orissa. The round fruits with purple coloured stripes are preferred in Maharashtra and north Karnataka. The major constraints in yields are fruit and shoot borer (Leucinodes arbonalis), Jassids (Empoasca Sp.), Epilachna beetles, and root knot nematodes (Meloidogyne sp.). The major diseases are damping off, phomopsis blight, little leaf virus, Sclerotium and bacterial wilt.

The quality of brinjal fruit is associated with reduced level of phenols and increased levels of sugars and proteins. The phenols and ortho-dihydroxy phenols have been reported to be the contributing factors for bitterness and discolouration of fruits (Chadha et al., 1990a). Sweetness is associated with total sugars and reducing sugar content in fruit. The proteins in brinjal have high biological value (71%) and digestibility coefficient (75%) and are associated with nutritive value of fruit. Fruit density, dry matter content and seed content in fruit are related to cooking quality of fruit. Rind thickness and keeping quality index are important factors for fleshiness and shelf-life of fruits, respectively.

Information on the nature and magnitude of variability present in population owing to genetic and non-genetic causes is an important prerequisite for starting any systematic breeding programme. It is desirable to know the existing variability present for various morphological and fruit characters in different cultivars of brinjal. This type of information can be of immense utility for further crop improvement programmes.

Yield is a complex variable and depends upon a large number of factors and their interactions. Knowledge of the association of these characters with yield is pre-requisite to isolate desirable genotypes. The importance of correlations, direct and indirect effects between yield and quality parameters need not be over-emphasized in identifying ideal genotypes and further improvement of the yield and quality.

The recombination of different desirable traits spread over in different diverse genotypes is important for the improvement of yield and quality in any crop. The effectiveness of technique like Mahalanobis D^2 statistic to analyse the genetic diversity of populations has been proved useful. It is generally agreed that genetically diverse parents will show maximum heterosis and offer the maximum chance of isolating transgressive segregants. It serves the purpose of identifying probable parents for obtaining the best recombinants from the population. The present investigation aims to study the genetic diversity present in the material. Such studies based on yield and yield contributing traits are scanty in brinjal.

Mere presence of a high amount of genetic diversity in population may not be adequate to effect improvement over the best of existing cultivars. The choice of parents poses problems and this is the first important step in any plant breeding programme aimed at improving yield or other attributes. Combining ability studies are useful in classifying parental lines in terms of their ability to produce good hybrids and desirable recombinants in segregating generations.

The primary goal of plant breeding is to raise yield and improve quality of produce from crop plants through gene recombination. Further, hybrid vigour is a term encompassing phenotypic potentials of F_1 hybrids to perform better than their parents. The commercial exploitation of this phenomenon has been possible in brinjal because the cost of F_1 seed production and seed requirement per unit area are low. Most of the local varieties which are grown by the farmers have not been fully exploited. The information is available on various yield related traits and quite a few hybrid combinations have been reported. However, the information on components related with fruit quality is meagre. Sporadic attempts have been made to improve the quality in brinjal.

Numerous biometrical techniques have been developed to generate information on genetic nature and mode of inheritance of various characters among which diallel cross technique has been widely used in almost all crop plants. Combining ability analysis of Griffing (1956) provides a guideline to the plant breeders in selecting potential parents and crosses to be effectively utilized in breeding programme.

Genetic architecture of the plant also comprises of morphological qualitative characters which are controlled by major genes with little or no influence of environment. Characters like colour, shape, spinyness of fruit, etc., are important from the point of consumer preferences. Pigmentation on various parts of the plant serves as good genetic markers for the identification of varieties and in seed production.

Keeping all these points in view, an investigation was carried out with the following objectives:

1. To study the genetic variability, nature and magnitude of genetic diversity among the collected genotypes.

2. To estimate the correlation between yield and yield contributing traits and direct and indirect effects of these traits on fruit yield.

3. To estimate the extent of heterosis for fruit yield, its component characters and fruit quality parameters.

4. To determine the nature of gene action for yield, yield attributes and quality related parameters.

5. To identify the best combiner and best specific cross combination for use in future breeding programmes.

6. To study the inheritance of some of the qualitative characters.

CHAPTER - II

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

The review of literature pertaining to various aspects of the investigations is presented under the following headings.

2.1 Variability and components of variation

2.2 Inter character correlations and path coefficient analysis

2.3 Genetic diversity

2.4 Heterosis

2.5 Gene action and combining ability

2.6 Inheritance of qualitative characters

2.1 Variability and components of variation

Basic understanding of the genetic variability of quantitative characters is a prerequisite for the planning of a breeding programme. The magnitude of variability and its genetic components are the most important aspects of genetic constitution of the breeding material. The genetics of metric traits centres around the study of the extent of variation and partitioning it into components attributed to aforesaid causes.

A wide range of variations was reported for fruit yield, fruit and plant morphological characters in brinjal by Singh *et al.* (1974), Singh and Nandpuri (1974), Bhutani et al. (1977), Singh and Singh (1980b), Chadha and Sidhu(1983), Dhankhar and Singh (1983), Chadha and Paul (1984) and Mishra and Mishra (1990b). In general, the variations among the set of genotypes were significant for different characters under their studies.

Bahaeldin *et al*. (1968) reported the lowest gcv for plant height and days to flower. Srivastava and Sachan (1973b) observed highest genotypic and phenotypic coefficient of variation for fruits per plant and the lowest for branches and days to flower.

Mehrotra and Dixit (1973) reported a wide range of phenotypic variation for fruit yield per plant, fruit length and plant height and lowest for top girth of fruit in 45 varieties of brinjal. They observed high heritability and high genetic advance for number of branches, plant height and bottom girth of fruit.

Singh *et al*. (1974) observed a high genotypic coefficient of variation (gcv) for fruit weight, fruit length and yield per plant, while moderate variability estimates were recorded for fruits per plant, seed weight per fruit and rind thickness by Hiremath and Rao (1974). They further reported high heritability along with high genetic advance for number of fruits/plant, seed weight per fruit and rind thickness in 14 strains of brinjal.

Prasad and Prakash (1974) reported high genotypic coefficient of variation, high heritability and high genetic advance for seeds per fruit, fruit breadth and number of branches in 10 varieties of brinjal.

Singh and Nandpuri (1974) observed moderate to high estimates of heritability for days to first picking, number of fruits per plant and plant height, while number of branches and fruit yield per plant had low heritability estimates in 48 varieties of brinjal. Singh et al. (1974) reported high heritability and high genetic advance for fruit length, yield per plant and fruit circumference but fruit weight had low estimates of both these parameters in 24 varieties of brinjal.

Mishra and Roy (1976) observed high genotypic coefficient of variation for fruit weight, number of fruits and fruit yield per plant along with high heritability and high genetic advance in a study of 26 varieties of brinjal.

Bhutani et al. (1977) reported high estimates of genotypic coefficient of variation, heritability and genetic advance for marketable fruits and total number of fruits per plant in 17 diverse varieties, while Dhankhar et al. (1977) observed significant phenotypic and genotypic variability for several characters in 39 varieties of brinjal.

Salehuzzaman and Joarder (1980) studied 15 parental lines and nine F_1 hybrids and observed high estimates of genotypic coefficient of variation, heritability and genetic advance for fruit weight, fruit volume and fruit number per plant. Similarly, Singh and Singh (1980b) reported high estimates of genotypic coefficient of variation, heritability and genetic advance for fruit yield, number of fruits per plant and fruit girth in seven parents along with F_1 and F_2 of their diallel crosses.

Chadha and Sidhu (1983) reported high phenotypic and genotypic coefficient of variations for fruit yield per plant, number of fruits per plant, fruit breadth and fruit weight while low estimates were observed for plant height, number of branches, days to first harvest and length of fruit for both these parameters in 39 varieties. All these characters had high heritability and high genetic advance except in the case of plant height and days to first harvest. Dhankhar and Singh (1983) reported high genotypic variance for fruit yield, number of fruits, fruit weight, length and girth of fruit, days to 50 per cent flowering and number of branches in normal and ratoon crops of 39 varieties. They further noticed high heritability coupled with high genetic advance for fruit yield, number of fruits, fruit weight and number of branches, while plant height, characters related to size of fruit and days to 50 per cent flowering had low estimates for both these parameters. Sinha (1983) observed high genotypic coefficient of variation and high heritability for number of fruits per plant, fruit length, circumference ratio and fruit weight in 19 varieties.

Chadha and Paul (1984) noticed higher genotypic coefficient of variation for number of fruits per plant compared to total yield, days to flower and plant height in a set of 40 genotypes. They observed high heritability coupled with high genetic advance for total yield and number of fruits per plant, while the other characters had only high heritability.

Gopimony *et al*. (1986) reported high heritability coupled with high genetic advance for fruit yield per plant and fruit weight in 27 varieties. Similarly, Kalda *et al*. (1988) observed high estimates of both these parameters for number of fruits per plant, fruit weight and fruit index in 36 diverse genotypes.

Vadivel *et al*. (1988) observed high genotypic coefficient of variation for number of fruits, fruit length and fruit girth in four F_2 progenies of five parents. They further noticed high heritability coupled with high genetic advance for number of fruits per plant and fruit yield. Vadivel and Bapu (1989) noticed high heritability for secondary branches, fruit length and fruit diameter in F_2 and F_3 generations of EP 27 x EP 47. However, days to flowering, number of fruits per plant and fruit yield had moderately high heritability in F_2 and high heritability in F_3 generations. All these above characters had high genetic advance. They further reported high coheritability estimates for fruit number with number of branches in another study of 19 genotypes (Vadivel and Bapu, 1989 a).

Mishra and Mishra (1990b) studied genetic parameters in F_1 generation of 8 x 8 diallel cross and observed high estimates of genotypic coefficient of variation, heritability and expected genetic advance for fruit weight and fruits per plant, while branches per plant, and yield per plant had moderately high estimates for all these parameters.

Vadivel and Bapu (1990a) reported high heritability for fruits per plant, fruit yield, fruit length and fruit weight in F_2 and F_3 generations of EP 27 x EP 47 cross. They also observed high heritability coupled with high genetic advance for fruit number per plant, fruit length and fruit diameter in another study with F_2 of Pattabhiram x Annamalai. Fruit yield, number of fruits per plant and fruit diameter had high genotypic coefficient of variation, while days to flower and plant height had low genotypic coefficient of variation (Vadivel and Bapu, 1990b).

Nainar et al. (1991) studied F_3 progeny of four intervarietal crosses and observed high heritability coupled with high genetic advance in two crosses namely, SM 19 x SM 1 and SM 19 x SM 2 for number of fruits per plant, fruit weight and fruit yield per plant.

In general, the components of genetic parameters reported for fruit yield, yield related fruit attributes and morphological characters by various workers were based on limited number of genotypes or segregating populations. Reports on fruit quality related components like stalk length of fruit, fruit density and keeping quality index are not available except for a report on seed weight per fruit and rind thickness (Hiremath and Rao, 1974).

2.2 Inter character correlations and path coefficient analysis

Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for improvement in yield. Phenotypic correlation is the observable correlation between two variables; it includes both genotypic and environmental effects. Genotypic correlation, on the other hand, is the inherent association between two variables; it may be either due to pleiotropic action of genes, linkage or both or due to developmentally induced relationships. Pleiotrophy does not necessarily cause a detectable correlation because it is generated from many fold effects of gene(s) on more than one character. Correlations are helpful to ascertain the real components of yield which is a complex character. The correlation coefficient indicates the degree of relationship between characters but it alone does not give the clear picture of association between yield and its components. The knowledge of direct and indirect effects of yield components on yield is important for designing suitable selection strategies.

The concept of path coefficient analysis was originally developed by Wright in 1921 but, the technique was first used for plant selection by Dewey and Lu in 1959. Path analysis is simply a standardised partial regression coefficient which splits the correlation coefficients into the measures of direct and indirect effects of a set of independent variables on the dependent variable. The path analysis unravels whether the association of these characters with yield is due to their direct effects on yield or is a consequence of their indirect effects via some other trait(s). If the correlation between a component character and the yield is due to large direct effects, selection can be useful for such a character in order to improve yield. But if the correlation is mainly due to indirect effect of the character through another component trait, the breeder has to select for the latter trait through which the indirect effect is exerted.

Gotoh (1956) revealed that genotypic correlations were higher than the phenotypic ones and high positive correlation between plant height and stem diameter. Bahaaldin et al. (1968) reported that short plant and early flowering were positively correlated with large number of fruits and long fruit shape. Hiremath and Rao (1974) observed highly significant positive correlation between fruit yield and number of fruits per plant, while rind thickness was negatively correlated with fruit yield. That yield per plant was highly and positively correlated with number of fruits per plant, was reported by several workers in brinjal (Srivastava and Sachan, 1973a), Singh and Nandpuri (1974), Singh and Khanna (1978), Singh and Singh (1980a), Salehuzzaman and Joarder (1980), Dhankhar and Singh (1984) and Randhawa et al. (1989).

Singh and Khanna (1978) observed that plant height did not show any association with plant spread and number of branches but it was negatively correlated with fruit number and yield. Kalyanasundaram (1979) found that yield per plant was positively correlated with flower diameter, fruit volume and fruit diameter, while it was negatively correlated with fruit length.

Vijay et al. (1978b) reported that yield was positively correlated with fruits per plant, length of fruit, number of branches, weight and size of fruit and it was negatively correlated with days to flowering both at phenotypic and genotypic levels.

Mak and Vijiamungam (1980) showed that fruit yield was positively correlated with number of fruits, mean fruit weight, fruit length, number of primary branches and number of seeds per fruit.

Singh and Singh (1980a) studied the association in 90 F_2 populations and observed that fruit yield was positively correlated with plant height, number of fruits per branch, number of fruits per plant and fruit diameter both at phenotypic and genotypic levels. It was negatively correlated with days to flowering at phenotypic level but positively at genotypic level. Fruit diameter and number of fruits per branch were the main factors contributing to fruit yield.

Singh and Singh (1981) reported positive correlation between fruit yield with fruit length, fruit weight and number of fruits per plant, while it was negatively correlated with days to flower, plant height and fruit girth. Fruit girth had direct effect on yield followed by fruit length and fruit weight.

Sinha (1983) noticed positive correlation of fruit yield with number of fruits per plant, plant height and number of branches per plant both at genotypic and phenotypic level, while fruit yield was positively correlated with fruit length and circumference ratio at genotypic level. Fruits per plant, fruit length and circumference ratio had maximum direct effect on fruit yield.

Chadha and Sidhu (1983) observed that total yield per plant had positive and significant association with plant height, number of branches and fruit weight and negative association with days to first harvest. Plant height was positively associated with fruit breadth and fruit weight. Number of fruits, length and breadth of fruit and weight of fruit were positively associated with each other, except fruit length with weight and breadth of fruit.

Dhankhar and Singh (1983) reported that fruit yield per plant was positively associated with number of branches and number of fruits per plant, while it was negatively correlated with days to 50 per cent flowering and fruiting. They further observed negative correlation of number of fruits per plant with weight of fruit, girth of fruit and days to 50 per cent flowering and fruiting and length of fruit with girth of fruit, days to 50 per cent flowering and fruiting and plant height.

Chadha and Paul (1984) reported significant positive correlation between total fruit yield per plant with number of fruits per plant and plant height and significant negative correlation between yield per plant with number of days to first flower. But, Sharma et al. (1985) observed that fruit yield per plant was positively correlated with number of fruits per plant and path analysis revealed that fruit yield was directly affected by fruit number.

Khurana *et al*. (1988) reported that fruit yield was positively correlated with fruit diameter and fruit weight and it was negatively correlated with fruit length. Number of fruits was negatively correlated with fruit diameter. Path analysis revealed that leaf area, number of branches and stem weight had direct positive effects on fruit yield in study of 17 genotypes.

Vadivel and Bapu (1988) revealed that number of fruits per plant, number of branches and fruit weight had positive direct effect on fruit yield, while plant height and days to flower had negative direct effect on fruit yield. They observed that fruit yield was positively correlated with number of fruits per plant, number of branches and fruit length, while fruit yield was negatively correlated with days to flower and plant height in a set of 19 brinjal cultivars.

Vadivel and Bapu (1989b) reported that number of fruits per plant, number of branches per plant, plant height and fruit weight directly affected the fruit yield per plant in descending order of importance. Number of fruits per plant had negative indirect effect through fruit length and fruit weight on fruit yield per plant in F_3 progenies of a cross between EP 27 x EP 47.

Randhawa *et al*. (1989) observed highly significant correlation between fruit yield and number of fruits per plant, fruit length and fruit weight; and fruit weight with fruit girth. However, negative associations were found between fruit numbers per plant and fruit weight, fruit length and fruit girth. Path analysis revealed that number of fruits per plant and fruit weight had maximum direct effect on fruit yield. Fruit length had direct positive effect on yield but, it had a high indirect effect through fruit weight and a negative indirect effect through number of fruits per plant.

Mishra and Mishra (1990a) observed that fruit yield per plant was positively associated with plant height, girth of main stem, fruit weight, number of branches and fruits per plant. Positive association were also found between fruit length, fruit girth and fruit weight, while fruits per plant was negatively correlated with fruit girth and fruit weight in a study of 30 genotypes. Path analysis revealed that number of fruits per plant, fruit weight and branches per plant were the most important characters contributing towards yield.

Kumar *et al*. (1990) reported positive correlation between fruit yield per plant with fruit length, number of primary branches and number of fruits per plant but it was not correlated with fruit diameter in 21 , a set of cultivars.

Nainar *et al*. (1990) studied correlation and path analysis in F_3 progenies of four crosses and showed that number of fruits per plant had positive significant correlation with fruit yield per plant in all the four crosses. Number of fruits per plant, fruit weight and fruit length exhibited direct positive influence on fruit yield per plant in that order in all the four crosses.

Vadivel and Bapu (1990b) studied correlation in F_2 population of Pattabhiram x Annamalai cross and revealed that fruit yield was positively associated with number of fruits per plant, fruit length, number of branches and plant height.

Devi and Sankar (1991) studied direct and indirect effects of different yield contributing traits on fruit yield based on phenotypic correlations in 15 diverse genotypes. Number of fruits per plant, fruit diameter and fruit weight had direct positive effect on fruit yield in brinjal.

In general, the correlations, direct and indirect effects of fruit yield with yield related components were reported by various workers in different sets of genotypes or segregating population in brinjal. The association of yield and few quality parameters like rind thickness (Hiremath and Rao, 1974) and number of seeds per fruit (Mak and Vijiarungam, 1980) were reported. The correlations of fruit quality parameters like stalk length of fruit, fruit density and keeping quality index with fruit yield have not been reported by earlier workers. Therefore, correlations direct and indirect effects of different fruit quality parameters on yield and its components will be useful for simultaneous improvement of yield along with fruit quality in brinjal.

2.3 Genetic diversity

A successful breeding programme requires enough diversity among germplasm available. More diverse the parents, within a reasonable range, better are the chances of improvement in yield and other characters under consideration. The literature on genetic diversity is scanty in brinjal.

Lal and Srivastava (1978) studied variability in 42 genotypes of brinjal and classified them into four clusters based on D^2 analysis. Clusters I, II, III and IV had 20, 19, 2 and 1 varieties, respectively. Clusters I and II had minimum divergence, whereas clusters III and IV exhibited maximum divergence from other clusters and between them.

Dhankhar et al. (1979) identified five genetically diverse clusters from a set of 40 genotypes based on the type of damage by Leucinodes orbonalis Gn. There was considerable shifting in the allocation of genotypes to different clusters in normal and ratoon crops. Intercluster distance was largest between clusters IV and V in normal crop, while in ratoon crop, intercluster distance was largest between clusters III and V.

Tambe (1984) identified five clusters from 25 varieties of brinjal with substantial genetic divergence between them. Clusters A, B, C, D and E had 7, 4, 2,2 and 10 varieties, respectively. The maximum intercluster distance was between D and E clusters and minimum inter-cluster distance was between A and B clusters. The geographical distribution did not necessarily follow clustering pattern in brinjal in his studies.

Sidhu and Chadha (1988) reported five distinct morphological groups recognized specifically by total yield and number of days to first harvest through metroglyph and index score analysis of 39 indigenous and few exotic varieties of brinjal.

In general, the reports on genetic diversity are few in available genotypes. The information on genetic diversity in the collections of local varieties will be useful in the selection of parents in improvement of brinjal crop.

2.4 Heterosis

Nagai and Kida (1926) were probably the first to observe hybrid vigour in crosses among some Japanese varieties of brinjal. Later on, Kakizaki (1928), Daskaloff (1941), Pal and Singh (1946), Odland and Noll (1948), Mishra (1961), Peter and Singh (1973), Vijay and Nath (1978), Bhutani et al. (1980), Dixit et al. (1982), Balamohan et al. (1983); Sidhu and Chadha (1985), Dixit and Gautam (1987), Chadha et al. (1990b) and Shankaraiah and Rao (1990) reported heterosis for different characters in brinjal.

2.4.1 Number of days to flower

Most of the studies have revealed heterosis for earliness, while in a few studies, heterosis for lateness was observed. Nagai and Kida (1926) observed heterosis for days to flowering in F_1 hybrids. Kakizaki (1931) reported that the first harvesting time and earliness was generally found in most of the crosses than that of parents. Daskaloff (1937) noticed that all the crosses in his study surpassed their parents in earliness. Earliness in flowering and fruiting has also been recorded in brinjal by Daskaloff (1941), Odland and Noll (1948), Capinin and Alviar (1949), Mishra (1961) and Raman (1964).

Baha-Eldin et al. (1968) noticed earliness in the F_1 hybrid of Black Beauty x P.I. 169651. Oganesyan (1971) observed dominance of earliness in crosses in which the parents differed comparatively little from each other.

Vishwanathan (1973) observed heterosis for earliness in eight intervarietal hybrids from crosses involving five parents. Genchev and Popova (1973) observed strong heterosis for earliness in egg plant hybrids, L-8 x No-12 and No-2 x Delicatesse. Todkar (1975) and Kohinkar

(1980) also reported that F_1 hybrids showed earliness in flowering and fruiting.

Chadha and Sidhu (1982) observed a range of 1.40 to 16.62 per cent negative heterosis over better parent for number of days to first harvest. While, Patil and Shinde (1984) reported 26.7 per cent of all the crosses were significantly earlier than their better parents. Sidhu and Chadha (1985) reported three crosses to be earlier to their mid and better parents. Shankaraiah and Rao (1990) also observed earliness in three crosses over the best parent.

However, Oganesyan (1971) reported that in some of the crosses, F_1s were intermediate between the parents. Mital et al. (1976), Salehuzzaman (1981) and Chadha et al. (1990 b) failed to get heterosis for earliness in brinjal.

2.4.2 Fruit yield per plant

Hybrid vigour for fruit yield per plant has been reported by many workers (Kakizaki, 1930, 1931; Venkataramani, 1946; Pal and Singh, 1949; Gotoh, 1952; Mishra, 1961; Komochi, 1963; Raman, 1964; Tiwari, 1966; Baha-Eldin et al., 1968; Thakur et al., 1968; Silvetti and Brunelli, 1970; Scossiroli et al., 1972; Lal et al., 1974; Dharmegowda, 1975; Oganesyan, 1976 and Popova et al., 1976). The heterosis in these studies ranged from 8.00 to 112.37 per cent over their parents.

Singh *et al.* (1978) reported wide range of heterosis in their studies with eight parents and 20 F_1s. Maximum heterosis was 106.67 per cent over better parent in the cross Sel 5 x Pusa Purple Cluster. The heterosis for fruit yield has also been reported by Dhankhar *et al.*(1980), Kohinkar (1980), Cheah *et al.*, (1981), Joarder *et al.*(1981), Dixit *et al.* (1982), Kandaswamy *et al.* (1983) and Balamohan *et al.* (1983).

Chadha and Sidhu (1982) reported a range of 6.50 to 142.19 per cent heterosis over better parent in 19 of the 21 crosses. Patil and Shinde (1984) observed significant positive heterosis in many crosses. Sidhu and Chadha (1985) reported a range of 7.42 to 45.71 per cent heterosis over better parent. Dixit and Gautam (1987) also reported significant heterosis over the best parent in four crosses.

Chadha *et al.* (1990b) studied heterosis in a seven parent half diallel for two seasons. Two hybrids showed positive significant heterosis over better parent in both seasons.

2.4.3 Number of fruits per plant

In several of the studies so far reported, heterosis was on the positive side (Nagai and Kida, 1926; Lantican *et al.*, 1936; Komochi, 1963; Raman, 1964; Tiwari, 1966; Choudhary, 1966; Jadhav, 1967; Baha-Eldin *et al.*, 1968;

Thakur *et al*., 1968; Randhawa and Sukhija (1973), Vishwanathan, 1973; Lal *et al*., 1974; Todkar, 1975; Popova *et al*., 1976; Rani *et al*., 1977; Joarder *et al*., 1981; Chadha and Sidhu, 1982; Dixit *et al*., 1982; Balamohan *et al*., 1983 and Dixit and Gautam, 1987) for the character.

Chadha and Sidhu (1982) observed a range of 1.78 to 176.62 per cent heterosis over better parent in 11 of the 21 crosses studied. Similarly, Dixit and Gautam (1987) reported a range of 3.80 to 60.1 per cent heterosis over better parent. Shankaraiah and Rao (1990) observed significant positive heterosis over better parent in five crosses for the number of fruiting branches.

2.4.4 Plant height

The manifestation of heterosis for plant height has been reported by many workers (Kakizaki, 1931; Odland and Noll, 1948; Mishra, 1961; Raman, 1964; Tiwari, 1966; Thakur *et al*., 1968; Viswanathan, 1973; Peter and Singh, 1974 and Singh *et al*., 1978).

Thakur *et al*. (1968) observed an increased height of F_1 hybrids which varied from 20.1 to 43.9 per cent over the mid parental values. Peter and Singh (1974) observed -1.16 to 19.6 and -11.14 to 23.49 per cent of heterosis in the F_1s over their better and mid parental values, respectively. Singh *et al*. (1978) also reported similar magnitude (0.7 to 23.7 per cent) of heterosis over better parent.

Chadha and Sidhu (1982) reported a range of 1.29 to 30.32 per cent heterosis over better parent in 13 crosses. Sidhu and Chadha (1985) observed a range of 4.91 to 23.64 per cent heterosis over better parent. Chadha *et al*.(1990b) reported significant positive heterosis over better parent in nine of the 21 crosses grown in two seasons. Shankaraiah and Rao (1990) observed significant positive heterosis in five of the 19 crosses.

2.4.5 Plant spread

Pal and Singh (1946) reported heterosis for plant spread (10.3 to 65.6 per cent) over the mean of the parents. Superiority of F_1 hybrids of brinjal over their parents in respect of spread of the plant has also been reported by Mishra (1961), Jadhav (1967), Rajasekharan (1970), Todkar (1975) and Cheah *et al*. (1981) and Shankaraiah and Rao (1990).

2.4.6 Number of branches

Nagai and Kida (1926) noticed heterosis for number of branches. Pal and Singh (1946) observed heterosis for number of branches from -3.2 to 65.7 per cent and -6.9 to 54.4 per cent over mid parent and superior parents, respectively. Mishra (1961) recorded maximum increase in the number of branches in hybrids up to 41.6 per cent over male parent and 39.6 per cent over female parent.

Heterosis for number of branches has also been reported by Jadhav (1967), Thakur *et al*. (1968), Rajasekaran (1970), Randhawa and Sukhija (1973), Todkar (1975), Chadha and Sidhu (1982) and Balamohan *et al*.(1983).

Patil and Shinde (1984) reported 13.3 and 10.0 per cent of crosses for primary and secondary branches, respectively which showed significant heterosis. Singh and Kumar (1988) observed heterobeltiosis for number of branches in crosses Pusa Purple Cluster x H_4 and PPC x Sel.5.

Chadha *et al*. (1990b) observed negative heterosis over better parent in majority of crosses for primary branches in two seasons, while Shankaraiah and Rao (1990) reported significant positive heterosis over better parent in five crosses for number of fruiting branches.

2.4.7 Average fruit weight

Several workers have noticed heterosis for fruit weight (Lantican *et al*., 1936; Gotoh, 1953; Mishra, 1961; and Raman, 1964). Jadhav (1967) observed heterosis for the average weight of fruit was between -98.01 and 44.88 per cent. Thakur *et al*. (1968), Randhawa and Sukhija (1973), Vishwanathan (1973), Todkar (1975) and Mital *et al*. (1976) also reported appreciable heterosis for this character.

Chadha and Sidhu (1982) observed a significant heterosis over better parent in five out of 21 F_1s. Sidhu and Chadha (1985) reported a range of 3.77 to 67.39 per cent heterosis over better parent in 15 F_1s. Similarly, Dixit and Gautam (1987) reported a range of 6.7 to 46.4 per cent heterosis over better parent in 30 F_1s. Chadha et al. (1990b) observed significant negative heterosis for average fruit weight over better parent in majority of the crosses in two seasons.

2.4.8 Fruit length and fruit girth

Jadhav (1967) observed heterosis for length of fruit between -8.92 and 29.68 per cent. Vishwanathan (1973) and Todkar (1975) also reported appreciable heterosis for fruit length, while Lal et al. (1974) observed heterosis in one cross to the extent of 16.9 per cent for length of fruit.

Jadhav (1967) reported heterosis of -13.23 to 5.49 per cent for fruit girth. Todkar (1975) also observed heterosis for girth of fruit, while Lal et al. (1974) did not find any heterosis for the character in his study.

Chadha and Sidhu (1982) observed heterosis in the range of 1.29 to 70 and 38.10 to 177.37 per cent over better parent for fruit length and breadth of fruit, respectively.

Patil and Shinde (1984) reported significant heterosis in 6.7 and 26.7 per cent of crosses for fruit length and fruit girth, respectively.

Sidhu and Chadha (1985) observed a range of 10.87 to 121.80 and 10.44 to 50 per cent heterosis over better parent for fruit length and breadth of fruit, respectively. However in the study of Dixit and Gautam (1987), only one of the 30 hybrids had positive heterosis over better parent for fruit length. However, none of the crosses showed heterosis for fruit girth.

2.4.9 Fruit density

Dharmagouda (1975) reported the heterosis for fruit density from -49.0 to 142.0; -57.60 to 174.44 and -18.22 to 6.25 over mid parent, better parent and best parent, respectively. But, Salimath (1979) did not find heterosis over either mid parent or over the better parent values.

2.4.10 Keeping Quality index

Salimath (1979) reported a wide range of heterosis for keeping quality from -32.08 to 40.27 and -66.32 to 110.36 per cent over mid and better parent, respectively.

2.4.11 Seed weight per fruit

Dharmegowda (1975) reported the range of heterosis from -57.92 to 138.56, -106.53 to 416.62 and 93.19 to 635.26 per cent over mid, better and best parent, respectively for number of seeds per fruit. Popova *et al*. (1976) noticed appreciable heterosis for number of seeds per fruit.

Salimath (1979) reported a range of heterosis between -81.57 to 108.89 and -40.38 to 250.56 per cent over mid and better parent, respectively for number of seeds per fruit.

2.4.12 <u>Biochemical composition of fruits</u>

Mishra (1966) reported an increase (maximum 28 per cent) in total solids in some hybrids than in parents. However, there was no marked difference in total sugars between parents and F_1 hybrids in brinjal.

Dahiya *et al*. (1984) reported that none of the hybrids exhibited significant heterosis over superior and best parent for dry matter. Five hybrids showed positive heterosis over superior parent for total sugars which varied from 0.40 to 8.56 per cent. Two hybrids namely, Ludhiana Local Long x BR 112 and Banaras Giant x PPL showed positive heterosis over best parent.

Singh *et al*. (1988) reported a range from 6.51 to 8.77 per cent dry matter in fruits of eight parents, while their 25 hybrids ranged from 6.23 to 8.08 per cent dry matter. Crude protein ranged from 0.91 to 1.11 per cent and 0.92 to 1.10 per cent in parents and hybrids, respectively. Total phenols varied from 110.08 to 143.24 mg per 100 g and 101 to 182.89 mg per 100 g fresh fruits in parents and hybrids, respectively in brinjal.

In general, the heterosis for yield and different yield components have been reported by many workers in brinjal. Few workers have reported heterosis for fruit quality parameters like fruit density, keeping quality index, seed weight per fruit, dry matter, total sugars, total phenols and crude protein. The information in simultaneous improvement of yield along with different fruit quality parameters will be useful in hybrids for its further exploitation.

2.5 Gene action and combining ability

The majority of the metric characters are governed by polygenes and study of inheritance of these characters is important to ascertain the genetic basis. Among the several biometrical methods, the diallel analysis is widely employed in the study of inheritance of metric traits. The diallel method is more sophisticated to evaluate genetic aspects adequately in one generation and unaffected by segregation and linkage. It is also useful in measuring hybrid performance and genetic architecture of parents.

The diallel analysis technique in which a complete set of F_1 hybrids including parents and/or reciprocals are used, was first proposed by Jinks and Hayman (1953). Later, Griffing (1956a) suggested two other modified diallel methods which included a set of F_1 hybrid only.

Griffing (1956a) examined critically the concept of combining ability and concluded that when a set of inbred lines is used in a diallel crossing system, a genetic interpretation in terms of quantitative inheritance is made possible by the fact that the analysis is really a "gamete" combining ability analysis. Thus, the genetic properties of a diploid individual may be regarded as a combination of the genetic properties of the two gametes which unite to form the individual. The average performance of each single cross progeny is broken into components relating to general combining ability (main effects) and specific combining ability (interactions), assuming a fixed model, in a diallel cross analysis. General combining ability (gca) is composed of additive effects as well as additive x additive type of epistasis, whereas, specific combining ability (sca) involves both dominance and epistasis (Griffing, 1956b). The performance of a single cross can be adequately predicted on the basis of general combining ability if sca mean square is not significant. On the contrary, the significance of sca mean squares determines the importance of interactions in the performance of single cross progeny. The literature pertaining to gene actions and combining ability in brinjal is presented below.

Scossiroli *et al.* (1972) observed epistatic effects for date to anthesis, plant height and earliness of maturity in a six variety F_1 and F_2 diallel cross analysis by Hayman's method. The dominance estimates for fruit yield per plant and synchrony of ripening were 0.73 and 0.80, respectively.

Singh et al. (1974) reported significant variances for GCA and SCA in F_1 and F_2 generations of a seven variety diallel for all the six characters studied. Additive gene action was observed for days to flowering, plant height, number of fruits per plant, while non-additive gene action was predominant for yield per plant and fruit girth in F_1 and F_2 generations. Number of fruits per plant showed more pronounced epistatic gene action in F_2 generation. None of the parents and hybrids were good for all the characters.

Peter and Singh (1974) revealed that days to flowering and number of primary branches were governed by non-additive gene action, while length of fruit and equatorial perimeter of fruit were governed by additive gene action in a 5 x 5 diallel analysis. Both additive and non-additive gene actions governed the expressions of weight of fruits per plant (yield) and plant height.

Lal and Pathak (1974) observed predominance of additive gene action for all characters in a 7 x 7 diallel cross. Similarly, Gill et al. (1976) observed predominance of additive effects for most of the characters studied in a six variety diallel without reciprocals and their segregating generations and back crosses.

Dharmegowda (1977) noticed additive and non-additive effects for all seven characters studied except for seeds per fruit in a nine variety diallel. Over-dominance was noticed for seeds per fruit.

Srivastava and Bajpai (1977) noticed higher additive genetic variance than non-additive genetic variance for number of days to flowering and plant height, while the opposite was noticed for number of branches and plant spread. General and specific combining ability effects were significant for all characters except for the number of days to flowering. Crosses with high specific combining ability effects tended to be those whose parents had good general combining ability.

Vijay _et al_. (1978a) observed significant gca and sca variances in a 6 x 6 diallel analysis for all the four characters studied. The magnitude of gca variance was higher than sca variance indicating the greater importance of additive gene action.

Singh _et al_. (1978) observed parents T_1, T_3 and Pusa Purple Long to be good combiners for yield and earliness in 15 x 4 line x tester.

Dharmegowda _et al_. (1979a) reported partial dominance for all characters except number of seeds per fruit which was overdominant in 9 x 9 diallel analysis. Muktakeshi had good gca effect for yield and days to flowering, while Arkakusumar had good gca effect for yield, number of fruits, fruit density and number of seeds per fruit.

Singh et al. (1979) reported the predominance of non-additive gene action for days to flowering, number of fruits per branch, fruit weight and yield per plant both in F_1 and F_2. For fruit girth and fruit shape index, additive genetic variance was larger than non-additive genetic variance in both generations in fractional diallel involving 20 parents, 90 F_1 and 90 F_2. Pusa Purple Cluster, BGL and Pusa Purple Long were found to be good general combiners for fruit yield.

Sidhu et al. (1980) noticed that both additive and dominant gene effects were important for fruit yield per plant, fruit length, and days to flowering. Additive gene effects were more important than dominant gene effects for fruit number, fruit weight and fruit girth.

Bhutani et al. (1980) noticed both additive and non-additive gene effects for all the characters in study with 6 x 6 half diallel. Non-additive gene effects were predominant for fruit yield per plant. Pusa Purple Long, Br 112 and Aushey were the best general combiners for most characters. The crosses PPL x R 34, Pusa Kranti x Aushey and Br 112 x Sel-26 were with high sca values for yield.

Joarder et al. (1981) noticed dominance effects more than additive effects for most characters in a study of five single crosses with their parents, F_2, BC_1 and BC_2 at two locations. Duplicate epistasis was seen for all characters. Thal x Japani showed highest heterosis for yield at both localities.

Borikar et al. (1981) observed predominance of additive genetic effects for fruit yield per plant, plant height and number of branches per plant in a 4 x 4 diallel. Yield per plant was also influenced by non-additive effects, while Singh et al. (1981) reported high specific combining ability variances for all the seven characters studied in 15 line x 4 tester analysis. Four crosses had significant sca effects for yield per plant.

Dixit et al. (1982) noticed highly significant differences for gca and sca for all characters, except fruit length and fruit girth for sca. General combining ability effects were greater than sca for all characters. Pusa Purple Long, PH_4, S_{16} and Aushey were the best general combiners for most characters. The best specific combinations were PPL x Aushey, Br 112 x R 34, PH4 x Pusa Kranti, PH4 x S16 and PH4 x Aushey for total yield.

Singh et al. (1982) reported that over-dominance played a major part in the manifestation of heterosis followed by partial dominance in five top yielding crosses. Maximum heterosis was 140.19 per cent in PPL x 5317 for yield.

Salehuzzaman and Alam (1983) reported that the additive gene effects predominated for fruit weight, while dominance and duplicate epistasis were most important for number of fruits and fruit yield per plant by six generation mean analysis for two crosses.

Dixit et al. (1984) noticed importance of both additive and non-additive gene action for fruit yield per plant, number of fruits per plant and plant height. Additive gene action was important for fruit length, fruit circumference and weight of fruit in 8 x 8 half diallel analysis. Partial dominance was observed for all characters, except for fruit yield per plant and plant height which were controlled by over-dominance and complete dominance.

Sinde and Patil (1984) based on their study with 5 lines x 3 testers, observed significant variance for all characters due to female, male and female x male interactions except for primary and secondary branches among parents, and primary branches among crosses. Among female parents, Arka Kusumakar had high gca effects for number of fruits per plant, fruit length and fruit yield per plant. Among males, Azad Kranti had high gca effects for plant height, fruit length and fruit yield per plant.

Patil and Shinde (1985) noticed highly significant variances due to GCA and SCA for all the characters in a 7 x 7 half diallel analysis. The predominance of additive gene action was observed for plant height, number of primary branches, number of secondary branches, fruit length, fruit girth, fruit weight and fruit yield except plant spread. The gca effects indicated that none of the parents was a good general combiner for all the characters.

Dahiya *et al*. (1985) observed significant variance due to GCA and SCA for all the characters in a study involving 10 line x 4 tester analysis. Parents Ludhiana Local Long, Pusa Kranti (♀), PPL and PH4 (♂) had high gca for most of the characters. Cross Sel.1-1 x BR 112 exhibited highest sca for total yield.

Gopinath and Madalageri (1986) noticed significant additive, dominance and epistatic gene effects for days to flower, plant height, number of fruits per plant, fruit length, fruit breadth and fruit yield per plant in a six generation analysis involving one cross.

Kumar and Ram (1987) noticed predominance of additive genetic variance for six yield related and phenological traits and non-additive genetic variance for early and total fruit yield per plant in a 6 x 6 half diallel analysis. Pusa Purple Long, PPC, Pant Samrat and T3 were the best general combiners among the parents.

Following graphical analysis of a 9 x 9 half diallel, Chadha and Hegde (1987) revealed partial dominance for number of fruits per plant, fruit length, fruit diameter, shape index, days to fruiting and plant height. However, complete dominance was observed for days to flowering and over-dominance for yield. A complementary type of epistasis was shown for plant height.

Singh and Mital (1988) revealed non-additive gene action for days to flowering, plant height and fruit yield per plant in a 12 parent half diallel analysis.

Singh and Kumar (1988) observed highly significant variances for gca and sca for plant height, number of fruits per kg, fruit length, number of fruits per plant and yield per plant except number of primary branches in five parent half diallel analysis. ARU-1 and Sel 5 were good general combiners for fruit yield and PPC x Sel 5 was the best specific combination for yield.

Chadha and Hegde (1989) observed highly significant gca variance for all the characters. Variance due to sca was significant for yield per plant, shape index, number of fruits per plant, fruit length and plant height, while non-significant sca effects were observed for fruit diameter, days to flowering and fruiting. H4 was the best general combiner for many characters including yield, while Sult x H-4 was the best cross combination for yield.

Chadha and Sharma (1989) revealed duplicate epistasis for fruit number per plant and fruit yield per plant in a six generation analysis of two crosses. Kumar and Ram (1989) reported importance of both additive and non-additive components for plant height, number of fruits per plant and fruit weight in six parent diallel analysis.

Mishra and Mishra (1990c) reported Round White, Pusa Kranti, Bhubaneswar-4 and Keonjhar-1 as good general combiner for most characters. The PPL x Bhubaneswar-4 and other four crosses were good specific combinations for fruit yield per plant in eight parent half diallel analysis.

Employing the method of six generation mean analysis, Singh and Rai (1990) showed the importance of additive gene action for yield per plant, number of fruits per plant and fruit length in cross PDL x PPL, while dominance gene action played a major role in the expression of all characters in cross Erangare x PPL.

Chadha _et al_. (1990a) studied the inheritance of glycoalkaloids, total phenols and ortho-dihydroxy phenols by analysing six generation mean in two crosses. Additive effect were more important for glycoalkaloids. Dominance effect was important for ortho-dihydroxy phenols in Annamali x PBr 91-9, while epistasis was predominant in PPL x Pb. Chamkila. Negative additive x dominance type of interactions were observed for total phenols in Annamali x PBr 91-1 cross, while both additive and non-additive gene actions were important in cross PPL x Pb.Chamkila for total phenols. Glycoalkaloid content in their study was not associated with bitterness, whereas, both bitterness and discoloration increased with increasing percentage of total phenols.

Verma (1991) revealed the importance of both additive and non-additive components of genetic variance in the expression of dry matter and protein content in a 6 x 6 half diallel of brinjal. Varieties PPL, T3 and P8 contributed a large number of favourable alleles for protein content, while S16 and T3 were the best general combiner for dry matter content.

Sawant et al. (1991) revealed predominance of additive gene action for number of fruits per cluster and yield. Non-additive gene action was predominant for plant height, plant spread, number of fruits per plant, early flowering and fruit weight in 7 line x 2 tester analysis. Krishnakati Local was good general combiner for fruit weight and yield.

Lawande et al. (1992) observed variation in gene effects from cross to cross in a five crosses six generation mean analysis for fruit number, fruit weight and fruit yield per plant. The predominance of additive gene effects were observed for fruit number and fruit weight, while yield per plant exhibited additive gene effects. The components of additive x dominance and dominance x dominance also played an important role for this character.

In general, different gene actions were reported for yield and its components by many workers through different techniques in a set of different varieties. The potential parents and crosses were reported for yield and its components for improvement of yield in brinjal. However, there was little attempt to elicit the genetics of fruit quality parameters. Therefore, the information on genetics of different fruit quality parameters and its potential parents and crosses will be useful for improvement of fruit quality along with yield in brinjal.

2.6 Inheritance of qualitative characters

Fukusawa (1964) observed trigenic control of fruiting habit (solitary vs clustered) in an interspecific cross between *Solanum melongena* x *Solanum gumingii* Dunal. However, the mode of inheritance of the spiny vs spineless condition was not definitely established.

Sambandam (1964) observed that purple hypocotyl over green in three crosses was governed by a single dominant gene. Sinha *et al*. (1966) noticed an evidence of linkage in coupling phase for genes of anther tip and pedicel pigmentation and genes for leaf vein, stem and petiole pigmentation in F_2 population of two inter-varietal crosses in brinjal. Independent segregation of anther tip pigmentation from leaf vein, stem and petiole pigmentation and of pedicel pigmentation from leaf vein, stem and petiole pigmentation was noted.

Tigchelaar (1967) reported 11 genes in five groups for anthocyanin colouration in egg plant (1) Three independently inherited basic colour genes with alleles in order of dominance 'D', 'd', 'd^t' and 'd^w', 'p', 'p' and 'p^w', Y and y (2) Ac determines the structure of the anthocyanin produced (3) Light-independent synthesis is controlled by 'puc' in the fruit and 'Ca' in the anthers. Vegetative tissues had an absolute light requirement but corolla pigments are formed in dark (4) Several diluting genes were indicated. 'Dil', and 'Dil_2' had three alleles, while 'R' completely inhibited fruit colour with no effect on the flower or hypocotyl. 'Dil' and 'AC' are partially and 'Dil_2' and 'puc' were completely linked. (5) The copigmentation genes 'GW' and 'GV' in the fruit induced chlorophyll formation and varieg-ted pattern, respectively.

Swamy Rao (1970) observed monogenic control of colour on stem, petiole, midrib, flower and fruit, fruit shape and fruiting pattern in two varieties.

Thakur <u>et al</u>. (1969) reported two genes Sc_1 and Sc_2 for plant colour in cross Pusa Purple Long x White Cluster, while one gene Sc_1 in cross 137 x White Cluster for plant colouration. Purple corolla, Pc, was monogenically dominant over white and green flesh monogenically dominant over white. Presence of spines was controlled by a single dominant gene, Sp. Fruit colour was controlled by dominant complementary genes, P and D. Sambandam

(1969) observed several linked genes for purple pigmentation in different parts of the egg plant. The genes Ph, Al, Pb, Pm, Pu, Pl, St and s are concerned with the pigmentation of the hypocotyl, epicotyl, leaf, leaf midrib, leaf margin, upper and lower surface of calyx, anther sutur and fruit skin, respectively. Ph, Pb, Pu, Pl, St and s are linked. Fruit skin colour and flesh colour were inherited independent of each other.

Choudhari (1972) reported monogenic dominance for tallness. Deeply lobed leaves (L^1) was incompletely dominant over slightly lobed leaves (l) and fruit colour was governed by a single pair of alleles with G^A (green) incompletely dominant over g^m (white).

Rangaswamy and Kadambavanasundaram (1973) revealed that the seedling colour was governed by duplicate factors segregating in the ratio of 15:1 for green and albino in the F_2 of Solanum indicum L. x Solanum melongena L. Prickled condition on petiole, leaf surface and stem, incurved style tip, cluster fruit pattern and green striped fruit colour were monogenic dominant over non-prickled condition of petiole, leaf surface and stem, erect style tip, non-clustering fruit pattern and purple fruit colour, respectively. Dark purple corolla and long fruit shape showed partial dominance over light purple corolla colour and round fruit shape, respectively.

Choudhari (1977) observed that round fruits were controlled by a single dominant gene (R^R) and were dominant over both long oval and short oval fruit type (r^r). Green fruits were controlled by a single gene G^M and was partially dominant over white fruit g^m, the heterozygote ($G^m gm$) having green, mosaic fruit. White fruit with green stripes was controlled by a single gene WGS and was dominant over white fruit (W^{gs}).

Wanjari and Khapre (1977) observed that purple hypocotyl (Phy Phy) and purple stem (Pst Pst) were monogenically dominant over green. Young fruit colour (no shading vs purple shading) was controlled by two genes, Shyf and Shf were responsible for purple shading and I-shyf inhibited expression of ShyF. Pst, Phy and I-shyf appeared to be linked in the order given.

Shariff and Habib (1977) reported that colour of leaf and stem and presence or absence of spines on their surfaces were both monogenically inherited. Purple and spiny condition were dominant over green and spineless. The dihybrid ratio indicated independent assortment of the genes.

Cheah *et al*. (1981) observed incomplete dominance of dark purple pigmentation over non-purple, complete dominance of spined calyx over spineless. Grooved fruit surface was completely dominant over smooth. This character was controlled by two loci. The number of loci controlling fruit shape was estimated as three.

Nimbalkar and More (1980) studied the inheritance in cross between Mukta Keshi and White Green in brinjal. Monogenic inheritance of spines on stem, petiole, vein and leaf incision was observed. Duplicate gene interaction was recorded for pigmentation in stem, petiole and vein. Pleiotropic gene action for the characters namely, stem, petiole and vein colour as well as for spines on stem, petiole and vein was recorded. The duplicate gene interaction for pigmentation has been symbolised as Pst_1 and Pst_2.

Nimbalkar and More (1981b) indicated that fruit shape was controlled by four genes designated as of_1, ofb_1, ofb_2 and ofb_3. Oblong fruit resulted from the presence of one of these, together with two of the other three which appeared to be duplicate genes in a cross between White Green x Manjari Gota.

Nimbalkar and More (1981a) observed monogenic behaviour of spineless character. The stem colour and petiole colour characters were governed by three factors and gave segregation ratio of 54:10 and 57:7, respectively. Leaf colour was governed by four factors and it gave a segregation ratio of 162:94 in a cross between Mimkar Green Round and SM 213. Cross over values of 3.9 per cent and 10.09 per cent were recorded between the factors of stem colour, petiole colour and leaf colour, respectively. Similarly, factor of petiole colour was found to be linked with that of the leaf colour gene with a recombination value of 8.16 per cent.

More *et al.* (1982) observed monogenic (3:1) behaviour of spineness and fruit colour characters in SM2 x Nimbkar Green Round. Stem colour and flower size showed trigenic inheritance and gave segregation in the ratio of 49:15 and 51:13, respectively.

Patil and More (1983c) revealed that leaf colour, and leaf vein colour were each controlled by two complementary genes (9:7 ratio in F_2) in a cross Nimbkar Green Round x Kalinapur Type-2. Stem colour was controlled by three complementary genes $csta_1$, $cstb_1$ and $cstc_1$, while fruit colour was also controlled by three complementary genes pfa_1, pfb_1 and pfb_2. Purple leaves, leaf vein, stem and fruit were dominant over green. One of the genes for stem colour and one of the genes for fruit colour were each linked to one of the genes for colour of leaf veins.

Patil and More (1983a) observed that leaf vein colour was controlled by two complementary genes. Fruit colour, fruit size and fruit shape were controlled by three different genes in each case in Kalinapur Type-2 x Suruti Gota. Leaf vein colour was linked with fruit colour and fruit size. Fruit size was linked with fruit shape. In cross Kalinapur

Type-2 x White Green, they observed three genes control for leaf vein and fruit pigmentation, fruit size and shape (Patil and More, 1983b).

Khapre *et al*. (1985) revealed the genetic control of plant habit (2 genes), spinyness of leaves (3 genes), type of leaf margin (3 genes), purple colour of young fruit (1 gene) and flesh colour (1 gene) in cross *S.melongena* x *Solanum indicum* L.

Khapre *et al*. (1986) revealed monogenic control of purple stem colour, while leaf vein colour, purple shade on young leaves, corolla colour (white or purple) and calyx colour (green or purple) were each governed by the interaction of three or more pairs of non-allelic genes.

Khapre *et al*. (1987b) observed a ratio of 80 cluster:175 non-cluster in F_2 and 1 cluster:15 non-cluster in test cross (BC_2) generations in a cross of *Solanum melongena* cv. American White (non-cluster) x *Solanum indicum* (cluster type).

Khapre *et al*. (1987a) revealed that spined vs. spineless stems and leaves were controlled by three complementary genes of which any two must be in the dominant condition for spines and Spined calyxes are controlled by two complementary genes and an inhibitor, all dominant in *Solanum indicum* and all recessive in American White.

Pleiotropic effects were also detected. Two independently recessive genes, one in spineless stemmed and one in spineless leaved plants were responsible for spine leaves and spined calyxes, respectively. While two complementary genes in spineless stemmed plants were responsible for spined calyxes.

The inheritance of pigmentation and thornyness in different parts of the plant was studied by many workers. The number of genes and its interactions varied in the expression of the same character in different contrasting parents in general. There was little attempt to elicit the inheritance of important qualitative characters like fruit colour, spinyness of calyx, fruit shape and fruiting habit in brinjal. However, there was no reports on gene interactions involved in the expression of same characters at different developmental stages of plant parts.

CHAPTER - III

MATERIAL AND METHODS

III. MATERIAL AND METHODS

The investigation consisted of three experiments to fulfil the set objectives. The experiments were conducted in the fields of the Department of Genetics and Plant Breeding, College of Agriculture, University of Agricultural Sciences, Dharwad between 1990 and 1992.

3.1 Experiment I

The objective of this experiment was to evaluate 76 genotypes for variability, genetic parameters, correlation and path analysis in respect of 15 yield and yield contributing characters. The estimation of genetic diversity was based on 15 characters and 75 genotypes after excluding one hybrid (Arka Navneet).

3.1.1 Material

The material for this part of the study comprised of 76 brinjal genotypes collected from different sources within India. The particulars of these genotypes are given in Table 1. The experiment with 76 genotypes was conducted during *kharif* 1990-91 season. The experiment was laid out in a randomized block design with three replications. A single row of 10 hills was planted with spacing of 90 x 75 cm in each plot. The other package of practices followed as per University recommendations throughout the crop growth period. The crop was grown solely under rainfed conditions. The observations were recorded on five randomly selected, competitive plants.

Table 1. Genotypes studied in Experiment I

Sl. No.	Name	Source
1	2	3
1	Arka Kusumakar	Indian Institute of Hort.Research, Bangalore (Karnataka)
2	Arka Sirish	"
3	Arka Sheel	"
4	Higna Dorla	Punjabrao Krishi Vidyapeeth, Akola (Maharashtra)
5	White Madhapuri	"
6	Bhaurad No.2	"
7	Bhaurad No.3	"
8	Tambalwadi Local	"
9	Higna Dorla (Th.)	"
10	Murki	"
11	Jalgaon Local	"
12	Aruna	"
13	Chikhalgaon-1	"
14	Vaishali	Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra)
15	PBR 129-5	"
16	Shekharwadi	"
17	Mahabaleswar	"
18	Solanon Writti	"
19	Krishna Kati	"
20	Shirur-1	"
21	S 249-10	"
22	Kapadne	"
23	Pure White	"
24	Borgaon-1	"
25	P 5-8	"
26	Gote-2	"
27	Kalyanpur T-2	"
28	P-B	"

Contd..

Table 1(Contd.)

1	2	3
29	Dorly	Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra)
30	Majri Gota	"
31	Ruchira	"
32	Aru-1	Konkan Krishi Vidyapeeth, Dapoli (Maharashtra)
33	Gare Local	"
34	White Long	"
35	Kranti	"
36	Banaras Green	"
37	PBR 91-1	"
38	Aru 1-C	"
39	S-258	"
40	SM-2	"
41	S 25-2	"
42	BB-7	"
43	MPU-1	"
44	Wkl-25	"
45	White Cluster	"
46	Oblong Local	"
47	Khed Shivapuri	"
48	IMR 12-8	"
49	SM 78	"
50	Kapadane-1	"
51	SM 133	Kerala Agricultural University, Trichur (Kerala)
52	SM 121	"
53	SM 135	"
54	Junagad Oblong	Gujarath Agricultural University, Junagad (Gujarath)
55	Surya	Kerala Agricultural University, Trichur (Kerala)
56	PI 349612	University of Agricultural Sciences, Dharwad (Karnataka)

Contd..

1	2	3
57	WCGR 112-8	University of Agricultural Sciences, Dharwad
58	Udupi Gulla	"
59	Gokak Local	"
60	Malapur Local	"
61	Kali Ravai	"
62	Taiwan Naga	"
63	Mugad Local	"
64	Banaras Giant	"
65	Saundatti Local	"
66	Beauty White	"
67	Madina	"
68	Ceylone	"
69	Black Beauty	"
70	Composite-1	"
71	Composite-2	"
72	Pusa Purple Long	Indian Agricultural Research Institute, New Delhi
73	Pusa Kranti	"
74	Pusa Bhairav	"
75	Raidurg Local	University of Agricultural Sciences, Dharwad (Karnataka)
76	Arka Navneet	Indian Institute of Horticultural Research, Bangalore (Karnataka)

3.1.2 Observations recorded

The following observations were recorded on each of the five competitive plants selected at random and the treatment totals and averages were computed for each plot. The characters studied and techniques adopted to record the observations were as given below.

3.1.2.1 Plant morphological traits

3.1.2.1.1 Days to flower

The number of days from sowing in nursery beds to the first opening of flowers in 50 per cent of the plants in a treatment, was recorded.

3.1.2.1.2 Fruit yield per plant

The weight of fruits per plant (g) was recorded at each plucking and the fruit yield per plant was computed as a sum of all the pluckings.

3.1.2.1.3 Number of fruits per plant

The total number of fruits harvested from all the pluckings was recorded and the average number of fruits per plant was worked out.

3.1.2.1.4 Plant height

The height of the plants (cm) was measured from the ground level to the tallest shoot of the plant at the last plucking.

3.1.2.1.5 Plant spread

The plant spread (cm) between the farthest tip of the shoot on either sides of the plant along the row or across the row was measured at the last plucking of the fruits.

3.1.2.1.6 Number of primary branches

The total number of branches arising directly from the main stem were counted at the time of last plucking.

3.1.2.1.7 Number of secondary branches

The total number of branches arising from the primary branches were counted at the time of last plucking.

3.1.2.2 Fruit parameters

Ten fruits at edible stage were taken from five observational plants at the time of first plucking and the following observations were made.

3.1.2.2.1 Fruit weight

The fresh weight of all the individual fruits (g) was taken and mean weight per fruit was worked out.

3.1.2.2.2 Fruit length

The length of fruits (cm) was measured from the base of calyx to the tip of the fruit.

3.1.2.2.3 Fruit girth

The maximum girth of fruit (cm) was measured with the help of a tape.

3.1.2.2.4 Fruit stalk length

The length of fruit stalks (cm) was measured from its tip to the base of calyx.

3.1.2.2.5 Fruit density

The volume of fruit was measured by water displacement methods. Fruit density was calculated by dividing weight of fruit with volume of fruit.

3.1.2.2.6 Keeping quality index of fruit

The fresh fruits were stored at room temperature for five days and the index of keeping quality was calculated as:

$$\text{Keeping quality index} = \frac{\text{Fresh fruit weight-fruit weight after 5 days of storage}}{\text{Fresh fruit weight}} \times 100$$

3.1.2.2.7 Rind thickness

Five ripe fruits at random were taken from Observational plants in each genotype. These fruits were cut in the middle and the thickness of rind was measured in cm with the help of a micrometer screw guage.

3.1.2.2.8 Seed weight per fruit

The weight of air dried seeds extracted from five ripe fruits that were taken for measuring rind thickness, were recorded.

3.1.3 Statistical methods

The data collected from experiment - I was subjected to the following analysis. The data in percentages were transformed into arc-sine values for further analysis in case of keeping quality index of fruit only.

3.1.3.1 Analysis of variance

The statistical analysis was done by following the concept of randomized block design. Experimental results were subjected to analysis of variance as suggested by Panse and Sukhatme (1967). The structure of ANOVA for a random model is presented below.

Analysis of variance table

Source of variation	Degrees of freedom	Mean sum of squares (MSS)	Expected value of MSS
Replication	(r-1)	M_1	-
Varieties	(v-1)	M_2	$6\ e^2 + r\ 6g^2$
Error	(r-1)(v-1)	M_3	$6\ e^2$
Total	(rv-1)	$(M_1 + M_2 + M_3)$	

Where,

r = Number of replications

v = Number of varieties

e = Error

3.1.3.2 Estimation of genetic parameters

Genotypic and phenotypic variances and coefficient of variances were computed from the ANOVA table based on the expected mean sum of squares as follows. The treatment sum of squares is made up of environmental variation along with "r" times the genetic variance ('r' being the number of replications).

Hence,

$$6\,g^2 = \frac{M_2 - M_3}{r}$$

$$6\,p^2 = 6\,g^2 + 6\,e^2 \text{ or } \frac{M_2 - M_3}{r} + M_3$$

Where,

$6\,g^2$ = genotypic variance

$6\,p^2$ = phenotypic variance

$6\,e^2$ = environmental variance

The genotypic and phenotypic coefficients of variance were then computed as follows:

3.1.3.2.1 Phenotypic coefficient of variation (PCV)

$$PCV = \frac{6\,p^2}{\bar{X}} \times 100$$

Where,

$\bar{X}$ = general mean value of the character

3.1.3.2.2 Genotypic coefficient of variation (GCV)

$$GCV = \frac{6\,g^2}{\bar{X}} \times 100$$

3.1.3.2.3 Heritability

Heritability in broad sense was computed using the following formula.

$$\text{Heritability } (h^2) = \frac{6g^2}{6p^2} \times 100$$

3.1.3.2.4 Genetic advance (GA)

The extent of genetic advance to be expected from selecting five per cent of the superior progeny was calculated using the following formula (Robinson *et al.*, 1949).

$$\text{Genetic advance (GA)} = i\ 6\ ph^2$$

Where,

i = intensity of selection

h^2 = heritability in broad sense

6p = phenotypic standard deviation.

The value of 'i' was taken as 2.06 when 5 per cent of the individuals are selected.

3.1.3.2.5 Genetic advance per cent over mean (GAM)

$$GAM = \frac{GA \times 100}{\bar{X}}$$

3.1.3.3 Correlation and path analysis

3.1.3.3.1 Genotypic and phenotypic correlations

Analysis of variance and covariance for the individual characters and for pairs of characters, respectively were done following Panse and Sukhatme (1967). Genotypic (rg) and phenotypic (rp) coefficients of correlation were calculated using the formulae suggested by Al-Jibourie *et al.* (1958).

$$rp_{1.2} = \frac{Cov\ P_{1.2}}{\sqrt{Var\ P_1 \times var.\ P_2}}$$

Where,

$rP_{1.2}$	=	Phenotypic correlation between characters X_1 and X_2
$Cov\ P_{1.2}$	=	Phenotypic covariance of character X_1 and X_2
$Var.P_1$	=	Phenotypic variance of character X_1
$Var.P_2$	=	Phenotypic variance of character X_2

$$rg_{1.2} = \frac{Cov\ G_{1.2}}{\sqrt{Var.G_1 \times Var.G_2}}$$

Where,

$rg_{1.2}$	=	Genotypic correlation between characters X_1 and X_2
$Cov.G_{1.2}$	=	Genotypic covariance of characters X_1 and X_2
$Var.G_1$	=	Genotypic variance of character X_1
$Var.G_2$	=	Genotypic variance of character X_2

The correlation coefficients were compared with table value of correlation coefficients at one and five per cent levels of significance (Snedecor and Cochran, 1967).

3.1.3.3.2 Path coefficient analysis

Path coefficient analysis suggested by Wright (1921) and illustrated by Deway and Lu (1959) was carried out to know the direct and indirect effects of yield related morphological and fruit traits on fruit yield. The correlation observed between two traits was separated to direct and indirect effects by this procedure. Standard path coefficient which are the standardized partial regression coefficients were obtained by solving the following set of 'p' simultaneous equations through the use of "Doolittle technique' as described by Goulden (1959).

$$rX_1Y = a + br\ X_1X_2 + cr\ X_1X_3 + \text{--------}$$

$$rX_2Y = ar\ X_1X_2 + b + cr\ X_2X_3 \quad \text{--------}$$

$$rX_3Y = ar\ X_1X_3 + br\ X_2X_3 + C + \text{--------}$$

$$\vdots$$

$$rX_{15}Y = ar\ X_1X_{15} + br\ X_2X_{15} + cr\ X_3X_{15} + \text{--------}$$

Where,

a, b, c-----k are direct effects of X_1, X_2, X_3 ----- X_{15}, respectively and br X_1X_2, Cr X_1X_3,--------jr $X_{14}X_{15}$ are indirect effects.

$$\text{Residual effect(R)} = 1 - \sqrt{a^2 + b^2 + c^2 + \text{----} + K^2 + 2abr\ X_1X_2 + 2\ acr\ X_1X_3 + \text{--------}}$$

3.1.4 Diversity analysis

3.1.4.1 Computation of D^2 values

Mahalanobis D^2 statistic (1936) was used for assessing the genetic divergence between varieties. The generalized distance between any two populations is defined as

$$\Delta^2 = \sum\sum \lambda_{ij} s_i s_j$$

Where,

λij = is the reciprocal matrix to the common dispersion matrix.

s_i = is the difference between the mean values of two populations for the i^{th} character ($\mu i_1 - \mu i_2$)

s_j = is the difference between the mean values of the two populations for the j^{th} character ($\mu j_1 - \mu j_2$)

μ = vector of mean values for all the characters.

The formula for the estimation of distance D^2 from samples

$$D^2p = \underset{\sim}{d}^1 \; S^{-1} \; \underset{\sim}{d}$$

Where,

D^2p = Square of the distance considering P varieties

$\underset{\sim}{d}$ = Vector of observed difference of the mean values of all the characters ($\bar{X}_{11} - \bar{X}_{12}$)

S^1 = Inverse of variance covariance matrices

Formula for computation of D^2 values requires inversion of the matrix and becomes complicated especially when the number of variables under consideration are large. Therefore, the original correlated unstandardised variables (X_i) were transformed to standardized uncorrelated variables (Y_i), so that the computation of D^2 values reduces to simple summation of the squares of the differences between values of transformed variables of the population that is, $\sum (di)^2$. The transformation was effected by Dwyer's square root method (Mujumdar and Rao, 1958).

From the newly transformed uncorrelated variables, the square of the distance was computed using the formula

$$D^2 = (Y_{i1} - Y_{i2})^2$$

where,

Y_{ij} = Vector of transformed mean values.

The square root of the D^2 values gives the generalized distance between two populations. The D^2 values were then arranged in a matrix form.

3.1.3.4.2 Grouping of genotypes into various clusters

The grouping of genotypes was done by using Tocher's method as described by Rao (1952). In this method, the two genotypes having smallest distance from each other were considered first to which the third genotype having smallest average D^2 value from the first two genotypes was added. Then comes the nearest fourth population and so on. At a certain stage when it was felt that after adding a particular genotype, there was abrupt increase in the average D^2, that population was not included in that cluster. Thus, the process was continued till all the genotypes were included in one or the other cluster. After the formulation of clusters, inter and intra-cluster distances were calculated. The square root of the average D^2 values were obtained to represent the distances between and within the clusters.

3.2 Experiment-II

The objectives of this experiment were to obtain information on the nature of gene action for yield and quality related components and to identify potential parents and crosses for these traits for production of high yielding and better fruit quality cultivars.

3.2.1 Material

The material for this part of the investigation consisted of 10 unrelated parents and their 45 F_1s (without reciprocals). The 10 parents were 1) White Madhapuri, 2) Higna Dorla, 3) Gare Local, 4) SM 135, 5) Surya, 6) Gokak Local, 7) Malapur Local, 8) Taiwan Naga 9) Pusa Kranti and 10) Pusa Bhairav. They happened to be from five distinct clusters based on 15 quantitative traits considered for experiment I. The primary selection of parents was based on the fruit characteristics.

The above 1 to 10 code numbers were used to denote the genotypes hereafter.

3.2.2 Hybridization programme

The 10 genotypes chosen were crossed in a diallel fashion without reciprocals to produce 45 F_1 combinations. The crossing was done during *rabi*/summer season of 1990-91. The procedure of hand emasculation in the evening and pollination of emasculated flower buds during next morning was adopted to get crossed fruits. After complete ripening of crossed fruits, the seeds from these fruits were extracted separately for each cross.

3.2.3 Experimental lay out

The experiment was laid out during *rabi*-summer 1991-92 season at the Botany garden of the Department of Genetics and Plant Breeding, College of Agriculture, Dharwad. The experiment was laid out in a randomised block design with three replications. Ten parents and their 45 F_1s were planted each in single row of 15 plants. The spacing was 75 x 60 cm between and within rows and irrigated weekly throughout the crop growth period. The recommended package of practices were followed.

3.2.4 Observations recorded

Observations similar to those in section 3.1.2 were recorded. The additional characters studied and techniques adopted to record the observations are as given below.

3.2.4.1 Plant morphological traits

3.2.4.2. Stem girth

The girth of the stem (cm) was measured at the ground level at the time of last plucking.

3.2.4.3 Biochemical parameters of the fruit

Five fruits of optimum size at edible stage were selected for estimation of following biochemical parameters during last plucking from each genotype in all the three replications. These fruits were dried in oven at 65° ± 1°C till they attained constant weight. The dehydrated samples were finely ground to pass through 40 mesh sieve. A composite sample of five dried fruits of each genotype in each replication was used for further estimation.

3.2.4.3.1 Dry matter

The fresh weight and the dehydrated fruit weight after drying five fruits in oven at 65°C till constant weight were taken for each genotype in each replications. Per cent dry matter in fruits at edible stage of fruits was calculated as

$$\text{Dry matter (\%)} = \frac{\text{Weight of dried fruits}}{\text{Weight of fresh fruits}} \times 100$$

Extraction of dried fruit sample in alcohol

One gram of dried fine fruit powder from each genotype was extracted in 10 ml of 80 per cent hot ethanol. The supernant liquid was filtered through filter paper. The residue was re-extracted two to three times. The filterate was stored at $4^{o}C$ in tightly closed plastic bottles. This alcoholic extract was made up to 25 ml with 80 per cent alcohol and used for the estimation of phenols and sugars.

3.2.4.3.2 Total phenols

The phenols were estimated in the suitable aliquots of alcoholic extract of dry fruits as described above with Folin-ciocalteau reagent as per the method suggested by Swain and Hillis (1959).

3.2.4.3.3 Estimation of orthodihydroxy phenols

Orthodihydroxy phenols were also estimated in the alcoholic extract following a method by Nair and Vaidyanathan (1964).

3.2.4.3.4 Estimation of total sugars

Total sugars were estimated in alcohol free extract of dry fruits after hydrolysis with H_2SO_4 and estimated the reducing sugars present in the hydrolysates following Nelson (1944) method.

3.2.4.3.5 Estimation of reducing sugars

The reducing sugars were estimated in alcohol free extract of dry fruits, following the method of Nelson (1944).

3.2.4.3.6 Estimation of crude protein by micro-Kjeldahl method

The crude proteins were estimated in dried fruit samples by micro-Kjeldahl method as outlined by AOAC (1965).

3.2.5 Statistical methods

The per cent data in all cases were transformed into arc-sine values for further statistical analysis. Treatment means based on the data collected for 22 characters were used for computing the analysis of variance (ANOVA) for parents, and F_1s for each character (Panse and Sukhatme, 1967). The sum of squares due to treatments were sub-divided into sum of squares due to parents, F_1s and parents vs F_1s.

3.2.5.1 Estimation of heterosis

The magnitude of heterosis in relation to mid parent, better parent and top parent was worked out. These were calculated as per cent increase or decrease of F_1s over their respective mid parent (MP), better parent (BP) and top parent (TP) values following the methods of Turner (1953) and Hays *et al.* (1955).

Mid parental value (MP) = $\frac{\bar{P}_1 + \bar{P}_2}{2}$

Per cent heterosis over MP = $\frac{\bar{F}_1 - \overline{MP}}{\overline{MP}} \times 100$

Per cent heterosis over BP = $\frac{\bar{F}_1 - \overline{BP}}{\overline{BP}} \times 100$

Per cent heterosis over TP = $\frac{\bar{F}_1 - \overline{TP}}{\overline{TP}} \times 100$

Where ,

$\bar{F}_1$, $\overline{MP}$, $\overline{BP}$ and $\overline{TP}$ are the mean values of F_1 hybrid, mid parent, better parent and top parent, respectively.

In case of days to flower, stalk length of fruit, seed weight per fruit, keeping quality index, total phenols(%) and orthodihydroxy phenols (%), lower parent was considered as better parent or top parent. For the rest of characters, the higher value was taken as better parent.

3.2.5.2 Test of significance

Standard error (SE) for heterosis over MP, BP and TP was calculated as follows.

SE for heterosis over MP = $\left(\frac{3\ EMS}{2\ r}\right)^{\frac{1}{2}}$

SE for heterosis over BP or TP = $\left(\frac{2EMS}{r}\right)^{\frac{1}{2}}$

Corresponding critical difference (C.D.) values were calculated by multiplying the standard errors (SE) with table value of 't' at error degrees of freedom for 5 and 1 per cent level of probability and these were used to test the statistical significance.

3.2.5.3 Analysis of combining ability

The variation among treatments was partitioned into genetic components attributable to general (GCA) and specific (SCA) combining ability employing the procedure for method 2 and model I of Griffing (1956b).

$$Y_{ij} = u + g_i + g_j + s_{ij} + \frac{1}{bc}\sum_k \sum_l e_{ijkl}$$

$i, j = 1, \ldots\ldots\ldots\ldots p,$

$k = 1, \ldots\ldots\ldots\ldots b,$

$l = 1, \ldots\ldots\ldots\ldots c,$

Where,

u = population mean

p = number of parents

i and j = male and female parents of ij^{th} hybrid

b = number of replications

c = number of parents per family

g_i = general combining ability (gca) effect

$s_{ij} = s_{ji}$ = specific combining ability (sca) effect

e_{ijkl} = environmental effect associated with $ijkl^{th}$ observation

since, only plant mean values were considered for analysis $Me' = Me/bc$. The restrictions imposed were $\sum_i g_i = 0$ and $\sum s_{ij} = \sum s_{ji} = 0$ (for each i).

The structure of analysis of variance followed for combining ability as proposed by Griffing (1956) is as follows.

Source	df	SS	MSS	Expected mean squares
General combining ability	P-1	Sg	Mg	$6^2e + P + 2 \frac{1}{(P-1)} \Sigma g_i^2$
Specific combining ability	$\frac{P(p-1)}{2}$	Ss	Ms	$6^2e + \frac{2}{P(p-1)} \Sigma_i \Sigma_j s_{ij}^2$
Error	M	Se	M'e	6^2e

Where,

Sg(Sum of squares due to gca)

$$= \frac{1}{P+2} \left[\Sigma_i (X_{i\cdot} + X_{ii})^2 - \frac{4}{P} X^2{\cdot}0 \right]$$

Ss (sum of squares due to sca) $= \Sigma_i \Sigma_j X_{ij}^2 - \frac{1}{P+2} \Sigma_i (X_{i\cdot} + X_{ii})^2 \times$

$$\frac{2}{(P+1)\ (P+2)} X_{\cdot}^2$$

M'e = Me/bc

Me = error variance obtained from analysis of variance for RBD

$X_{i\cdot}$ = total of array of i^{th} parent in diallel table

X_{ii} = Mean of i^{th} parent

$X_{\cdot\cdot}$ = grand total of the $\frac{P(P-1)}{2}$ + P crosses values of diallel table that is, $\Sigma_i \Sigma_j X_{ij}$

X_{ij} = value of a cell involving a cross between i and j[th] parents

p = Number of parents

Significance of Mg/M'e and MS/M'e were tested by F test.

3.2.5.4 Estimation of combining ability effects

From the two way diallel table constructed, the following effects were estimated.

$$\text{gca effects } (g_i) = \frac{1}{p+2} \left(X_{i.} + X_{ii} - \frac{2}{n} X_{..} \right)$$

$$\text{Sca effects } (s_{ij}) = X_{ij} - \frac{1}{p+2} \left(X_{i.} + X_{ii} + X_{ji} + X_{j.} \right) + \frac{2}{(p+1)(p+2)} X_{..}$$

3.2.5.5 Standard errors of estimates

The variance of effects and of differences between effects were estimated by the formulae given below. The standard errors of these effects were then calculated by taking the square roots of variances.

$$\text{Var } (g_i) = \frac{p-1}{p(p+2)} \sigma^2_e$$

$$\text{Var } (S_{ii}) = \frac{p(p-1)}{(p+1)(p+2)} \sigma^2_e$$

$$\text{Var } (S_{ij}) = \frac{p^2 + p + 2}{(p+1)(p+2)} \sigma^2_e , \quad i \neq j$$

$$\text{Var}(g_i - g_j) = \frac{2}{(p+2)} \sigma^2_e , \quad i \neq j$$

$$Var\ (s_{ii}-s_{jj}) = \frac{2(r+1)}{p+2}\ \sigma^2 e \quad ; \quad i \neq j$$

$$Var\ (s_{ij}-s_{ik}) = \frac{2(r+1)}{p+2}\ \sigma^2 e \quad ; (i \neq j,\ k,\ j \neq k)$$

$$Var\ (s_{ij}-s_{kl}) = \frac{2p}{p+2}\ \sigma^2 e ; (i \neq j;\ k,l,\ j \neq k,l \text{ and } k \neq l).$$

The critical differences were calculated by multiplying the standard errors with 't' values at 5 and 1 per cent level of probability for error degrees of freedom.

3.2.5.6 Estimation of general predictability ratio

General predictability ratio was estimated as per the method suggested by Baker (1978) for 22 quantitative characters under investigation.

$$\text{General predictability ratio} = \frac{2\ GCA}{2\ GCA + SCA}$$

Where,

GCA = Variance due to general combining ability

SCA = Variance due to specific combining ability

3.2.5.7 Classification of parents and crosses based on combining ability

The overall status of parents and crosses were ascertained with respect to gca and sca, respectively as per the method outlined by Arunachalam and Bandyopadhyay (1979) as given below.

A parent expressing significant gca effects in desired direction for a character was given a score of +1, similarly a score of -1 was given to a parent showing significant gca effects in undesired direction. Parents showing non-significant gca (either positive or negative) were given a score of zero. In this manner, all the parents were scored for 22 characters and by adding these values, total score secured by a parent was found out. The mean score for all the parents was worked out. The parents whose total score was above the mean score were classified as high general combiner (H), the parents having a total score below the mean were considered as low general combiners (L). The same procedure was followed to classify the sca effects of 45 crosses into high and low categories.

3.2.5.8 Heterosis and *per se* performance across the traits

The method outlined by Arunachalam *et al.* (1984) was followed for computation of overall better parent heterosis and *per se* performance as compared to best variety. The procedures are briefly described below.

A cross was assigned +1 score for each trait when its mean value was significantly superior over the better parent in the desired direction. The score for each cross over all the characters was added to provide its total score. The mean of the total score for each of the cross was computed and the hybrid which had a total score equal to or above the mean were allotted a high and the rest a low status.

Similarly, the level of performance of hybrids for each character in comparison with the best parent (TP) was considered to work out overall *per se* performance of a cross over 22 characters. A cross was assigned +1 score for each trait when its mean value exceeded significantly superior over the best parent (TP) in the desired direction. The score for each cross over all the characters were added to provide its total score. The mean of the total score for each of the cross was computed and the hybrid which had total score equal to or above the mean were allotted a high (H) and the rest a low status (L).

3.3 Experiment III

The objectives of this experiment were to understand the nature of inheritance of different qualitative characters and gene interactions involved in the inheritance of these characters.

3.3.1 Material

Three parents namely, Pusa Purple Cluster (P_1), Krishna Kati (P_2) and White Madhapur (P_3) which differed in a number of qualitative characters were chosen for hybridisation. Following crosses were made based on contrasting characters.

<u>Cross I</u>

F_1 - Pusa Purple Cluster x Krishna Kati $(P_1 \times P_2)$

BC_1 - $(P_1 \times P_2) \times P_1$

BC_2 - $(P_1 \times P_2) \times P_2$

F_2 - F_1 selfed

<u>Cross II</u>

F_1 - Pusa Purple Cluster x White Madhapuri $(P_1 \times P_3)$

BC_1 - $(P_1 \times P_3) \times P_3$

BC_2 - $(P_1 \times P_3) \times P_1$

F_2 - F_1 selfed

3.3.2 Characters studied

Altogether 28 characters from two different sets of contrasting crosses were studied. They are as follows.

Characters	Contrasting pair
1. Main stem colour	Purple vs green
2. Branches colour	Purple vs green
3. Basal leaf midrib colour	Purple vs green
4. Basal leaf vein colour	Purple vs green
5. Basal leaf petiole colour	Purple vs green
6. Terminal leaf lamina colour	Purple vs green
7. Terminal leaf midrib colour	Purple vs green
8. Terminal leaf vein colour	Purple vs green

9.	Terminal leaf petiole colour	Purple vs green
10.	Pedicel colour of flower	Purple vs green
11.	Flower calyx colour	Purple vs green
12.	Flower petal colour	Purple vs white
13.	Petal line colour	Purple vs white
14.	Pubescence on flower pedicel	Present vs absent
15.	Pubescence on flower calyx	Present vs absent
16.	Colour of pubescence on floral parts	Purple vs green
17.	Fruit colour	Purple vs green or white
18.	Stalk colour of fruit	Purple vs green
19.	Calyx colour of fruit	Purple vs green
20.	Fruiting habit	Non-cluster vs cluster
21.	Pubescence on fruit stalk	Present vs absent
22.	Pubescence on fruit calyx	Present vs absent
23.	Colour of fruit pubescence	Purple vs green
24.	Fruit shape	Elongated vs round
25.	Thorn on stem	Present vs absent
26.	Thorn on leaf petiole	Present vs absent
27.	Thorn on leaf midrib	Present vs absent
28.	Thorn on leaf vein	Present vs absent

3.3.3 <u>Hybridisation and raising of F_1, F_2, BC_1 and BC_2</u>

The crossing between three parents was done during *Rabi*-summer 1990-91 to develop F_1 seeds. The F_1s were grown along with parents and backcrossed with their respective parents to get BC_1 and BC_2 seeds in each cross. The F_1s were selfed to get F_2 seed. Three contrasting parents, their F_1 hybrids, F_2, BC_1 and BC_2 populations were grown during 1991-92 *kharif* season at the Botany garden, College of Agriculture, Dharwad. The recommended package of practices were adopted during crop growth period. All observations were recorded at the right stage of expression of the character. Fifty plants each of parents and F_1s were observed for the contrasting characters. For backcrosses, and F_2, more than 300 plants were observed.

3.3.4 Statistical technique

The expected values corresponding to the observed values for each character were calculated on the basis of the presumed ratio. The deviations of these were put to chi-square test by using the following formula.

$$\chi^2 = \sum \frac{(O - E)^2}{E} \quad \text{with n-1 degrees of freedom.}$$

Where,

$\sum$ = Summation over all classes

O = Observed number

E = Expected number

n = Number of classes

Deviations were taken as significant whenever the calculated chi-square value was more than the table value (3.841) at 5 per cent level and one degree of freedom and the ratio presumed was taken as not fit. On the other hand, deviations were taken as non-significant if the calculated chi-square value was less than the table value (3.841) at 5 per cent level and one degree of freedom and ratio presumed as fit. However, the most appropriate ratio for the character was taken only after confirming ratios in backcross generations that is, test cross, BC_2.

CHAPTER - IV

EXPERIMENTAL RESULTS

IV. EXPERIMENTAL RESULTS

The results of the experiments conducted are presented in the following sections, seperately for the sake of convenience.

- 4.1 Estimates of genetic parameters
- 4.2 Inter character correlations
- 4.3 Path coefficient analysis
- 4.4 Diversity analysis
- 4.5 Heterosis, combining ability of yield, yield attributes and quality related components
- 4.6 Inheritance of qualitative characters

4.1 Estimates of genetic parameters

4.1.1 Analysis of variance

Analysis of variance was carried out for 15 characters including plant morphological and fruit parameters in a set of 76 cultivars of brinjal. The variances (mean squares) due to known and unknown causes were computed by using the method suggested by Lush (1940), Choudhary and Prasad (1968) and are presented in Table 2. The variance due to treatments (genotypes) was tested for its significance by F test.

The treatment variances for all the 15 characters were highly significant indicating large amount of variation

Table 2. Analysis of variance (mean squares) for fifteen characters among 76 cultivars of brinjal.

Sl. No.	Source characters	Replication	Treatments	Error	Coefficient of variation (%)
1	Days to flower	19.739**	47.195**	1.635	1.63
2.	Fruit yield per plant (g)	27385.870	580118.310**	10146.015	13.01
3.	Number of fruits per plant	2.583	157.280**	2.890	13.49
4.	Plant height (cm)	57.154*	385.310**	14.926	4.41
5.	Plant spread (cm)	42.274	322.296**	48.784	7.30
6.	Primary branches (Nos)	10.613**	0.5268**	0.150	10.38
7.	Secondary branches (Nos.)	71.247**	39.789**	3.961	8.98
8.	Fruit weight (g)	121.584**	1967.666**	19.654	5.53
9.	Fruit length (cm)	0.4080	27.567**	0.772	10.79
10.	Fruit girth (cm)	1.873	19.108**	1.922	9.20
11.	Stalk length of fruit (cm)	0.426	4.163**	0.608	9.26
12.	Fruit density	0.00014	0.0046**	0.0074	3.74
13.	Rind thickness (cm)	0.00438	0.0351**	0.0015	5.56
14.	Keeping quality Index	2.1017	34.833**	1.594	4.76
15.	Seed weight per fruit (g)	0.3431*	5.2699**	0.0856	10.05
-	Degrees of freedom	2	75	150	-

*, ** - Significant at 5 and 1 per cent levels of probability, respectively

for all the characters under study among the genotypes. The coefficient of variation was found to range between 1.63 (days to flower) and 13.49 (number of fruits per plant) per cent in the experiment. The variation due to replication was highly significant for characters namely, days to flower, primary branches, secondary branches, fruit weight and significant for plant height and seed weight per fruit at one and five per cent levels of probability, respectively.

4.1.2 Genetic parameters

The mean, range, phenotypic and genotypic coefficients of variation, heritability and expected genetic advance estimates for each character are presented in Table 3. The wide range of variation was observed for all the characters under study. The fruit yield per plant ranged between 180 and 2621 g among the genotypes followed by plant height (66.3 - 121.0 cm), plant spread (57.7 - 116.1 cm) and days to flower (68.7 - 87.7 days). Other plant morphological characters ranged between 3 and 35.3 for number of fruits per plant, 12.3 and 33.1 for number of secondary branches and 2.7 and 4.6 for number of primary branches. The wide range of variation was also noticed for different fruit parameters. Fruit weight ranged between 44.3 and 160.7 g followed by fruit length (3.7 to 24.0 cm), fruit girth (9.0 to 21.7 cm), keeping quality (7.9 to 29.2%), stalk length (4.7 to 10 cm), seed weight per fruit (0.63 to 7.37 g), fruit density

Table 3. Mean, range and genetic parameters of fifteen quantitative characters in 76 cultivars of brinjal.

Sl. No.	Characters	Mean	Range	Phenotypic variance	Genotypic variance	Phenotypic coeff. of variation(%)	Genotypic coeff.of variation(%)	Heritability (broad sense) (%)	Genetic advance	Genetic advance over mean (%)
1	2	3	4	5	6	7	8	9	10	11
1.	Days to flower	78.17	68.7 - 87.7	16.821	15.187	5.247	4.985	90.28	7.628	9.758
2.	Fruit yield per plant (g)	774.38	180 - 2621	200136.780	18990.760	57.771	56.287	94.93	874.850	112.974
3.	Number of fruits per plant	12.6	3 - 35.3	54.353	51.463	58.112	56.930	94.68	14.380	114.125
4.	Plant height(cm)	87.59	66.3 - 121.0	138.388	123.461	13.43	12.68	89.21	21.62	24.68
5.	Plant spread(cm)	95.57	57.7 - 116.1	139.95	91.17	12.379	9.99	65.14	15.87	16.61
6.	Primary branches (Nos.)	3.72	2.7 - 4.6	0.275	0.126	14.087	9.517	45.64	0.49	13.24
7.	Secondary branches (Nos.)	23.16	12.3 - 33.1	15.904	11.943	17.997	15.595	75.09	6.169	27.84
8.	Fruit weight(g)	80.158	44.3 - 160.7	668.99	649.34	32.267	31.79	97.06	51.71	64.52
9.	Fruit length(cm)	8.145	3.7 - 24.0	9.704	8.932	38.247	36.69	92.04	5.91	72.52
10.	Fruit girth(cm)	15.06	9.0 - 21.7	7.651	5.729	18.366	15.893	74.88	4.27	28.33
11.	Stalk length of fruit (cm)	7.246	4.7 - 10.8	1.793	1.185	18.480	15.025	66.11	1.823	25.167
12.	Fruit density	0.727	0.64- 0.86	0.002	0.0013	6.189	4.938	63.547	0.059	8.109
13.	Rind thickness(cm)	0.687	0.35 - 0.93	0.013	0.0112	16.37	15.39	88.40	0.205	29.81
14.	Keeping quality index	20.21	7.9 - 29.2	12.675	11.079	13.43	12.56	87.41	0.411	24.184
15.	Seed weight per fruit (g)	2.912	0.63 - 7.37	1.814	1.728	46.24	45.14	95.28	2.64	90.768

(0.64 to 0.86) and rind thickness (0.35 to 0.93 cm). The lowest range of variation was observed for number of primary branches per plant (2.7 to 4.6), fruit density (0.64 to 0.86) and rind thickness among the genotypes (0.35 to 0.93 cm).

In general, the phenotypic variances and phenotypic coefficients of variation (PCV) were greater than respective genotypic variances and genotypic coefficients of variation (GCV) for all the characters. The highest genotypic coefficient of variation was exhibited by number of fruits per plant (56.93%) followed by fruit yield per plant (56.28%). A low GCV was found for other plant morphological traits like the number of secondary branches per plant (15.60%), plant height (12.68%), plant spread (9.99%), number of primary branches per plant (9.52%) and days to flower (4.98%).

Among the fruit parameters, the highest GCV was shown by seed weight per fruit (45.14%) followed by fruit length (36.69%) and fruit weight (31.79%). Other fruit parameters exhibited low GCV for fruit girth (15.89%), rind thickness (15.39%), stalk length (15.02%), keeping quality index (12.56%) and fruit density (4.94%). Similar was the trend for phenotypic coefficient of variation (PCV) for all the characters. The above observations revealed the lowest GCV and PCV for fruit density and days to flower.

The heritability estimates in broad sense were high for all the morphological traits except primary branches (45.64%). Similarly, the heritability estimates for all fruit parameters were also high, which ranged between 97.06 (fruit weight) and 63.55 (fruit density) per cent among the genotypes.

The highest estimate of genetic advance (%) over mean was shown by number of fruits per plant (114.12) followed by fruit yield per plant (112.97). Other plant morphological traits exhibited moderate to low estimates of genetic advance ranging between 9.57 (days to flower) and 27.84 per cent (number of secondary branches).

The high estimates of genetic advance (%) over mean was exhibited by seed weight per fruit (90.77), fruit length (72.52) and fruit weight (64.52). Other fruit traits showed moderate to low estimates of genetic advance over mean ranging between 8.11 (fruit density) and 29.81 per cent (rind thickness).

The estimates of genetic parameters revealed that moderate to high GCV accompanied with high estimates of heritability and genetic advance were exhibited by some characters namely, fruit yield per plant, number of fruits per plant, fruit weigt, fruit length and seed weight per fruit.

4.2 Correlations between characters

The inter character correlations at phenotypic and genotypic levels between 15 characters in the present investigation were worked out and are presented in Table 4.

Among the characters considered, number of fruits per plant, average fruit weight, and fruit length showed significant positive correlation with fruit yield both at phenotypic and genotypic levels. The keeping quality index showed negative significant genotypic correlation with fruit yield, while it was not significant at phenotypic level. The stalk length of fruit showed high positive correlation with fruit yield both at genotypic and phenotypic levels but was comparatively low and non-significant. Similarly, fruit density showed appreciable negative correlation with fruit yield but it was not significant at both phenotypic and genotypic levels. The other characters like days to flower, plant spread, primary branches, rind thickness of fruit and seed weight per fruit showed low but positive correlation with fruit yield per plant. However, the characters like plant height, secondary branches and fruit girth showed low and negative correlation with fruit yield per plant at both genotypic and phenotypic levels.

Among the associations between different morphological and fruit traits, the days to flower exhibited significant positive correlation with seed weight per fruit

Table 4. Phenotypic and genotypic correlations of 15 quantitative characters in brinjal.

Sl. no.	Character	Days to flower	Fruit yield/ plant	No.of fruits/ plant	Plant height (cm)	Plant spread	Primary branches	Secondary branches	Fruit weight
1	2	3	4	5	6	7	8	9	10
1.	Days to flower		0.040	0.093	0.101	-0.028	-0.038	0.106	-0.192
2.	Fruit yield per plant	0.042		0.791**	-0.004	0.081	0.050	-0.055	0.271*
3.	No.of fruits per plant	0.093	0.790**		-0.033	-0.038	0.005	-0.078	-0.104
4.	Plant height	0.129	-0.025	-0.055		0.385**	0.293**	0.208	-0.042
5.	Plant spread	-0.020	0.061	-0.092	0.427**		0.270*	0.446**	0.225*
6.	Primary branches	-0.091	0.069	0.013	0.453**	0.416**		0.107	-0.001
7.	Secondary branches	0.151	-0.070	-0.102	0.219	0.501**	0.133		-0.009
8.	Fruit weight	-0.208	0.287*	-0.103	-0.048	0.270*	0.015	-0.019	
9.	Fruit length	-0.168	0.535**	0.317**	-0.003	-0.011	0.121	-0.301**	0.505**
10.	Fruit girth	-0.180	-0.013	-0.300**	-0.256*	0.170	-0.054	0.207	0.636**
11.	Stalk length of fruit	-0.087	0.173	-0.134	0.360**	0.184	0.325**	-0.144	0.491**
12.	Fruit density	0.147	-0.179	-0.098	-0.050	-0.037	-0.256*	0.358**	-0.028
13.	Rind thickness	0.212	0.024	-0.100	0.031	0.088	-0.123	0.154	-0.062
14.	Keeping quality index	0.180	-0.224*	-0.003	0.143	0.009	0.152	-0.213	-0.556**
15.	Seed weight per fruit(g)	0.257*	0.048	-0.159	-0.031	0.135	-0.253*	0.184	0.144

Contd

Table 4 (Contd..)

Sl. No.	Character	Fruit length (cm)	Fruit girth (cm)	Stalk length of fruit (cm)	Fruit density	Rind thickness	Keeping quality index	Seed weight per fruit
1	2	11	12	13	14	15	16	17
1.	Days to flower	-0.154	-0.146	-0.066	0.117	0.199	0.152	0.236*
2.	Fruit yield per plant	0.509**	-0.002	0.161	-0.164	0.024	-0.206	0.058
3.	No. of fruits per plant	0.306**	-0.239*	-0.073	-0.109	-0.089	-0.007	-0.140
4.	Plant height	0.001	-0.183	0.292**	-0.042	0.027	0.120	-0.025
5.	Plant spread	-0.005	0.162	0.186	-0.006	0.090	-0.032	0.117
6.	Primary branches	0.037	-0.063	0.147	-0.161	-0.053	0.073	-0.144
7.	Secondary branches	-0.270*	0.164	-0.092	0.264*	0.114	-0.185	0.163
8.	Fruit weight	0.487**	0.558**	0.404**	-0.008	-0.056	-0.510**	0.138
9.	Fruit length		-0.141	0.324**	-0.199	-0.131	-0.303**	-0.140
10.	Fruit girth	-0.167		0.078	0.001	0.130	-0.320**	0.200
11.	Stalk length of fruit	0.371**	0.056		0.013	-0.066	-0.104	0.060
12.	Fruit density	-0.228*	0.013	-0.015		-0.041	-0.054	0.071
13.	Rind thickness	-0.158	0.151	-0.092	-0.023		-0.101	0.363**
14.	Keeping quality index	-0.344**	-0.382**	-0.140	-0.086	-0.116		0.007
15.	Seed weight per fruit (g)	-0.142	0.227*	0.057	0.104	0.393**	0.011	

*, ** = Significant at 5 and 1 per cent levels of probability, respectively.

- Above the diagonal - phenotypic correlations
- Below the diagonal - genotypic correlations

at phenotypic and genotypic levels. Days to flower showed non-significant and appreciable positive correlation with plant height, secondary branches, fruit density, rind thickness and keeping quality index of fruit at phenotypic and genotypic level, while days to flower exhibited negative and non-significant correlation with fruit weight, fruit length, and fruit girth at phenotypic and genotypic levels.

Number of fruits per plant showed highly significant positive correlation with fruit length both at phenotypic and genotypic levels. On the contrary, it exhibited significant negative correlation with fruit girth at phenotypic and genotypic level. Number of fruits per plant exhibited non-significant negative correlation with other traits except primary branches (0.013) and days to flower (0.093) at phenotypic and genotypic levels.

Plant height showed highly significant positive correlation with plant spread, primary branches and stalk length of fruit at phenotypic and genotypic levels. Plant height exhibited negative significant correlation with fruit girth at genotypic level, while the correlation was non-significant at phenotypic level. Plant height exhibited non-significant positive correlation with secondary branches and keeping quality index of fruit at phenotypic and genotypic levels. The remaining traits exhibited low negative correlation with plant height at phenotypic and genotypic level.

The plant spread showed significant positive correlation with primary branches, secondary branches and fruit weight both at phenotypic and genotypic levels. The other traits like fruit girth, stalk length of fruit and seed weight per fruit exhibited non-significant positive correlation with plant spread at phenotypic and genotypic levels.

The primary branches exhibited highly significant positive correlation with stalk length of fruit at genotypic level but it was non-significant at phenotypic level. Similarly, it showed significant and negative correlations with fruit density and seed weight per fruit at genotypic level only.

The secondary branches showed significant negative correlation with fruit length, while it exhibited positive significant correlation with fruit density at both phenotypic and genotypic levels.

The fruit weight exhibited highly significant positive correlation with fruit length, fruit girth and stalk length of fruit, while it showed highly significant negative correlation with keeping quality index of fruit at both phenotypic and genotypic levels.

Fruit length showed highly significant positive correlation with stalk length of fruit at phenotypic and genotypic levels, while it exhibited highly significant negative correlation with keeping quality index of fruit at phenotypic and genotypic levels. The fruit length exhibited significant negative correlation with fruit density at genotypic level only.

The fruit girth showed highly significant negative correlation with keeping quality index of fruit at phenotypic and genotypic levels. On the other hand, it showed a positive significant correlation with seed weight per fruit at genotypic level only.

The rind thickness of fruit showed highly significant positive correlation with seed weight per fruit at both genotypic and phenotypic levels.

In general, the genotypic correlations were higher in magnitude over respective phenotypic correlations except for in the case of days to flower with plant spread, fruit yield with seed weight per fruit, number of fruits per plant with keeping quality index and fruit density, fruit girth with primary branches and stalk length, seed weight with stalk length of fruit and rind thickness with fruit density. The phenotypic correlation between above mentioned characters were slightly of a higher order of magnitude than their respective genotypic correlations.

4.3 Path coefficient analysis

The genotypic coefficients of correlation between different characters under study were subjected to path coefficient analysis for partitioning the direct and indirect effects of these traits on fruit yield, which was considered as the dependent variable. The direct and indirect effects of various traits are given in Table 5.

The highest direct positive effect on fruit yield was from days to flower (0.035)followed by primary branches (0.026), stalk length of fruit, number of fruits per plant (0.003)and rind thickness (0.002). The highest negative direct effect on fruit yield was from fruit weight (-0.084) followed by fruit length (-0.069), fruit girth (-0.057), keeping quality index (-0.006), plant height (-0.004), secondary branches (-0.004), fruit density (-0.003) and plant spread (-0.002) in order of magnitude.

Though the number of fruits per plant had highest positive correlation with fruit yield, the maximum indirect positive contribution was through days to flower followed by fruit length, fruit weight and fruit density in order of magnitude. Other characters had negative indirect effect through number of fruits per plant except plant height, primary branches and keeping quality index.

Table 5. Direct and indirect effects of fourteen quantitative characters on fruit yield in brinjal.

Sl. No.	Characters	Days to flower	Number of fruits per plant	Plant height	Plant spread	Primary branches	Secondary branches	Fruit weight
1	2	3	4	5	6	7	8	9
1.	Days to flower	0.035	0.075	-0.001	-0.001	0.003	0.005	0.029
3.	No. of fruits per plant	0.810	0.003	0.000	-0.006	-0.000	-0.003	0.014
4.	Plant height(cm)	-0.004	0.005	-0.004	0.027	-0.015	0.007	-0.044
5.	Plant spread	0.063	-0.001	0.016	-0.002	-0.014	0.017	-0.074
6.	Primary branches	-0.033	-0.003	-0.031	-0.002	0.026	0.005	0.011
7.	Secondary branches	0.034	0.005	0.022	-0.001	0.032	-0.004	-0.082
8.	Fruit weight (g)	-0.137	-0.007	0.000	0.017	-0.000	-0.001	-0.084
9.	Fruit length (cm)	0.342	-0.006	0.000	-0.001	-0.004	-0.010	0.257
10.	Fruit girth (cm)	0.302	-0.006	0.001	0.011	0.002	0.007	-0.243
11.	Stalk length of fruit	0.206	-0.003	-0.001	0.012	-0.011	-0.005	-0.108
12.	Fruit density	-0.065	0.005	0.000	-0.002	0.008	0.012	-0.080
13.	Rind thickness	0.048	0.007	-0.000	0.006	0.004	0.005	-0.081
14.	Keeping quality index	-0.031	0.006	-0.001	0.001	-0.005	-0.007	-0.002
15.	Seed weight per fruit	0.121	0.009	0.000	0.009	0.008	0.006	-0.129

Contd..

Table 5 (Contd..)

Sl. No.	Characters	Fruit length	Fruit girth	Stalk length of fruit	Fruit density	Rind thickness	Keeping quality index	Seed weight per fruit	Correlation with fruit yield per plant
1	2	10	11	12	13	14	15	16	17
1.	Days to flower	-0.057	-0.054	-0.018	-0.010	0.010	-0.006	0.031	0.042
3.	No. of fruits per plant	0.108	-0.091	-0.028	0.006	-0.005	0.000	-0.019	0.790**
4.	Plant height(cm)	0.007	-0.001	-0.077	0.074	0.003	0.002	-0.004	-0.025
5.	Plant spread	-0.037	-0.004	0.051	0.038	0.002	0.004	-0.000	0.061
6.	Primary branches	-0.002	0.041	-0.016	0.067	0.016	-0.006	-0.005	0.069
7.	Secondary branches	0.003	-0.103	0.063	-0.030	-0.023	0.007	0.007	-0.070
8.	Fruit weight (g)	0.172	0.192	0.101	0.002	-0.003	0.017	0.017	0.287*
9.	Fruit length (cm)	-0.069	-0.050	0.076	0.015	-0.008	0.011	-0.017	0.535**
10.	Fruit girth(cm)	-0.087	-0.057	0.012	-0.001	0.007	0.012	0.027	-0.013
11.	Stalk length of fruit	-0.067	0.127	0.017	0.001	-0.004	0.004	0.007	0.173
11.	Fruit density	0.004	-0.078	0.004	-0.003	-0.001	0.003	0.013	-0.179
13.	Rind thickness	0.008	-0.054	0.046	-0.019	0.002	0.004	0.048	0.024
14.	Keeping quality index	0.076	-0.117	-0.116	-0.029	0.006	-0.006	0.001	-0.224*
15.	Seed weight per fruit	-0.020	-0.049	0.069	0.012	-0.007	0.019	-0.000	0.048

The figures underlined are direct path effects. Residual effects .. 0.1589

The fruit length, had highly significant positive correlation with fruit yield but showed negative direct effect on fruit yield. The maximum indirect positive contribution was from days to flower and fruit weight through fruit length.

Fruit weight was another important character which had positive significant correlation with fruit yield but showed negative direct effect on fruit yield. Fruit length, fruit girth and stalk length of fruit had maximum indirect positive effect through fruit weight on fruit yield per plant.

The keeping quality index had negative significant genotypic correlation with fruit yield, which was mainly contributed indirectly by fruit girth and stalk length of fruit through keeping quality index.

The magnitude of direct effect of all the traits was lower than genotypic correlation due to positive and negative indirect contribution of different traits under study through respective traits, except fruit girth. The direct negative effect of fruit girth on fruit yield showed higher magnitude over their respective genotypic correlation between these traits. The fruit weight and fruit length showed maximum negative indirect contribution through fruit girth, while days to flower had indirect positive effect through fruit girth on fruit yield.

Among the other traits, indirect effect of the number of fruits per plant, fruit weight and seed weight per fruit contributed positively through days to flower, while fruit length, fruit girth, stalk length of fruit and fruit density showed maximum negative indirect effect through days to flower on fruit yield.

The indirect effect of stalk length of fruit, fruit weight and primary branches were negative through plant height, while plant spread and fruit density showed maximum positive indirect effect through plant height on fruit yield per plant.

Fruit density, fruit girth, rind thickness and fruit weight contributed positively indirectly through primary branches, while days to flower, plant height and stalk length of fruit exhibited maximum negative indirect effect through primary branches.

Indirect effect of days to flower, plant height, primary branches and stalk length of fruit was maximum positive through secondary branches, while fruit weight, fruit girth, fruit density and rind thickness had high negative indirect effect through secondary branches on fruit yield.

Positive indirect effect of days to flower and fruit girth were maximum through stalk length of fruit, while fruit weight and fruit length exhibited maximum negative effects through stalk length of fruit on fruit yield per plant.

Negative indirect effect of days to flower, fruit weight and fruit girth was maximum through fruit density, while secondary branches and seed weight per fruit had maximum positive effect through fruit density on fruit yield per plant.

Days to flower, stalk length of fruit and seed weight per fruit exhibited maximum positive indirect effect through rind thickness, while fruit weight, fruit girth and fruit density showed maximum negative indirect effect through rind thickness on fruit yield per plant.

Seed weight per fruit had no direct effect on fruit yield per plant. But days to flower, and stalk length of fruit exhibited positive indirect effect through seed weight per fruit, whereas fruit weight had a maximum indirect negative effect through seed weight per fruit on fruit yield per plant.

Path analysis of 14 plant morphological and fruit related parameters revealed that number of days to flower, primary branches and stalk length of fruit exhibited maximum direct effect on fruit yield. But positive indirect contribution through fruit weight, fruit length and fruit girth on yield were evident.

4.4 Diversity analysis

The genetic diversity existing in a collection of 75 genotypes under study with respect to 15 plant morphological and fruit characters was analysed by using Mahalanobis's generalised distance (D^2) analysis. The results obtained are presented hereunder.

4.4.1 Mahalanobis's (D^2) analysis

The correlated unstandardised means of the characters under study were transformed to standardised uncorrelated set of variables using Duyer's square root method (Rao, 1952). The statistical distance (Mahalanobis's D^2) between pairs of genotypes was obtained as the sum of squares of differences between corresponding uncorrelated values of any two genotypes. Since each produced 75 combinations, 5625 D^2 values were obtained for 75 genotypes. The D^2 values ranged from 21.485 (between genotypes 52 and 53) to 2080.369 (between genotypes 5 and 72).

Based on the calculated squares of the generalised distances (D^2 values), genotypes under study were grouped into seven clusters following the method suggested by Tocher (Rao, 1952) (Table 6). The cluster-I was the

Table 6. Distribution of seventyfive cultivars of Brinjal in seven clusters.

Sl. no.	Cluster number	Total varieties	Varieties
1	I	59	1. Arka Kusumaker, 2. Arka Shirish, 3. Arka Sheel, 4. Higna Dorla, 6. Bhamrad No.2, 7. Bhamrad No.3, 8. TambalWadi Local, 9. Higna Dorla (Th.), 12. Aruna, 13. Chikhalgaon-1, 15. PBR 129-5, 16. Shekharwadi, 17. Mahabaleswar, 18. Solanoa writti, 19. Krishna Kati, 20. Shirur-1, 21. R 249-10, 22. Kapadne 23. Pure White, 24. Borgaon-1, 25. P 5-8, 26. Gota-2, 28. P-8, 29. Dorly, 30. Majri Gota, 33. Gare Local, 37. PBR 91-1, 38. Aru 1C, 39. S 258, 40. SM-2, 41.S 35-2 42. BB-7, 43. MPU-1, 44. Wkl-25, 45. White Cluster, 46. Oblong Local, 47. Khed Shivpuri, 48. IHR-12B, 49. SM-78, 50. Kapadane-1, 51. SM 133, 52. SM 121, 53. SM 135, 55. Surya, 56. PI 348612, 57. W CGR 112-8, 58. Udupi Galla, 60. Malapur Local, 61. Kali Rawai, 62. Taiwan Naga, 63. Nagad Local, 64. Banaras Giant, 65. Saudetti Local, 66. Beauty white, 67. Medina, 68. Ceylone, 69. Black Beauty, 70. Composite-1, 71. Composite-2.
2	II	5	34. White Long, 35. Kranti, 36. Banaras Green, 59. Gokak Local, 75. Raidurg Local.
3	III	4	10. Murki, 11. Jalgaon Local, 31. Mushira, 32. Aru-1.
4	IV	2	27. Kalyanpur T2, 73. Pusa Kranti.
5	V	2	14. Vaishali, 54. Junagad Oblong.
6	VI	2	72. Pusa Purple Long, 74. Pusa Bhairav.
7.	VII	1	5. White Madhapuri

largest and it consisted of 59 varieties. Second and third clusters had five and four varieties, respectively. Clusters IV, V and VI had two varieties each, whereas cluster VII had only one genotype (White Madhapuri).

The average within (intra) and between (inter) cluster distances and D^2 values are given in Table 7. The intra-cluster distances varied from 14.85 to 25.42 for clusters I and VI, respectively. The inter-cluster distances ranged between 18.24 (I with V) and 41.57 (VI with VII). The maximum genetic divergence was observed between clusters VI and VII as revealed by the maximum inter-cluster distance of 41.57. The inter-cluster proximity was seen to be maximum between clusters I and V as indicated by the lowest inter-cluster distance of 18.24.

Cluster I which comprised of 59 varieties was closely related with clusters V, VII, II and III in that order with respective D values of 18.24, 18.43, 19.27 and 20.77, whereas it was more diverse from clusters VI and IV clusters with the respective D values of 32.50 and 23.31.

Cluster II also showed the minimum diversity with clusters V and VII with D values of 20.93 and 21.82, respectively. The farthest clusters from the second cluster were VI, III and IV showing D values of 34.91, 26.48 and 23.50 in that order.

Table 7. Average intra (diagonal) and inter (off diagonal) cluster distances and D^2 values in brinjal.

Cluster	I	II	III	IV	V	VI	VII
I	14.85 (220.562)	19.27 (371.367)	20.77 (431.301)	23.31 (543.586)	18.24 (332.597)	32.50 (1056.247)	18.43 (339.546)
II	[illegible]	15.23 (231.998)	26.48 (701.072)	23.50 (552.245)	20.93 (438.135)	34.91 (1218.926)	21.82 (476.092)
III			16.14 (260.417)	30.62 (937.374)	19.91 (396.546)	35.74 (1277.034)	21.95 (481.854)
IV				16.083 (258.665)	19.83 (393.278)	23.98 (575.001)	31.81 (1011.916)
V					16.71 (279.327)	25.89 (670.376)	23.93 (572.450)
VI						25.42 (646.041)	41.57 (1728.041)
VII							0.00

Figures in parantheses are D^2 values

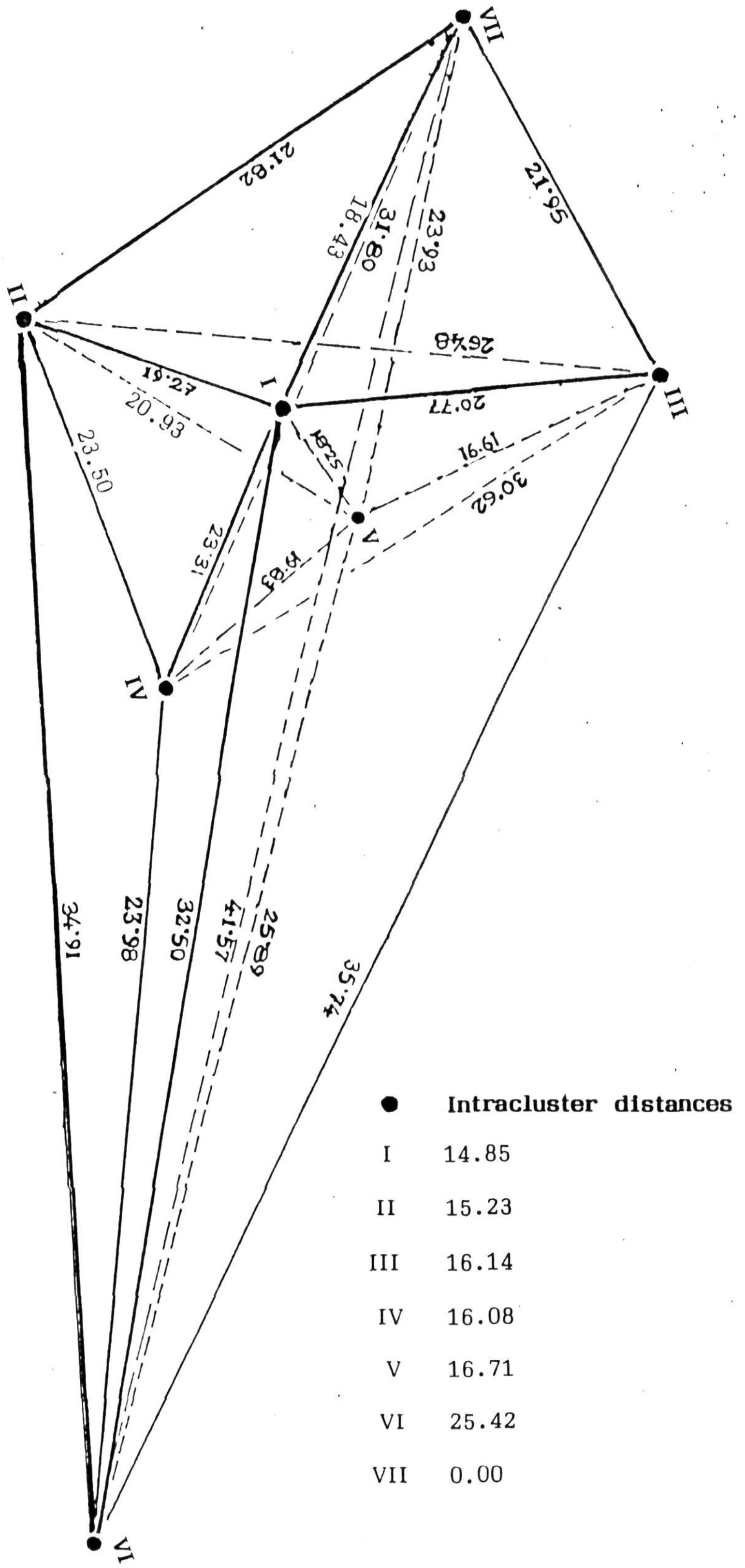

FIG 1. INTER CLUSTER DISTANCE (D) AMONG SEVENTY FIVE GENOTYPES GROUPED IN SEVEN CONSTELLATIONS.

Third cluster showed close proximity to V and VII, where the D values were 19.91 and 21.95, respectively. The VI and IV clusters showed the maximum D values of 35.74 and 30.62 from this cluster.

The fourth cluster consisting of two genotypes, presented least D value estimates of 19.83 and 23.98 from clusters V and VI in that order and was closely related to those clusters. The farthest cluster was VII (D = 31.81) from it.

Cluster number V was closely related to I, II, III and IV clusters as reflected by the least inter-cluster D values and so the farthest relationship against cluster VI (D = 25.89).

Cluster VI was in close proximity to IV and V clusters with corresponding D values of 23.98 and 25.89, respectively. The clusters VII, III, II and I showed the maximum D values of 41.57, 35.74, 34.91 and 32.50, respectively from this cluster and thus formed the farthest clusters from it. The cluster VI showed considerable divergence with all other clusters and many a times the distances observed were higher than any of the other inter-cluster distances.

Cluster VII formed a solitary cluster of a single genotype, was in close proximity to clusters I, II

III and V with intercluster distances 18.43, 21.82, 21.95 and 23.93, respectively. It showed maximum intercluster distances with clusters VI and IV, the D values being 41.57 and 31.81, respectively.

The mean values of each of the 15 characters for seven clusters are presented in Table 8. With regard to the days to flowering, cluster VI was the earliest (74.3 days) closely followed by clusters I and III (77.6). Cluster VII showed the highest mean (83.6 days) for the character followed by cluster II, IV and V with 83.2, 82.5 and 81.5 days to flower, respectively.

The mean values for the fruit yield per plant differed considerably among the clusters. The cluster VI showed the highest fruit yield per plant (234 8 g), while cluster VII had the lowest yield (274.3 g). Cluster I was second lowest in ranking, (662.5 g), while the remaining clusters II, III, IV and V with the mean yield of 1068.7 g, 1179.0 g, 1291.35 g and 1349.3 g, respectively, were close to one another.

The mean number of fruits per plant also differed considerably among the clusters, cluster III had the highest mean of 29.6 of fruits per plant, followed closely by cluster VI and V with a mean of 25.4 and 21.8 fruits per plant, respectively. Cluster VII had the lowest mean

Table 8. Means of clusters from seventy-five genotypes in respect of fifteen characters in brinjal.

Sl. no.	Characters	Mean of cluster						
		I	II	III	IV	V	VI	VII
1.	Days to flower	77.6	83.2	77.6	82.5	81.5	74.3	83.6
2.	Fruit yield per plant(g)	662.5	1068.7	1179.0	1291.35	1349.3	2348.0	274.3
3.	Number of fruits per plant	10.8	13.94	29.6	13.5	21.8	25.4	7.7
4.	Plant height (cm)	87.6	99.8	84.6	81.4	77.7	71.2	101.2
5.	Plant spread (cm)	95.5	103.60	93.1	103.8	75.6	89.7	92.4
6.	Primary branches (Nos.)	3.76	3.66	3.55	3.75	3.05	3.8	3.4
7.	Secondary branches (Nos.)	22.0	24.3	21.9	26.4	15.2	21.0	28.2
8.	Fruit weight (g)	78.4	82.3	55.0	137.8	89.5	126.3	38.7
9.	Fruit length(cm)	7.86	8.22	6.9	10.15	10.35	18.0	3.7
10.	Fruit girth (cm)	14.98	15.54	13.42	18.8	15.0	16.35	12.0
11.	Stalk length of fruit (cm)	7.2	7.5	6.3	7.7	7.0	8.8	7.0
12.	Fruit density	0.73	0.73	0.71	0.70	0.75	0.70	0.86
13.	Rind thickness(cm)	0.68	0.85	0.64	0.62	0.73	0.67	0.70
14.	Keeping quality index	21.0	21.6	19.5	11.0	15.6	13.3	16.5
15.	Seed weight per fruit (g)	2.71	5.69	2.25	3.87	2.96	2.28	1.94

followed by clusters I, IV and II with 7.7, 10.8, 13.5 and 13.94 fruits per plant, respectively.

The cluster VII had the highest mean plant height (101.2 cm) followed by clusters II, I, III and IV with 99.8, 87.6, 84.6 and 81.4 cm respectively. The cluster VI showed the lowest (71.2 cm) mean plant height followed by the cluster V (77.7 cm).

The clusters IV and II had the highest mean plant spread of 103.8 and 103.60 cm, respectively, were close to each other. The moderate mean plant spread was shown by clusters I, III, VII and VI with the mean plant spread of 95.5, 93.1, 92.4 and 89.7 cm, respectively. The plant spread was the lowest for cluster V (75.6 cm).

There was very little variation for the number of primary branches among the clusters, which ranged between 3.05 (cluster V) and 3.8 (cluster VI). However, number of secondary branches per plant showed more variation between the clusters. Cluster VII had the highest number of secondary branches followed by cluster IV with a mean of 28.2 and 26.4, respectively. The clusters II, I, III and VI had a mean of 24.3, 22.0, 21.9 and 21 number of secondary branches per plant, respectively. Cluster V had the lowest number of secondary branches (15.2).

The cluster IV showed the highest mean fruit weight followed by cluster VI with a mean weight per fruit of 137.8 and 126.3 g, respectively. The clusters V, II and I showed the mean fruit weight of 89.5, 82.3 and 78.4 g, respectively. Cluster VII had the lowest average weight per fruit (38.7 g).

The cluster VI showed the highest mean fruit length of 18.0 cm and cluster VII had the lowest length of fruit (3.7 cm). For other clusters the mean fruit length was 10.35 (V), 10.15 (IV), 8.22 (II), 7.86 (I) and 6.9 (III) cm.

The highest mean fruit girth was seen in cluster IV (18.8 cm) followed by cluster VI (16.35 cm). The mean fruit girth in clusters II, V, I, III and VII was 15.54, 15, 14.98, 13.42 and 12.0 cm, respectively.

The cluster VI showed the highest mean stalk length of fruit (8.8 cm) and for cluster III, the stalk length was the lowest (6.3 cm). The clusters IV, II, I, V and VII had a mean stalk length of 7.7, 7.5, 7.2, 7.0 and 7.0 cm, respectively.

The highest density of fruit was found in cluster VII with a mean of 0.86, while clusters IV and VI showed the lowest (0.70) mean density of fruit. The clusters V, I, II and III had a mean fruit density of 0.75, 0.73, 0.73, 0 0.73 and 0.71, respectively.

The cluster II showed the highest mean rind thickness followed by the cluster V with a mean of 0.85 and 0.73 cm, respectively. Other clusters, VII, I, VI, III and IV showed a mean rind thickness of 0.70, 0.68, 0.67, 0.64, and 0.62 cm, respectively.

The lowest keeping quality index was observed in cluster IV followed by clusters VI, V and VII with a mean of 11.0, 13.3, 15.6 and 16.5, respectively. The remaining clusters II, I and III had higher index of 20.6, 21.0 and 19.5, respectively.

The highest mean weight of seed per fruit was observed in cluster II followed by cluster IV with a mean of 5.69 and 3.87 g, respectively. Other clusters VII, III, VI, I and V had a mean of 1.94, 2.25, 2.28, 2.71 and 2.96 g, respectively.

In general, an appreciable variation among the clusters was found for fruit yield per plant, number of fruits per plant, fruit weight and fruit length.

4.5 Heterosis, combining ability for yield, yield attributes and quality related characters

Diallel analysis of 10 diverse parents along with their 45 F_1s (without reciprocals) was done to estimate heterosis, combining ability and gene action for 22 characters in brinjal. These parents happened to be from five distinct clusters based on 15 plant morphological and fruit characters in experiment I. Six parents were from the largest cluster I and one each from the other clusters, II, IV, VI and VII. The results are presented below.

4.5.1 Analysis of variance (ANOVA)

The analysis of variance for 22 characters is presented in Table 9. The ANOVA indicated highly significant differences among the treatments for all the characters under study. The differences among the hybrids and also among parents were also highly significant for all the characters except primary branches and stem girth among parents. The variance for parents vs hybrids was highly significant for all characters except for the number of primary branches, stem girth, fruit length and stalk length of the fruit. Variance on account of dry matter (%) were significant at 5 per cent level among parent vs hybrids.

4.5.2 Heterosis for various characters

The mean performance of parents, hybrids and magnitude of heterosis expressed as percentage increase or decrease over mid-parent, better parent and top parent values for 22 characters are presented in Tables 10 to 31.

4.5.2.1 Number of days to flower

A considerable range of variation was observed

Table 9. Analysis of variance (mean squares) for twenty-two characters in diallel crosses of brinjal.

Sl. no.	Characters	Sources					
		Replication	Treatments	Parents	Hybrids	Parents vs hybrids	Error
1	2	3	4	5	6	7	8
1.	Degrees of freedom	2	54	9	44	1	108
1.	Days to flower	74.6606**	148.5724**	27.2778**	124.0303**	2320.0758**	2.9189
2.	Fruit yield per plant (g)	327103.05**	212435.62**	51151.66**	221711.28**	1255862.30**	7611.11
3.	No.of fruits per plant	71.6788**	93.5960**	140.8185**	85.3428**	31.7337**	1.7714
4.	Plant height(cm)	119.7515**	391.7295**	165.2630**	393.0953**	2369.8347**	16.5787
5.	Plant spread(cm)	53.5818*	125.6947**	173.7815**	106.2367**	549.0670**	14.2547
6.	Primary branches (Nos)	3.2909**	1.3217**	0.4481	1.5175**	0.5660	0.4267
7.	Secondary branches (Nos)	48.5636**	7.4316**	5.7222*	7.4758**	20.8758**	2.2118
8.	Stem girth(cm)	0.0225	0.4122**	0.3036	0.4438**	0.0007	0.2055
9.	Fruit weight(g)	170.2364	2702.5046**	3023.7370**	2606.9788**	4014.5485**	71.7117
10.	Fruit length(cm)	1.4946*	21.8575**	29.7349**	20.7412**	0.0748	0.3397
11.	Fruit girth (cm)	0.1559	18.0943**	29.6102**	15.4939**	28.8659**	1.1727
12.	Stalk length of fruit (cm)	1.3453*	1.7143**	2.2297**	1.6427**	0.2294	0.3600
13.	Fruit density	0.0009	0.0055**	0.0086**	0.0042**	0.0354**	0.0006

Contd..

Table 9 (Contd..)

1	2	3	4	5	6	7	8
14.	Keeping quality index	1.0844	14.8300**	8.3827**	15.3560**	49.7132**	1.5889
15.	Rind thickness(cm)	0.0003	0.0186**	0.0341**	0.0092**	0.2916**	0.0014
16.	Seed weight per fruit (g)	0.3850	3.4470**	3.7173**	3.2513**	9.6222**	0.1336
17.	Dry matter(%)	0.0205	2.7327**	1.3788**	3.0601**	0.5077*	0.0829
18.	Total phenols(%)	0.0001	1.4358**	0.6706**	1.6154**	0.4230**	0.0028
19.	Orthodihydroxy-phenols (%)	0.0031**	0.1772**	0.0238**	0.2000**	0.5571**	0.0006
20.	Total sugars (%)	0.0162	10.2710**	3.8684**	11.6831**	5.7639**	0.1046
21.	Reducing sugars(%)	0.0955	8.6838**	3.7931**	9.7029**	7.8591**	0.0589
22.	Crude protein(%)	0.9571	13.6696**	9.8731**	13.9674**	34.7350**	0.3212

*, ** = Significant at 5 and 1 per cent levels of probability, respectively.

among parents and hybrids (Table 10). The parents flowered between 83 (Pusa Bhairav) and 92 days (Higna Dorla, Gokak Local and Taiwan Naga), while the hybrids ranged between 68 (3 x 5) and 95 days to flower (1 x 4).

Out of 45 crosses, 41 crosses had highly significant negative heterosis and one cross had highly significant positive heterosis over the mid parent value. The range of heterosis was from -24.17 (3 x 6) to 9.01 (1 x 4) per cent over mid parent.

Thirtythree crosses showed a highly significant negative heterosis over better parent and positive heterosis was found in three crosses. Four crosses exhibited significant negative heterosis over better parent. The range of heterosis over better parent was from -23.34 (3 x 5) to 7.59 (1 x 4) per cent.

The heterosis over best parent varied from -18.07 (3 x 5) to 14.46 (1x4) per cent and 22 crosses exhibited significant heterosis in desired direction. Five crosses showed significant positive heterosis over the best parent in undesired direction.

4.5.2.2 <u>Fruit yield per plant</u>

Mean fruit yield per plant varied from 716.3 (Higna Dorla) to 1035.7 (Gokak local and Pusa Bhairav) and 725.3 (4 x 7) to 1785 g (6 x 10) among parents and hybrids,

Table 10. Mean performance of parents, F_1's magnitude of heterosis over mid parent, better parent and top parent for days to flower in brinjal

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	88.3	-	-	-
2	Hignadorla	92.0	-	-	-
3	Gare local	90.0	-	-	-
4	SM 135	86.0	-	-	-
5	Surya	88.7	-	-	-
6	Gokak local	92.0	-	-	-
7	Malapur local	90.0	-	-	-
8	Taiwan naga	92.0	-	-	-
9	Pusa Kranti	91.0	-	-	-
10	Pusa Bhairav	83.0	-	-	-
11	1 x 2	92.0	2.05	4.19**	10.84**
12	1 x 3	82.3	-7.68**	-6.79**	- 0.01
13	1 x 4	95.0	9.01**	7.59**	14.46**
14	1 x 5	84.0	-5.08**	-4.87**	1.20
15	1 x 6	84.0	-6.82**	-4.87**	1.20
16	1 x 7	85.0	-4.65**	-3.74*	2.41
17	1 x 8	78.0	-13.48**	-11.66**	-6.02**
18	1 x 9	84.0	- 6.30**	- 4.87**	1.20
19	1 x 10	80.0	- 6.60**	- 3.61*	-3.61*
20	2 x 3	83.0	- 8.79**	- 7.79**	0.0
21	2 x 4	82.0	- 7.86**	- 4.65**	-1.20
22	2 x 5	78.0	-13.67**	-12.06**	-6.02**
23	2 x 6	82.0	-10.87**	-10.87**	-1.20
24	2 x 7	83.0	- 8.79**	- 7.78**	0.0
25	2 x 8	78.0	-15.22**	-15.22**	-6.02**

Contd..

Table 10 (Contd..)

1	2	3	4	5	6
26	2 x 9	83.3	- 8.96**	- 8.46**	0.360
27	2 x 10	69.3	-20.80**	-16.51**	-16.51**
28	3 x 4	74.0	-15.91**	-13.95**	-10.84**
29	3 x 5	68.0	-23.89**	-23.34**	-16.07**
30	3 x 6	69.0	-24.17**	-23.30**	-16.87**
31	3 x 7	75.7	-15.89**	-15.89**	- 8.79**
32	3 x 8	69.3	-23.85**	-23.00**	-16.50**
33	3 x 9	85.0	- 6.08**	- 5.55**	2.41
34	3 x 10	82.3	- 4.85**	- 0.84	- 0.84
35	4 x 5	72.3	-17.23**	-15.93**	-12.89**
36	4 x 6	82.0	- 7.86**	- 4.65**	- 1.20
37	4 x 7	82.7	- 6.02**	- 3.84*	- 0.40
38	4 x 8	80.0	-10.11**	- 6.98**	- 3.61*
39	4 x 9	84.0	- 5.08**	- 2.32	1.20
40	4 x 10	81.3	- 3.79**	- 2.05	- 2.05
41	5 x 6	80.0	-11.45**	- 9.81**	- 3.61*
42	5 x 7	78.0	-12.70**	-12.06**	- 6.02**
43	5 x 8	78.7	-12.89**	-11.27**	- 5.18**
44	5 x 9	68.3	-23.98**	-23.00**	-17.71**
45	5 x 10	84.0	- 2.15	1.20	1.20
46	6 x 7	78.0	-14.28**	-13.33**	- 6.02**
47	6 x 8	75.0	-18.48**	-18.48**	- 9.64**
48	6 x 9	88.0	- 3.82**	- 3.30*	6.02**
49	6 x 10	82.0	- 6.28**	- 1.20	- 1.20
50	7 x 8	86.0	- 5.49**	- 4.44**	3.61*
51	7 x 9	74.0	-18.23**	-17.78**	-10.84**
52	7 x 10	87.0	0.58	4.82**	4.82**
53	8 x 9	73.0	-20.22**	-19.78**	-12.05**
54	8 x 10	72.0	-17.71**	-13.25**	-13.25**
55	9 x 10	71.3	-18.04**	-14.10**	-14.10**
CD (0.05)		2.76	2.39	2.76	2.76
CD (0.01)		3.65	3.16	3.65	3.65

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

respectively (Table 11).

In 25 crosses heterosis over mid parent was statistically significant positive and one cross (4 x 7), there was significant negative heterosis. The heterosis ranged between -17.53 (4 x 7) and 82.67 (1 x 7) per cent over mid parent .

In all 20 crosses exhibited significant positive heterosis over better parent, while in four crosses, there was significant negative heterosis. The heterosis over better parent varied from -28.19 (4 x 7) to 72.35 (6 x 10) per cent.

The significant positive heterosis over best parent was shown by 15 crosses, while nine crosses exhibited significant negative heterosis over top parent. The heterosis over best parent ranged between -29.97 (4 x 7) and 72.35 (6 x 10) per cent.

4.5.2.3 Number of fruits per plant

The average number of fruits per plant ranged between 8.7 (SM 135 and Malapur Local) and 31.7 (Pusa Bhairav) in parents and 7.0 (4 x 7) and 33.0 (6 x 10) in crosses (Table 12).

In 20 crosses, there was a significant positive heterosis over mid parent, while eight crosses showed

Table 11. Mean performance of parents, F_1's magnitude of heterosis over mid parent, better parent and top parent for fruit yield (g) in brinjal.

Sl. No.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	744.3	-	-	-
2	Hignadorla	716.3	-	-	-
3	Gare local	858.3	-	-	-
4	SM 135	749.0	-	-	-
5	Surya	1029.0	-	-	-
6	Gokak local	1035.7	-	-	-
7	Malapur local	1010.0	-	-	-
8	Taiwannaga	880.0	-	-	-
9	Pusa Kranti	971.3	-	-	-
10	Pusa Bhairav	1035.7	-	-	-
11	1 x 2	863.3	18.21*	15.99*	- 16.64*
12	1 x 3	875.0	9.20	1.94	- 15.52*
13	1 x 4	845.3	13.21	12.86	- 18.38**
14	1 x 5	1024.0	15.49*	- 0.48	- 1.13
15	1 x 6	1070.7	20.30**	3.38	3.37
16	1 x 7	1602.3	82.67**	58.64**	54.71**
17	1 x 8	1385.7	70.62**	57.46**	33.79**
18	1 x 9	831.3	- 3.09	-14.41	- 19.73**
19	1 x 10	1195	34.27**	15.38*	15.38*
20	2 x 3	1197.3	52.08**	39.50**	15.60*
21	2 x 4	935.7	27.71**	24.92**	- 9.65
22	2 x 5	940.7	7.80	- 8.58	- 9.17
23	2 x 6	1105.7	26.22**	6.76	6.76
24	2 x 7	843.7	- 2.25	-16.46*	-18.54**
25	2 x 8	986.0	23.53**	12.04	- 4.80
26	2 x 9	1479.3	75.31**	52.3**	42.83**
27	2 x 10	1156.3	32.0**	11.64	11.64
28	3 x 4	1006.3	25.21**	17.24*	- 2.84
29	3 x 5	840.7	-10.91	-18.80**	18.83**
30	3 x 6	1432.7	51.29**	38.33**	38.33**

Contd..

Table 11 (Contd..)

1	2	3	4	5	6
31	3 x 7	1016.0	8.76	0.59	- 1.90
32	3 x 8	843.0	-3.01	- 4.20	-18.61**
33	3 x 9	1640.0	79.27**	68.84**	58.35**
34	3 x 10	1286.3	35.83**	24.20**	24.20**
35	4 x 5	968.0	8.89	- 5.93	- 6.54
36	4 x 6	938.0	5.11	- 9.43	- 9.43
37	4 x 7	725.3	-17.53*	-28.19**	-29.97**
38	4 x 8	1152.3	41.47**	30.94**	11.26
39	4 x 9	1230.3	43.03**	26.66**	18.79**
40	4 x 10	1575.3	76.59**	52.10**	52.10**
41	5 x 6	1715.0	66.12**	65.59**	65.59**
42	5 x 7	1210.0	18.18**	17.59*	16.83*
43	5 x 8	994.7	4.21	- 3.33	- 3.96
44	5 x 9	1046.0	4.59	1.65	0.10
45	5 x 10	1403.7	43.52**	43.25**	43.25**
46	6 x 7	1119.3	9.43	8.07	8.07
47	6 x 8	1566.3	63.52**	51.23**	51.23**
48	6 x 9	1022.3	1.87	- 1.29	- 1.29
49	6 x 10	1785.0	72.35**	72.35**	72.35**
50	7 x 8	1173.0	24.13**	16.14*	13.26
51	7 x 9	931.0	- 6.02	- 7.82	-10.11
52	7 x 10	918.0	-10.25	-11.36	-11.36
53	8 x 9	962.3	3.96	- 0.93	- 7.09
54	8 x 10	858.0	-10.42	-17.16*	-17.16*
55	9 x 10	1036.0	3.24	0.03	0.03
	C.D (0.05)	141.04	122.14	141.04	141.04
	C.D (0.01)	186.42	161.44	186.42	186.42

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

significant negative heterosis over mid parent. The heterosis ranged between -42.08 (7 x 10) and 45.39 (6 x 8) per cent over mid parent.

Significant positive heterosis over better parent was found in six crosses, whereas in 19 crosses, the number of fruits were less than their respective better parent. The amount of heterosis varied from -63.09 (7 x 10) to 40.60 (1 x 8) per cent over better parent.

The heterosis over best parent varied from -77.92 (4 x 7) to 4.10 (6 x 10) per cent. A total of 43 crosses exhibited significant negative heterosis over best parent, none of the crosses exceeded significantly over Pusa Bhairav.

4.5.2.4 Plant height

Mean plant height ranged between 58.3 (Higna Dorla) and 110 cm (Surya) among parents and 50.3 cm (3 x 4) to 101 cm (5 x 6) among hybrids (Table 13).

In 26 crosses, there was significant positive heterosis over mid parent, whereas five crosses showed significant negative heterosis. The heterosis ranged between -24.12 (3 x 5) and 45.99 (4 x 8) per cent over mid parent.

Significant positive heterosis was shown by 17 crosses over their respective better parent, while 13

Table 12. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for number of fruits in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	13.3	-	-	-
2	Hignadorla	12.3	-	-	-
3	Gare local	17.7	-	-	-
4	SM 135	8.7	-	-	-
5	Surya	19.3	-	-	-
6	Gokak local	16.0	-	-	-
7	Malapur local	8.7	-	-	-
8	Talwan naga	13.3	-	-	-
9	Pusa kranti	10.0	-	-	-
10	Pusa bhairav	31.7	-	-	-
11	1 x 2	12.0	-6.25	-9.77	-62.14**
12	1 x 3	13.0	-16.13**	-26.55**	-58.99**
13	1 x 4	11.3	2.73	-15.04	-64.35**
14	1 x 5	18.7	14.72*	- 3.12	-41.01**
15	1 x 6	15.3	4.64	- 4.37	-51.73**
16	1 x 7	14.3	30.0**	7.52	-54.89**
17	1 x 8	18.7	40.60**	-40.00	-41.01**
18	1 x 9	14.7	26.18**	10.53	-53.63**
19	1 x 10	17.0	-24.44**	- 46.37**	-46.37**
20	2 x 3	16.7	11.33	-35.99**	-47.32**
21	2 x 4	12.7	20.95*	70.32**	-59.94**
22	2 x 5	14.7	-6.96	-23.83**	-53.63**
23	2 x 6	16.7	18.02**	4.37	-47.32**
24	2 x 7	11.3	7.62	- 8.13	-64.35**
25	2 x 8	14.0	9.37	5.26	-55.84**
26	2 x 9	11.7	4.93	- 4.88	-63.09**
27	2 x 10	20.0	-9.09*	-36.91**	-36.91**
28	3 x 4	18.0	36.36**	1.69	-43.22**

Contd..

Table 12(contd.)

1	2	3	4	5	6
29	3 x 5	14.0	45.07**	-27.46**	-55.84**
30	3 x 6	23.7	40.65**	33.89**	-25.24**
31	3 x 7	13.3	00.76	-24.86**	-58.84**
32	3 x 8	12.0	-22.58	-32.20**	-62.14**
33	3 x 9	20.0	44.40**	12.99*	-36.91**
34	3 x 10	30.0	21.46**	- 5.36	- 5.36
35	4 x 5	16.0	14.28*	-17.10**	-49.53**
36	4 x 6	10.0	-19.03*	-37.5**	-68.45**
37	4 x 7	7.0	-19.54*	-19.54*	-77.92**
38	4 x 8	15.0	36.36**	12.78	-52.68**
39	4 x 9	13.3	42.24**	33.0**	-58.04**
40	4 x 10	17.7	-12.38**	-44.16**	-44.16**
41	5 x 6	20.7	17.28**	7.25	-34.70**
42	5 x 7	15.0	7.14	-22.28**	-52.68**
43	5 x 8	15.3	- 6.13	-20.72**	-51.73**
44	5 x 9	15.7	7.17	-18.65**	-50.47**
45	5 x 10	29.3	14.90**	- 7.57*	- 7.57*
46	6 x 7	13.0	5.26	-18.75*	-58.99**
47	6 x 8	21.3	45.39**	33.12**	-32.81**
48	6 x 9	15.0	15.38*	- 6.25	-52.68**
49	6 x 10	33.0	38.36**	4.10	4.10
50	7 x 8	12.3	11.82	- 7.52	-61.20**
51	7 x 9	9.7	3.74	- 3.0	-69.40**
52	7 x 10	11.7	-42.08**	-63.09**	-63.09**
53	8 x 9	16.0	37.34**	20.30*	-49.53**
54	8 x 10	21.3	- 5.33	-32.81**	-32.81**
55	9 x 10	22.0	5.52	-30.60**	-30.60**
C.D (0.05)		2.15	1.86	2.15	2.15
C.D (0.01)		2.84	2.46	2.84	2.84

*, ** - Significant at 5 and 1 per cent level of probability, respectively

Table 13. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for plant height (cm) in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	82.0	-	-	-
2	Hignadoria	58.3	-	-	-
3	Gare local	58.7	-	-	-
4	SM 135	68.0	-	-	-
5	Surya	110.0	-	-	-
6	Gokak local	71.3	-	-	-
7	Malapur local	75.7	-	-	-
8	Taiwan naga	65.3	-	-	-
9	Pusa kranti	69.0	-	-	-
10	Pusa bhairav	64.0	-	-	-
11	1 x 2	77.0	9.76*	-6.1	-30.0**
12	1 x 3	75.7	7.60	- 7.68	-31.45**
13	1 x 4	83.3	11.07**	1.58	-24.27**
14	1 x 5	86.3	10.10**	-21.54**	-21.54**
15	1 x 6	91.3	19.11**	11.34**	-17.0**
16	1 x 7	95.3	20.86**	16.22**	-13.36**
17	1 x 8	91.3	23.96**	11.34**	-17.00**
18	1 x 9	86.3	14.30**	5.24	-21.54**
19	1 x 10	86.7	18.77**	5.73	-21.18**
20	2 x 3	72.0	23.08**	22.66**	-34.54**
21	2 x 4	59.0	- 6.57	-13.23**	-46.36**
22	2 x 5	66.0	-21.57**	-40.00**	-40.00**
23	2 x 6	64.3	- 0.77	- 9.82*	-41.54**
24	2 x 7	60.0	-10.45*	-20.74**	-45.45**
25	2 x 8	72.7	17.64**	11.33*	-33.91**
26	2 x 9	68.0	6.83	- 1.45	-38.18**
27	2 x 10	70.0	14.47**	9.37	-36.36**
28	3 x 4	50.3	-20.60**	-26.03**	-54.27**
29	3 x 5	64.0	-24.12**	-41.82**	-41.82**
30	3 x 6	67.0	3.08	- 6.03	-39.10**

Contd..

Table 13.(Contd..)

1	2	3	4	5	6
31	3 x 7	71.0	5.65	- 6.21	-35.45**
32	3 x 8	72.0	16.13**	10.26*	-34.54**
33	3 x 9	74.3	16.37**	7.68	-32.45**
34	3 x 10	73.0	18.99**	14.06**	-33.64**
35	4 x 5	68.7	-22.81**	-37.54**	-37.54**
36	4 x 6	82.7	18.74**	15.99**	-24.82**
37	4 x 7	87.7	22.06**	15.85**	-20.27**
38	4 x 8	97.3	45.99**	43.09**	-11.54**
39	4 x 9	84.3	23.06**	22.17**	-23.36**
40	4 x 10	93.3	41.36**	37.21**	-15.18**
41	5 x 6	101.0	11.42**	- 8.18**	- 8.18**
42	5 x 7	92.70	- 0.16	-15.73**	-15.73**
43	5 x 8	90.3	3.02	-17.91**	-17.91**
44	5 x 9	85.3	- 4.69	-22.45**	-22.45**
45	5 x 10	86.0	- 1.15	-21.82**	-21.82**
46	6 x 7	87.7	19.32**	15.85**	-20.27**
47	6 x 8	84.7	24.01**	18.79**	-23.0**
48	6 x 9	84.3	20.17**	18.23**	-23.36**
49	6 x 10	82.3	21.65**	15.43**	-25.18**
50	7 x 8	83.3	18.16**	10.04*	-24.27**
51	7 x 9	77.7	7.39	2.64	-29.36**
52	7 x 10	78.3	12.10**	3.43	-28.82**
53	8 x 9	66.3	- 1.26	- 3.91	-39.73**
54	8 x 10	69.7	7.81	6.74	-36.64**
55	9 x 10	67.0	0.75	- 2.90	-39.10**
C.D (0.05)		6.58	5.70	6.58	6.58
C.D (0.01)		8.70	7.53	8.70	8.70

*, ** - significant at 5 and 1 per cent level of probability, respectively.

crosses exhibited significant negative heterosis. The heterosis ranged between -41.82 (3 x 5) and 43.09 (4 x 8) per cent over better parent. But none of the hybrids were taller than the tallest parent, Surya.

4.5.2.5 Plant spread

The mean plant spread varied from 45.0 (Gare Local) to 64.7 (Pusa Kranti) among parents and 45.0 (3 x 4) to 75.7 (7 x 8) cm among crosses (Table 14).

Of the 45 crosses, 23 exhibited significant positive heterosis over mid parent. The only hybrid that showed significant negative heterosis over mid parent was a cross between Taiwan Naga x Pusa Kranti. The heterosis ranged between -14.33 (8 x 9) and 36.13 (4 x 10) per cent over mid parent.

Twelve crosses showed significant positive heterosis over better parent, while eight crosses exhibited significant negative heterosis over their respective better parent. The heterosis over better parent varied from -21.51 (3 x 8) to 32.70 (4 x 10) per cent.

The only cross, 7 x 8, had a significantly higher plant spread than the best parent, Pusa Kranti. The heterosis over best parent ranged between -30.45 (3 x 4) and 17.00 (7 x 8) per cent.

Table 14. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for plant spread (cm) in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White madhapuri	55.7	-	-	-
2	Hignadorla	48.0	-	-	-
3	Gare local	45.0	-	-	-
4	BM 135	47.7	-	-	-
5	Surya	58.3	-	-	-
6	Gokak local	58.7	-	-	-
7	Malapur local	60.7	-	-	-
8	Taiwan naga	63.7	-	-	-
9	Pusa kranti	64.7	-	-	-
10	Pusa bhairav	45.3	-	-	-
11	1 x 2	52.3	0.868	- 6.10	-19.16**
12	1 x 3	60.0	19.16**	7.72	- 7.26
13	1 x 4	55.3	6.06	- 0.72	-14.53**
14	1 x 5	64.7	13.51*	10.98*	0.00
15	1 x 6	63.0	10.14*	7.32	- 2.63
16	1 x 7	59.0	1.37	- 2.80	- 8.81
17	1 x 8	57.3	-4.02	10.05*	-11.44**
18	1 x 9	62.3	3.48	- 3.71	- 3.71
19	1 x 10	63.3	25.35**	13.64*	- 2.16
20	2 x 3	60.0	29.03**	25.0**	- 7.26
21	2 x 4	61.7	28.94**	28.94**	- 4.64
22	2 x 5	61.7	16.09**	5.83	- 4.64
23	2 x 6	52.7	- 1.22	-10.22	-18.55**
24	2 x 7	59.7	9.84*	- 1.65	- 7.73
25	2 x 8	60.3	7.97	- 5.34	- 6.80
26	2 x 9	66.7	18.37**	3.09	3.09
27	2 x 10	57.7	23.69**	20.21**	-10.82*
28	3 x 4	45.0	- 2.91	- 5.66	-30.45**
29	3 x 5	48.7	- 5.71	-16.47**	-24.73**
30	3 x 6	52.3	0.67	-10.90*	-19.13**

Contd..

Table 14 (Contd..)

1	2	3	4	5	6
31	3 x 7	59.3	-12.20*	- 2.31	- 8.35
32	3 x 8	50.0	- 8.00	-21.51**	-22.72**
33	3 x 9	56.3	2.64	-12.98**	-12.98**
34	3 x 10	50.7	12.20*	11.92	-21.64**
35	4 x 5	54.7	3.21	- 6.17	-15.45**
36	4 x 6	61.0	14.66**	3.92	- 5.72
37	4 x 7	67.3	24.17**	10.87*	4.02
38	4 x 8	58.7	5.38	- 7.85	- 9.27
39	4 x 9	63.0	12.10*	- 2.63	- 2.63
40	4 x 10	63.3	36.13**	32.70**	- 2.16
41	5 x 6	67.3	15.04**	14.65**	4.02
42	5 x 7	67.0	12.61**	10.38*	3.55
43	5 x 8	70.0	14.75**	9.89*	8.19
44	5 x 9	58.0	- 5.69	-10.35*	-10.35*
45	5 x 10	61.3	18.34**	5.14	- 5.25
46	6 x 7	64.3	7.70	5.93	- 0.62
47	6 x 8	59.0	- 3.59	- 7.38	- 8.81
48	6 x 9	59.0	- 4.38	- 8.81	- 8.81
49	6 x 10	63.0	21.15**	7.32	- 2.63
50	7 x 8	75.7	21.70**	18.84**	17.00**
51	7 x 9	63.0	0.48	- 2.63	- 2.63
52	7 x 10	58.7	10.75*	- 3.29	- 9.27
53	8 x 9	55.0	-14.33**	-14.99**	-14.99**
54	8 x 10	51.3	- 5.87	-19.47**	-20.71**
55	9 x 10	56.7	3.09	-12.36*	-12.36*
C.D. (0.05)		6.1040	5.286	6.104	6.104
C.D. (0.01)		8.067	6.987	8.067	8.067

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

4.5.2.6 Number of primary branches per plant

The average number of primary branches ranged between 3.3 (parents 5, 8 and 10) and 4.3 (parents 3 and 9) in parents, but in hybrids it varied from 2.0 (6 x 9) to 5.0 (1 x 3, 1 x 5, 1 x 8, 1 x 9 and 1 x 10) (Table 15).

Three crosses exhibited significant positive heterosis over mid parent, while three crosses indicated negative significant heterosis over mid parent. The heterosis over mid parent ranged between -50.0 (6 x 9) and 36.99(1 x 10) per cent.

Three crosses, exhibited significant negative heterosis over better parent. The heterosis varied from -60.46 (6 x 9) to 25.0 (1 x 10) per cent over better parent. None of the crosses were significantly superior over their respective better or best parent.

The heterosis over best parent ranged between -53.49 (6 x 9) and 16.28 (1 x 10) per cent.

4.5.2.7 Number of secondary branches per plant

The average number of secondary branches ranged between 9 (Taiwan Naga) and 13.3 (White Madhepuri) in parents and 9 (3 x 4) and 15.7 (1 x 7) in crosses (Table 16).

Three crosses showed significant positive

Table 15. Mean performance of parents, F_1s, magnitude of heterosis ove mid parent, better parent and top parent for primary branches in brinjal

Sl. No.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White madhapuri	4.0	-	-	-
2	Higna dorla	4.0	-	-	-
3	Gare local	4.3	-	-	-
4	SM 135	3.7	-	-	-
5	Surya	3.3	-	-	-
6	Gokak local	3.7	-	-	-
7	Malapur local	3.7	-	-	-
8	Taiwan naga	3.3	-	-	-
9	Pusa kranti	4.3	-	-	-
10	Pusa bhairav	3.3	-	-	-
11	1 x 2	4.0	0.0	0.0	- 6.98
12	1 x 3	5.0	20.48	16.28	16.28
13	1 x 4	4.0	3.90	0.0	- 6.98
14	1 x 5	5.0	36.99**	25.0	16.28
15	1 x 6	4.8	11.69	7.5	0.00
16	1 x 7	4.7	22.08	17.5	9.30
17	1 x 8	5.0	36.99**	25.0	16.28
18	1 x 9	5.0	20.48	16.28	16.28
19	1 x 10	5.0	36.99**	25.00	16.28
20	2 x 3	4.7	13.25	9.30	9.30
21	2 x 4	4.3	11.69	7.50	0.00
22	2 x 5	3.7	1.37	- 7.5	-13.95
23	2 x 6	4.0	3.90	0.00	- 6.98
24	2 x 7	4.0	3.90	0.0	- 6.98
25	2 x 8	3.3	-9.59	- 17.5	-23.26
26	2 x 9	4.0	-3.61	- 6.98	- 6.98
27	2 x 10	3.3	-9.59	- 17.5	-23.26
28	3 x 4	3.3	-17.5	- 23.25	-23.26
29	3 x 5	3.3	-13.16	- 23.25	-23.26
30	3 x 6	3.3	-17.5	- 23.25	-23.26

Contd..

Table 15 (Contd..)

1	2	3	4	5	6
31	3 x 7	4.7	17.5	9.30	9.30
32	3 x 8	2.7	-28.55*	-37.21**	-37.21**
33	3 x 9	4.0	- 6.98	- 6.98	- 6.98
34	3 x 10	4.0	5.26	- 6.98	- 6.98
35	4 x 5	4.0	14.28	8.11	- 6.98
36	4 x 6	4.3	16.22	16.22	0.00
37	4 x 7	4.0	8.11	8.11	- 6.98
38	4 x 8	2.7	-22.86	-27.03	-37.21**
39	4 x 9	4.7	17.5	9.30	9.30
40	4 x 10	3.3	- 5.71	-10.81	-23.26
41	5 x 6	4.0	14.28	8.11	- 6.98
42	5 x 7	4.3	22.86	16.22	0.00
43	5 x 8	3.7	12.12	12.12	-13.95
44	5 x 9	4.0	13.16	0.0	0.0
45	5 x 10	3.7	12.12	12.12	-13.95
46	6 x 7	4.0	8.11	8.11	- 6.98
47	6 x 8	3.7	5.71	0.00	-13.95
48	6 x 9	2.0	-50.00**	-60.46**	-53.49**
49	6 x 10	3.7	5.71	0.0	-13.95
50	7 x 8	3.7	5.71	0.0	-13.95
51	7 x 9	4.3	7.5	0.0	0.0
52	7 x 10	2.3	-34.28*	-37.84**	-46.51**
53	8 x 9	3.7	- 2.63	-13.95	-13.95
54	8 x 10	3.3	0.0	0.0	-23.26
55	9 x 10	3.3	-13.16	-23.25	-23.26
C.D.(0.05)		1.056	9.914	1.056	1.056
C.D (0.01)		1.395	1.209	1.396	1.396

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

heterosis over the mid parent and three crosses, it was on the negative side. The heterosis over mid parent ranged between -26.48 (6 x 9) and 34.71 (5 x 8) per cent.

Significant positive heterosis over better parent was found in two crosses and in four crosses heterosis was on the negative side. The heterosis varied from -28.46 (6 x 9) to 26.21 (5 x 8) per cent over better parent.

A cross (1 x 6) showed significant positive heterosis over best parent and nine crosses exhibited significant negative heterosis over best parent. The heterosis over best parent ranged between -32.33 (3 x 4) and 20.30 (1 x 6) per cent.

4.5.2.8 <u>Stem girth</u>

The mean stem girth varied from 4.9 to 5.8 cm in parents and 4.4 (3 x 8) to 6.1 cm (4 x 7) in hybrids (Table 17).

A cross (3 x 8) exhibited significant negative heterosis over mid parent only. The heterosis over mid parent ranged between -15.38 and 11.32 (5 x 10) per cent.

Four crosses showed significant negative heterosis over better parent. The heterosis varied from -20.0 (3 x 8) to 8.16 (2 x 3) per cent over better parent.

Nine crosses exhibited significant negative heterosis over best parent. The heterosis ranged between

Table 16. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for secondary branches in brinjal.

Sl. no.	Parents and crosses	Mean value	Percentage heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	13.3	-	-	-
2	Hignadorla	12.0	-	-	-
3	Gare local	10.7	-	-	-
4	SM 135	11.0	-	-	-
5	Surya	10.3	-	-	-
6	Gokak local	12.3	-	-	-
7	Malapur local	12.7	-	-	-
8	Taiwan naga	9.0	-	-	-
9	Pusa Kranti	13.0	-	-	-
10	Pusa Bhairav	10.7	-	-	-
11	1 x 2	10.7	-15.41	-19.55*	-19.55*
12	1 x 3	14.0	16.67	16.67	5.26
13	1 x 4	12.0	- 1.23	- 9.77	- 9.77
14	1 x 5	10.3	-12.71	-22.56*	-22.56*
15	1 x 6	16.0	25.0**	20.30*	20.30*
16	1 x 7	15.7	20.77*	18.04	18.04
17	1 x 8	12.0	7.62	- 9.77	- 9.77
18	1 x 9	14.0	6.46	5.26	5.26
19	1 x 10	12.7	5.83	- 4.51	- 4.51
20	2 x 3	13.0	14.54	8.33	-2.25
21	2 x 4	13.3	15.65	10.83	0.0
22	2 x 5	11.3	1.34	- 5.83	-15.04
23	2 x 6	13.7	12.76	7.87	3.01
24	2 x 7	12.7	2.83	0.0	- 4.51
25	2 x 8	12.0	14.29	0.0	- 9.77
26	2 x 9	11.7	- 6.4	-10.0	-12.03
27	2 x 10	14.0	23.35*	16.67	5.26
28	3 x 4	9.0	-17.05	-18.18	-32.33**
29	3 x 5	10.3	- 1.90	- 3.74	-22.56*
30	3 x 6	10.3	-10.43	-16.26	-22.56*

Contd..

Table 16 (Contd..)

1	2	3	4	5	6
31	3 x 7	14.3	22.22*	12.60	7.52
32	3 x 8	10.3	4.57	- 3.74	-22.56*
33	3 x 9	13.7	15.61	5.38	3.01
34	3 x 10	12.0	12.15	12.15	- 9.77
35	4 x 5	11.7	9.86	6.36	-12.03
36	4 x 6	13.3	14.16	8.13	0.0
37	4 x 7	12.7	7.17	0.00	- 4.51
38	4 x 8	12.0	20.00	9.09	- 9.77
39	4 x 9	14.0	16.67	7.69	5.26
40	4 x 10	12.0	10.60	9.09	- 9.77
41	5 x 6	14.3	26.55**	16.26	7.52
42	5 x 7	14.0	21.74*	10.24	5.26
43	5 x 8	13.0	34.71**	26.21*	- 2.25
44	5 x 9	14.0	20.17*	7.69	5.26
45	5 x 10	12.0	14.29	12.15	- 9.77
46	6 x 7	13.0	4.0	2.36	- 2.25
47	6 x 8	12.7	19.25	3.25	- 4.51
48	6 x 9	9.3	-26.48**	-28.46**	-30.07**
49	6 x 10	12.3	6.96	0.0	- 7.52
50	7 x 8	12.3	13.36	- 3.15	- 7.52
51	7 x 9	13.3	3.50	2.31	0.0
52	7 x 10	9.7	-17.09	-23.62*	-27.07**
53	8 x 9	12.3	11.82	- 5.30	- 7.52
54	8 x 10	10.7	8.63	0.0	-19.55*
55	9 x 10	11.3	- 4.64	-13.08	-15.04
C.D (0.05)		2.404	2.082	2.404	2.404
C.D (0.01)		3.178	2.750	3.178	3.178

*, ** - Significant at 5 and 1 per cent level of probability, respectively

Table 17. Mean performance of parents, F_1s, magnitude of heterosis over mid parent, better parent and top parents for stem girth (cm) in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	5.8	-	-	-
2	Hignadorla	4.9	-	-	-
3	Gare local	4.9	-	-	-
4	SM 135	5.3	-	-	-
5	Surya	5.1	-	-	-
6	Gokak local	5.4	-	-	-
7	Malapur local	5.7	-	-	-
8	Taiwan naga	5.5	-	-	-
9	Pusa kranti	5.8	-	-	-
10	Pusa bhairav	5.5	-	-	-
11	1 x 2	5.5	2.60	- 5.17	-5.17
12	1 x 3	5.4	0.93	- 6.90	-6.90
13	1 x 4	5.4	-2.70	- 6.90	-6.90
14	1 x 5	5.2	-4.59	-10.34	-10.34
15	1 x 6	5.9	5.36	1.72	1.72
16	1 x 7	5.4	-6.09	- 6.90	- 6.90
17	1 x 8	5.7	0.88	- 1.72	- 1.72
18	1 x 9	5.7	- 1.72	- 1.72	- 1.72
19	1 x 10	5.2	- 7.96	-10.34	-10.34
20	2 x 3	5.3	8.16	8.16	- 8.62
21	2 x 4	5.1	0.0	- 3.77	-12.07
22	2 x 5	5.0	0.0	- 1.96	-13.79*
23	2 x 6	4.9	- 4.85	- 9.26	-15.52*
24	2 x 7	5.2	- 1.89	- 8.77	-10.34
25	2 x 8	4.7	- 9.61	-14.54*	-18.96**
26	2 x 9	5.7	6.54	- 1.72	- 1.72
27	2 x 10	4.7	- 9.61	-14.54*	-18.96**
28	3 x 4	4.8	- 5.88	- 9.43	-17.24**
29	3 x 5	4.9	- 2.0	- 3.92	-15.52*
30	3 x 6	5.0	- 2.91	- 7.41	-13.79*

Contd..

Table 17 (Contd..)

1	2	3	4	5	6
31	3 x 7	5.1	- 3.77	-10.53	-12.07
32	3 x 8	4.4	-15.38*	-20.0**	-26.81**
33	3 x 9	4.9	- 8.41	-15.52*	-15.52*
34	3 x 10	5.7	9.61	3.64	- 1.72
35	4 x 5	5.5	5.77	5.77	- 5.17
36	4 x 6	5.5	2.80	1.85	- 5.17
37	4 x 7	6.1	10.91	7.02	5.17
38	4 x 8	5.4	0.0	- 1.82	- 6.90
39	4 x 9	5.8	4.50	0.0	0.0
40	4 x 10	5.5	1.85	0.0	- 5.17
41	5 x 6	5.3	0.95	1.85	- 8.62
42	5 x 7	5.8	7.41	1.75	0.0
43	5 x 8	5.7	7.55	3.64	- 1.72
44	5 x 9	6.0	10.09	3.45	3.45
45	5 x 10	5.9	11.32	7.27	1.72
46	6 x 7	5.6	0.90	- 1.75	- 3.45
47	6 x 8	5.5	0.92	0.0	- 5.17
48	6 x 9	5.4	- 3.57	- 6.90	- 6.90
49	6 x 10	5.5	0.92	0.0	- 5.17
50	7 x 8	5.7	1.78	0.0	- 1.72
51	7 x 9	5.9	2.61	1.72	1.72
52	7 x 10	5.7	1.78	0.0	- 1.72
53	8 x 9	5.4	- 4.42	- 6.90	- 6.90
54	8 x 10	5.1	- 7.27	- 7.27	-12.07
55	9 x 10	5.3	- 6.19	- 8.62	- 8.62
C.D (0.05)		0.7330	0.635	0.733	0.733
C.D (0.01)		0.969	0.839	0.969	0.969

*, ** - Significant at 5 and 1 per cent level of probability, respectively

-26.81 (3 x 8) and 5.17 (4 x 7) per cent over best parent.

4.5.2.9 Average weight per fruit

The mean weight per fruit varied from 66 (Pusa Bhairav) to 160.7 g (Malapur Local) among parents and 75.7 (3 x 10) to 196.3 g (1 x 7) in crosses (Table 18).

In all 21 crosses exhibited significant positive heterosis over mid parent, whereas eight crosses had significant negative heterosis over mid parent. The heterosis ranged between -19.80 (3 x 4) and 62.63 (1 x 7) per cent over mid parent.

In five crosses significant positive heterosis and in 15 crosses significant negative heterosis over better parent were observed. The heterosis over better parent varied from -36.21 (3 x 4) to 34.39 (8 x 10) per cent.

Two crosses exhibited highly significant positive heterosis over top parent, while 36 crosses showed significant negative heterosis. The heterosis over best parent ranged between -52.89 (3 x 10) and 22.15 (1 x 7) per cent.

4.5.2.10 Mean length of fruit

The mean fruit length ranged between 6.7 (Gere Local) and 16.6 cm (Taiwan Naga) in parents and 5.9 (1 x 10) and 15.6 (8 x 10) in crosses (Table 19).

Table 18. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for fruit weight (g) in brinjal.

Sl. No.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1.	White Madhapuri	80.7	-	-	-
2.	Hignadorla	98.7	-	-	-
3	Gure local	82.7	-	-	-
4	SM 135	140.0	-	-	-
5	Surya	97.3	-	-	-
6	Gokak local	124.7	-	-	-
7	Malapur local	160.7	-	-	-
8	Taiwan naga	91.3	-	-	-
9	Pusa kranti	145.0	-	-	-
10	Pusa bhairav	66.0	-	-	-
11	1 x 2	77.0	-14.16*	-21.98**	-52.08**
12	1 x 3	84.3	3.18	1.93	-47.54**
13	1 x 4	138.0	25.06**	- 1.43	-14.12**
14	1 x 5	127.3	43.03**	30.83**	-20.78**
15	1 x 6	118.0	89.25**	- 5.37	-26.57**
16	1 x 7	196.3	62.63**	22.15**	22.15**
17	1 x 8	92.7	7.79	1.53	-42.31**
18	1 x 9	128.7	14.04**	-11.24*	-19.91**
19	1 x 10	78.7	7.29	- 2.48	-51.03**
20	2 x 3	102.0	12.46	3.34	-36.53**
21	2 x 4	100.7	-15.63**	-28.07**	-37.34**
22	2 x 5	92.7	- 5.41	- 6.08	-42.31**
23	2 x 6	112.0	0.27	-10.18	-30.30**
24	2 x 7	120.0	- 7.48	-25.33**	-25.33**
25	2 x 8	122.0	28.42**	23.61**	-24.08**
26	2 x 9	191.0	56.75**	31.72**	18.85**
27	2 x 10	88.0	6.86	-10.84	-45.24**
28	3 x 4	89.3	-19.80**	-36.21**	-44.43**
29	3 x 5	102.0	13.33*	4.83	-36.53**

Contd..

Table 18 (Contd..)

1	2	3	4	5	6
30	3 x 6	87	-16.10**	-30.23**	-45.86**
31	3 x 7	150	23.25**	- 6.66	- 6.66
32	3 x 8	106	21.84**	16.10*	-34.04**
33	3 x 9	109.3	48.70**	16.76**	5.35
34	3 x 10	75.7	1.81	- 8.46	-52.89**
35	4 x 5	100.0	-15.72**	-28.57**	-37.77**
36	4 x 6	114.0	-13.86**	-18.57**	-29.06**
37	4 x 7	136.0	- 9.54*	-15.37**	-15.37**
38	4 x 8	170.0	46.99**	21.42**	5.79
39	4 x 9	139.3	- 2.25	- 0.5	-13.32**
40	4 x 10	138.7	34.66**	- 0.93	-13.69**
41	5 x 6	148.7	33.96**	19.25**	- 7.47
42	5 x 7	143.0	10.85*	-11.01*	-11.01*
43	5 x 8	119.3	26.51**	22.61**	-25.76**
44	5 x 9	128.7	6.23	-11.24*	-19.91**
45	5 x 10	96.0	17.57*	-01.34	-40.26**
46	6 x 7	142.0	- 0.49	-11.64**	-11.64**
47	6 x 8	131.3	21.57**	5.29	-18.29**
48	6 x 9	131.3	- 2.63	- 9.45	- 18.29**
49	6 x 10	100.0	4.88	-19.81**	-37.77**
50	7 x 8	149.3	18.49**	- 7.09	- 7.09
51	7 x 9	156.0	2.06	- 2.92	- 2.92
52	7 x 10	152.0	34.10**	- 5.41	- 5.41
53	8 x 9	101.3	-14.26**	-30.14**	-36.96**
54	8 x 10	122.7	56.01**	34.39**	-23.65**
55	9 x 10	98.7	- 6.44	-31.93**	-38.58**
C.D (0.05)		13.72	11.88	13.72	13.72
C.D (0.01)		18.15	15.72	18.15	18.15

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

As many as 17 crosses showed significant positive heterosis over mid parent and an equal number of crosses also exhibited significant negative heterosis. The heterosis ranged between -39.05 (2 x 6) and 28.37 (3 x 5) per cent over the mid parent.

In five crosses significant positive heterosis and in 27 crosses significant negative heterosis over better parent were observed. The heterosis over better parent varied from -51.88 (2 x 6) to 19.23 (3 x 5) per cent.

In almost all (43) hybrids showed negative significant heterosis over the best parent, Taiwan Naga. The heterosis ranged between -64.46 (1 x 10) to -6.02 (8 x 10) per cent over best parent.

4.5.2.11 <u>Average girth of fruit</u>

The average girth of fruit ranged between 11.7 (Taiwan Naga) and 21.2 cm (Malapur Local) among parents and 13 (8 x 9) and 21.4 (4 x 6) cm among crosses (Table 20).

As many as 20 crosses exhibited significant positive heterosis, whereas, only four crosses showed significant negative heterosis over mid parent. The heterosis ranged between -21.49 (6 x 9) and 27.21 (6 x 10) per cent over mid parent.

In all, six crosses showed significant positive

Table 19. Mean performance of parents, F_1s, magnitude of heterosis over mid parent, better parent and top parent for fruit length (cm).

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	White Madhapuri	7.8	-	-	-
2	Higna dorla	7.7	-	-	-
3	Gare local	6.7	-	-	-
4	SM 135	9.2	-	-	-
5	Surya	7.8	-	-	-
6	Gokak local	13.3	-	-	-
7	Malapur local	10.0	-	-	-
8	Taiwan naga	16.6	-	-	-
9	Pusakranti	12.9	-	-	-
10	Pusa bhairav	11.2	-	-	-
11	1 x 2	6.13	-20.9**	-21.4**	-63.07**
12	1 x 3	8.5	17.24**	8.97	-48.79**
13	1 x 4	8.97	5.53	- 2.5	-45.96**
14	1 x 5	6.93	-11.15*	-11.15	-58.25**
15	1 x 6	9.37	-11.18**	-29.55**	-43.55**
16	1 x 7	11.17	25.50**	11.7*	-32.7**
17	1 x 8	9.7	-20.49**	-41.57**	-41.56**
18	1 x 9	7.7	-25.60**	-40.31**	-53.61**
19	1 x 10	5.9	-37.89**	-47.32**	-64.46**
20	2 x 3	6.0	-16.67**	-22.08**	-63.85**
21	2 x 4	7.0	-17.16**	-23.91**	-57.83**
22	2 x 5	6.3	-18.71**	-19.23**	-62.05**
23	2 x 6	6.4	-39.05**	-51.88**	-61.44**
24	2 x 7	7.8	-11.86*	-22.0**	-53.01**
25	2 x 8	10.5	-13.2**	-36.75**	-36.75**
26	2 x 9	12.3	19.42**	- 4.65	-25.9**
27	2 x 10	7.6	-19.57**	-32.14**	-54.22**
28	3 x 4	7.5	- 5.66	-18.48**	-54.82**
29	3 x 5	9.3	28.27**	19.23**	-43.97**
30	3 x 6	10.2	2.0	-23.31**	-38.55**

Contd ..

Table 19 (Contd..)

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
31	3 x 7	9.3	11.38*	- 7.00	-43.97**
32	3 x 8	9.8	-15.88**	-40.96**	-40.96**
33	3 x 9	10.9	11.22**	-15.50**	-34.34**
34	3 x 10	7.8	-12.85**	-30.36**	-53.01**
35	4 x 5	9.97	17.29**	8.37	-39.94**
36	4 x 6	11.17	- 0.71	-16.00**	-32.71**
37	4 x 7	9.7	1.04	- 3.00	-41.57**
38	4 x 8	13.1	1.55	-21.08**	-21.08**
39	4 x 9	10.1	- 8.60*	-21.70**	-39.16**
40	4 x 10	11.17	9.51*	- 0.26	-32.71**
41	5 x 6	12.4	17.53**	- 6.77	-25.30**
42	5 x 7	11.2	25.84**	12.0*	-32.53**
43	5 x 8	13.4	9.84**	-19.28**	-19.28**
44	5 x 9	10.54	1.74	-18.37**	-36.57**
45	5 x 10	9.57	0.74	-14.55**	-42.35**
46	6 x 7	12.8	9.87**	- 3.76	-22.89**
47	6 x 8	15.4	3.01	- 7.23*	- 7.23*
48	6 x 9	14.3	9.16**	7.92*	-13.85**
49	6 x 10	12.5	2.04	- 6.01	-24.70**
50	7 x 8	14.7	10.53**	-11.44**	-11.44**
51	7 x 9	12.5	9.17*	- 3.10	-24.70**
52	7 x 10	13.2	24.53**	17.86**	-20.48**
53	8 x 9	12.5	-15.25**	-24.70**	-24.70**
54	8 x 10	15.6	12.23**	- 6.02*	- 6.02*
55	9 x 10	12.4	2.90	- 3.88	-25.30**
C.D (0.05)		0.944	0.818	0.944	0.944
C.D (0.01)		1.249	1.082	1.249	1.249

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

heterosis over better parent, while 15 crosses exhibited negative heterosis. The heterosis varied from -26.97 (8 x 9) to 15.73 (1 x 9) per cent over better parent.

Negative significant heterosis over best parent were exhibited by 34 crosses. The heterosis ranged between -38.68 (6 x 9) and 0.94 (4 x 6) per cent over best parent.

4.5.1.12 Average stalk length of fruit

The average stalk length of fruit varied from 4.2 (Gare Local) to 7.3 cm (Taiwan Mega) in parents and 4.4 (1 x 2 and 3 x 10) to 7.3 cm (6 x 8) in crosses (Table 21).

Only one of the crosses (1 x 2) showed significant negative heterosis over mid parent, while three crosses exhibited positive significant heterosis. The heterosis ranged between -17.76 (1 x 2) and 24.53 (7 x 10) per cent over mid parent.

In 13 crosses, significant positive heterosis over better parent, was found. The heterosis varied from -12.0 (1 x 2) to 40.42 (7 x 10) per cent over better parent.

But, in as many as 30 hybrids, positive significant heterosis over the best parent was observed. The heterosis over best parent ranged between 4.76 (1 x 2) and 73.81 (6 x 8) per cent.

Table 20. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for fruit girth (cm) in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	16.8	-	-	-
2	Hignadorla	19.3	-	-	-
3	Gare local	16.9	-	-	-
4	SM 135	19.9	-	-	-
5	Surya	14.3	-	-	-
6	Gokak local	17.1	-	-	-
7	Malapur local	21.2	-	-	-
8	Taiwan naga	11.7	-	-	-
9	Pusa kranti	17.8	-	-	-
10	Pusa bhairav	12.3	-	-	-
11	1 x 2	16.13	-10.64*	-16.42**	-23.91**
12	1 x 3	19.4	15.13**	14.79**	- 8.49*
13	1 x 4	20.8	13.35**	4.52	- 1.89
14	1 x 5	19.3	21.16**	14.88**	- 8.96*
15	1 x 6	18.8	10.91*	9.94	-11.92**
16	1 x 7	20.4	7.37	- 3.77	- 3.77
17	1 x 8	16.3	14.38**	- 2.98	-23.11**
18	1 x 9	20.6	19.65**	15.73**	- 2.83
19	1 x 10	14.6	0.34	-13.09**	-31.13**
20	2 x 3	18.9	4.42	- 2.07	-10.85*
21	2 x 4	18.4	- 6.12	- 7.54	-13.21**
22	2 x 5	18.97	12.92**	- 1.71	-10.52*
23	2 x 6	16.5	- 9.34*	-14.51*	-22.17**
24	2 x 7	20.4	0.74	- 3.77	- 3.77
25	2 x 8	17.2	10.97*	-10.88*	-18.87**
26	2 x 9	21.1	13.75**	9.33*	- 0.47
27	2 x 10	17.6	11.39*	- 8.81	-16.98**
28	3 x 4	17.1	- 7.06	-14.07**	-19.34**
29	3 x 5	17.6	12.82*	4.14	-16.98**
30	3 x 6	19.3	13.53**	12.86*	- 8.96*

Contd..

Table 20 (Contd..)

1	2	3	4	5	6
31	3 x 7	20.2	6.04	- 4.72	- 4.72
32	3 x 8	16.7	16.78**	- 1.18	-21.23**
33	3 x 9	19.7	13.54**	10.67*	- 7.07
34	3 x 10	14.6	0.00	-13.61*	-31.13**
35	4 x 5	16.8	- 1.75	-15.58**	-20.75**
36	4 x 6	21.4	15.67**	7.54	0.94
37	4 x 7	21.4	4.14	0.94	0.94
38	4 x 8	16.4	3.80	-17.59**	-22.64**
39	4 x 9	19.4	2.92	- 2.91	- 8.49*
40	4 x 10	18.4	14.28**	- 7.54	-13.21**
41	5 x 6	17.7	12.74*	3.51	-16.51**
42	5 x 7	18.0	1.41	-15.09**	-15.09**
43	5 x 8	14.9	14.61*	4.19	-29.72**
44	5 x 9	18.7	16.51**	5.06	-11.79**
45	5 x 10	14.2	6.77	- 0.70	-33.02**
46	6 x 7	19.9	3.92	- 6.13	- 6.13
47	6 x 8	14.9	3.47	-12.86*	-29.72**
48	6 x 9	13.7	-21.49**	-23.03**	-35.38**
49	6 x 10	18.7	27.21**	9.36	-11.79*
50	7 x 8	16.5	0.30	-22.17**	-22.17**
51	7 x 9	19.8	1.54	- 6.60	- 6.60
52	7 x 10	17.7	5.67	-16.51**	-16.51**
53	8 x 9	13.0	-11.86*	-26.97**	-38.68**
54	8 x 10	13.4	11.67	8.94	-36.79**
55	9 x 10	15.7	4.32	-11.80*	-25.94**
C.D (0.05)		1.754	1.519	1.754	1.754
C.D (0.01)		2.321	2.010	2.321	2.321

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

Table 21. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for stalk length (cm) in brinjal.

Sl. no.	Parents and crosses	Mean value	Percent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	5.7	-	-	-
2	Higna dorla	5.0	-	-	-
3	Gare local	4.2	-	-	-
4	SM 135	5.2	-	-	-
5	Surya	5.0	-	-	-
6	Gokak local	6.2	-	-	-
7	Malapur local	5.9	-	-	-
8	Taiwan naga	7.3	-	-	-
9	Pusa kranti	5.7	-	-	-
10	Pusa bhairav	4.7	-	-	-
11	1 x 2	4.4	-17.76*	-12.0	4.76
12	1 x 3	5.5	11.11	30.95**	30.95**
13	1 x 4	5.5	0.92	5.77	30.95**
14	1 x 5	6.2	15.89*	24.0*	47.62**
15	1 x 6	5.8	- 2.52	1.75	38.09**
16	1 x 7	6.4	10.34	12.28	52.38**
17	1 x 8	6.2	- 4.61	8.77	47.62**
18	1 x 9	5.7	0.0	0.0	35.71**
19	1 x 10	4.7	- 9.61	0.0	11.90
20	2 x 3	5.4	17.39	28.57*	28.57*
21	2 x 4	5.2	1.96	4.0	23.81*
22	2 x 5	4.5	-10.00	-10.00	7.14
23	2 x 6	5.0	-10.71	0.0	19.05
24	2 x 7	4.8	-11.93	- 4.0	14.28
25	2 x 8	5.4	-12.19	8.0	28.57**
26	2 x 9	5.5	2.80	10.00	30.95**
27	2 x 10	4.7	- 3.09	0.0	11.90
28	3 x 4	4.5	- 4.25	7.14	7.14
29	3 x 5	4.9	6.52	16.67	16.67
30	3 x 6	4.8	- 7.69	14.28	14.28

Contd..

Table 21 (Contd..)

1	2	3	4	5	6
31	3 x 7	5.1	0.99	21.43	21.43
32	3 x 8	5.4	- 6.09	28.57*	28.57*
33	3 x 9	5.7	15.15	35.71**	35.71**
34	3 x 10	4.4	- 1.12	4.76	4.76
35	4 x 5	5.0	- 1.96	0.00	19.05
36	4 x 6	6.2	8.77	19.23*	47.62**
37	4 x 7	6.0	8.11	15.38	42.86**
38	4 x 8	7.1	13.60*	36.54**	69.05**
39	4 x 9	6.1	11.93	17.31	45.24**
40	4 x 10	5.5	11.11	17.02	30.95**
41	5 x 6	6.4	14.28	28.0**	52.38**
42	5 x 7	5.6	2.75	12.0	33.33**
43	5 x 8	6.4	4.06	28.00**	52.38**
44	5 x 9	5.1	- 4.67	2.0	21.43
45	5 x 10	5.1	5.13	8.51	21.43
46	6 x 7	6.4	5.78	8.47	52.38**
47	6 x 8	7.3	8.15	17.74*	73.81**
48	6 x 9	6.3	5.88	10.53	50.00**
49	6 x 10	6.0	10.09	27.65**	42.86**
50	7 x 8	6.2	- 6.06	5.08	47.62**
51	7 x 9	5.7	- 1.72	0.00	35.71**
52	7 x 10	6.6	24.53**	40.42**	57.14**
53	8 x 9	7.0	7.69	22.81**	66.67**
54	8 x 10	5.5	- 8.33	17.02	30.95**
55	9 x 10	5.1	- 1.92	8.51	21.43
C.D (0.05)		0.972	0.842	0.972	0.972
C.D (0.01)		1.286	1.114	1.286	1.286

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

4.5.1.13 Fruit density

The fruit density ranged between 0.68 (parent No.8) and 0.84 (parent Nos.2, 3 and 4) in parents and 0.69 (3 x 4), (6 x 8, 6 x 9 and 7 x 10) and 0.84 (1 x 2) in crosses (Table 22).

Three crosses exhibited significant positive heterosis over mid parent, while 28 crosses showed negative significant heterosis over mid parent. The heterosis over mid parent ranged between -17.86 (3 x 4) and 5.81 (2 x 7) per cent.

None of the hybrids had a better fruit density than their better parents. Instead, 34 crosses exhibited significant negative heterosis over better parent. The heterosis varied from -17.86 (3 x 4) to 3.[illegible]5 (1 x 5, 1 x 6) per cent over better parent.

4.5.2.14 Keeping quality index of fruit

The keeping quality index ranged between 15.7 (CM 135) and 22.1 (Surya) in parents and 9.5 (5 x 6) and 22.3 (4 x 6) in crosses (Table 23).

Four crosses showed highly significant positive heterosis and in 19 crosses had significant negative heterosis over mid parent. The heterosis ranged between -52.64 (5 x 7) and 32.74 (4 x 6) per cent over mid parent.

Table 22. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for fruit density in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	0.78	-	-	-
2	Higna dorla	0.84	-	-	-
3	Gare local	0.84	-	-	-
4	SM 135	0.84	-	-	-
5	Surya	0.77	-	-	-
6	Gokak local	0.77	-	-	-
7	Malapur local	0.71	-	-	-
8	Taiwan naga	0.68	-	-	-
9	Pusa kranti	0.76	-	-	-
10	Pusa bhairav	0.75	-	-	-
11	1 x 2	0.84	3.70	0.0	0.0
12	1 x 3	0.72	-11.11**	-14.28**	-14.28**
13	1 x 4	0.70	-13.58**	-16.67**	-16.67**
14	1 x 5	0.81	4.52*	3.85	- 3.57
15	1 x 6	0.81	4.52*	3.85	- 3.57
16	1 x 7	0.70	- 6.04*	-10.26**	-16.67**
17	1 x 8	0.74	- 3.90	- 5.13*	-11.90**
18	1 x 9	0.74	- 3.90	- 5.13*	-11.90**
19	1 x 10	0.77	0.65	- 1.28	- 8.33**
20	2 x 3	0.77	- 8.33**	- 8.33**	- 8.33**
21	2 x 4	0.74	-11.90**	-11.90**	-11.90**
22	2 x 5	0.70	-13.04**	-16.67**	-16.67**
23	2 x 6	0.73	- 9.32**	-13.09**	-13.09**
24	2 x 7	0.82	5.81*	- 2.38	- 2.38
25	2 x 8	0.72	- 5.26*	-14.28**	-14.28**
26	2 x 9	0.72	-10.00**	-14.28**	-14.28**
27	2 x 10	0.73	- 8.18**	-13.09**	-13.09**
28	3 x 4	0.69	-17.86**	-17.86**	-17.86**
29	3 x 5	0.82	1.86	- 2.38	- 2.38
30	3 x 6	0.74	- 8.07**	-11.90**	-11.90**

Contd..

Table 22 (Contd..)

1	2	3	4	5	6
31	3 x 7	0.76	- 1.93	- 9.52**	- 9.52**
32	3 x 8	0.72	- 5.26*	-14.28**	-14.28**
33	3 x 9	0.72	-10.00**	-14.28**	-14.28**
34	3 x 10	0.74	- 6.92**	-11.90**	-11.90**
35	4 x 5	0.74	- 8.07**	-11.90**	-11.90**
36	4 x 6	0.73	- 9.32**	-13.09**	-13.09**
37	4 x 7	0.78	0.64	- 7.14**	- 7.14**
38	4 x 8	0.72	- 5.26*	-14.28**	-14.28**
39	4 x 9	0.72	-10.00**	-14.28**	-14.28**
40	4 x 10	0.72	- 9.43**	-14.28**	-14.28**
41	5 x 6	0.73	- 5.19*	- 5.19*	-13.09**
42	5 x 7	0.70	- 5.40*	- 9.09**	-16.67**
43	5 x 8	0.73	+ 0.69	- 5.19*	-13.09**
44	5 x 9	0.73	- 4.97**	- 5.19*	-13.09
45	5 x 10	0.74	- 2.63	- 3.90	-11.90**
46	6 x 7	0.74	0.0	- 3.90	-11.90**
47	6 x 8	0.69	- 4.93*	-10.39**	-17.86**
48	6 x 9	0.69	- 9.80**	-10.39**	-17.86**
49	6 x 10	0.70	- 7.89**	- 9.09**	-16.67**
50	7 x 8	0.70	0.72	- 1.41	-16.67**
51	7 x 9	0.70	- 4.76*	- 7.89**	-16.67**
52	7 x 10	0.69	- 5.48*	- 8.0**	-17.86**
53	8 x 9	0.71	- 1.39	- 6.58*	-15.48**
54	8 x 10	0.72	0.69	- 4.00	-14.28**
55	9 x 10	0.75	- 0.66	- 1.32	-10.71**
C.D (0.05)		0.0397	0.0344	0.0397	0.0397
C.D (0.01)		0.0525	0.0455	0.0525	0.0525

*, **,- Significant at 5 and 1 per cent level of probability, respectively.

Table 23. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for keeping quality index in brinjal.

Sl. no.	Parents and cross	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White madhapuri	16.5	-	-	-
2	Higna dorla	15.8	-	-	-
3	Gare local	18.2	-	-	-
4	SM 135	15.7	-	-	-
5	Surya	22.1	-	-	-
6	Gokak local	17.9	-	-	-
7	Malapur local	21.4	-	-	-
8	Taiwan naga	18.0	-	-	-
9	Pusa kranti	19.8	-	-	-
10	Pusa bhairav	16.3	-	-	-
11	1 x 2	18.4	13.93	16.45	17.19
12	1 x 3	18.2	4.90	10.30	15.92
13	1 x 4	19.3	19.87**	22.93*	22.93*
14	1 x 5	15.5	-19.69**	- 6.06	- 1.27
15	1 x 6	14.9	-13.37*	- 9.70	- 5.09
16	1 x 7	20.9	10.29	26.67**	33.12**
17	1 x 8	18.4	6.67	11.51	17.20
18	1 x 9	16.1	-11.29	- 2.42	2.55
19	1 x 10	16.9	3.05	3.68	7.64
20	2 x 3	18.2	7.06	15.19	15.92
21	2 x 4	20.1	27.62**	28.02**	28.02**
22	2 x 5	20.6	8.71	30.38**	31.21**
23	2 x 6	16.6	- 1.48	5.06	5.73
24	2 x 7	17.3	- 6.99	9.49	10.19
25	2 x 8	16.7	- 1.18	5.70	6.37
26	2 x 9	16.8	- 5.62	6.33	7.01
27	2 x 10	19.4	20.87**	22.78*	23.57**
28	3 x 4	17.2	1.47	9.55	9.55
29	3 x 5	15.1	-25.06**	-17.03*	- 3.82
30	3 x 6	19.1	5.82	4.94	21.66*

Contd..

Table 23 (Contd..)

1	2	3	4	5	6
31	3 x 7	16.1	-18.69**	-10.99	2.55
32	3 x 8	15.0	-17.13**	-16.67*	- 4.46
33	3 x 9	12.0	-36.84**	-34.06**	-23.57**
34	3 x 10	17.7	2.61	8.59	12.74
35	4 x 5	17.1	- 9.52	8.92	8.92
36	4 x 6	22.3	32.74**	42.04**	42.04**
37	4 x 7	16.4	-11.59	4.46	4.46
38	4 x 8	14.1	-16.32*	-10.19	-10.19
39	4 x 9	14.4	-18.87**	- 8.28	- 8.28
40	4 x 10	10.5	-34.37**	-33.12**	-33.12**
41	5 x 6	9.5	-52.50**	-46.93**	-39.49**
42	5 x 7	10.3	-52.64**	-51.87**	-34.39**
43	5 x 8	18.3	- 8.73	1.67	16.56
44	5 x 9	13.7	-34.61**	-30.81**	-12.74
45	5 x 10	17.5	- 8.85	7.36	11.46
46	6 x 7	19.5	- 0.76	8.94	24.20**
47	6 x 8	11.6	-35.38**	-35.19**	-26.11**
48	6 x 9	12.9	-31.56**	-27.93**	-17.83*
49	6 x 10	15.1	-11.70	- 7.36	- 3.82
50	7 x 8	15.6	-20.81**	-13.33	- 0.64
51	7 x 9	15.7	-23.79**	-20.71**	0.00
52	7 x 10	15.4	-18.30**	- 5.52	- 1.91
53	8 x 9	19.2	1.59	6.67	22.29*
54	8 x 10	14.7	-14.28*	- 9.82	- 6.37
55	9 x 10	15.6	-13.57*	- 4.29	- 0.64
C.D (0.05)		2.042	1.768	2.042	2.042
C.D (0.01)		2.702	2.340	2.702	2.702

*, ** - Significant at 5 and 1 per cent level of probability, respectively

Six crosses exhibited positive significant heterosis over better parent, while 10 crosses showed negative significant heterosis. The heterosis ranged between -51.87 (5 x 7) and 42.04 (4 x 6) per cent over better parent.

Significant positive heterosis over best parent showed by nine crosses, while six crosses exhibited negative significant heterosis over best variety. The heterosis over best parent varied from -39.49 (5 x 6) to 42.04 (4 x 6) per cent.

4.5.2.15 <u>Rind thickness of fruit</u>

The mean rind thickness of fruit varied from 0.48 (White Madhapuri) to 0.85 cm (SM 135) in parents and 0.65 (7 x 10) to 0.90 cm (6 x 9) in hybrids (Table 24).

Thirtythree crosses exhibited significant positive heterosis over mid parent, while two crosses showed significant negative heterosis. The heterosis ranged between -8.11 (4 x 10) and 43.55 (5 x 10) per cent over mid parent.

In 11 crosses positive significant heterosis over better parent, and in eight crosses negative significant heterosis over better parent were observed. The heterosis over better parent varied from -20 (4 x 10) to 41.27 (5 x 10) per cent. None of the hybrids were significantly better than the best parent, Pusa Kranti. In as many as 30

Table 24. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for rind thickness (cm) in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	0.48	-	-	-
2	Hignadorla	0.62	-	-	-
3	Gare local	0.66	-	-	-
4	SM 135	0.85	-	-	-
5	Surya	0.61	-	-	-
6	Gokak local	0.70	-	-	-
7	Malapur local	0.71	-	-	-
8	Taiwan naga	0.55	-	-	-
9	Pusa kranti	0.78	-	-	-
10	Pusa bhairav	0.63	-	-	-
11	1 x 2	0.74	34.54**	19.35**	-12.94**
12	1 x 3	0.76	33.33**	15.15**	-10.59**
13	1 x 4	0.81	21.80**	- 4.71	- 4.71
14	1 x 5	0.75	37.61**	22.95**	-11.76**
15	1 x 6	0.84	42.37**	20.00**	- 1.18
16	1 x 7	0.80	34.45**	12.68**	- 5.88
17	1 x 8	0.72	39.80**	30.90**	-15.29**
18	1 x 9	0.76	20.63**	- 2.36	-10.59**
19	1 x 10	0.69	24.32**	9.52	-18.82**
20	2 x 3	0.69	7.81	4.54**	-18.82**
21	2 x 4	0.82	11.36**	- 3.53	- 3.53
22	2 x 5	0.78	26.83**	25.81**	- 8.23*
23	2 x 6	0.67	1.51	- 4.28	-21.18**
24	2 x 7	0.76	14.28**	7.04	-10.59**
25	2 x 8	0.73	21.79**	17.74**	-14.12**
26	2 x 9	0.79	12.06**	1.28	- 7.06
27	2 x 10	0.76	21.60**	20.63**	-10.59**
28	3 x 4	0.73	- 3.31	-14.12**	-14.12**
29	3 x 5	0.73	14.96**	10.61*	-14.12**
30	3 x 6	0.82	20.59**	17.14**	- 3.53

Contd..

Table 24 (Contd..)

1	2	3	4	5	6
31	3 x 7	0.86	25.55**	21.13**	1.18
32	3 x 8	0.82	35.54**	24.24**	- 3.53
33	3 x 9	0.82	13.89**	5.13	- 3.53
34	3 x 10	0.73	16.28**	13.64**	-11.76**
35	4 x 5	0.71	- 2.74	-16.47**	-16.47**
36	4 x 6	0.75	- 3.22	-11.76**	-11.76**
37	4 x 7	0.77	- 1.28	- 9.41*	- 9.41*
38	4 x 8	0.74	5.71	-12.94**	-12.94**
39	4 x 9	0.78	- 4.29	- 8.23*	- 8.23*
40	4 x 10	0.68	- 8.11*	-20.00**	-20.00**
41	5 x 6	0.82	25.19**	17.14**	- 3.53
42	5 x 7	0.78	18.18**	9.86*	- 8.23*
43	5 x 8	0.77	32.76**	26.23**	- 9.41*
44	5 x 9	0.82	17.98**	5.13	- 3.53
45	5 x 10	0.89	43.55**	41.27**	4.71
46	6 x 7	0.75	6.38	5.63	-11.76**
47	6 x 8	0.82	31.20**	17.14**	- 3.53
48	6 x 9	0.90	21.62**	15.38**	5.88
49	6 x 10	0.76	14.28**	8.57	-10.59**
50	7 x 8	0.73	15.87**	2.82	-14.12**
51	7 x 9	0.69	- 7.38*	-11.54**	-18.82**
52	7 x 10	0.65	- 2.98	- 8.45	-23.53**
53	8 x 9	0.77	-15.79**	-11.28**	-19.41**
54	8 x 10	0.83	-40.68**	-31.75**	-22.35**
55	9 x 10	0.76	7.80*	- 2.56	-10.59**
C.D (0.05)		0.061	0.052	0.061	0.061
C.D (0.01)		0.080	0.069	0.080	0.080

*, ** = Significant at 5 and 1 per cent level of probability, respectively.

crosses, negative significant heterosis over best parent was observed.

4.5.2.16 Average seed weight per fruit

The mean seed weight per fruit ranged between 2.1 (Pusa Bhairav) and 5.65 g (Higna Dorla) among parents and 1.95 (6 x 9) and 7.2 g (1 x 4) among crosses (Table 25).

Twentytwo crosses exhibited positive significant heterosis over mid parent, whereas five crosses showed negative significant heterosis over mid parent. The heterosis ranged between -43.36 (6 x 9) and 78.91 (1 x 10) per cent over mid parent.

One of the crosses (6 x 9) showed negative significant heterosis over the better parent. Thirtyfour crosses exhibited positive significant heterosis over better parent. The heterosis over better parent varied from -41.62 (6 x 9) to 166.67 (1 x 10) per cent.

As many as fortyone crosses had positive significant heterosis over the best parent. The heterosis over best parent ranged between -7.14 (6 x 9) and 242.86 (1 x 4) per cent.

4.5.2.17 Dry matter content of fruit

The mean dry matter content in fruits varied from 7.2 (Malapur local) to 9.3 (White Madhapuri) per cent among parents and 6.0 (5 x 8) to 9.5 (4 x 5) per cent among

Table 25. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for seed weight per fruit (g) in brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	4.16	-	-	-
2	Higna dorla	5.65	-	-	-
3	Gare local	2.60	-	-	-
4	SM 135	5.05	-	-	-
5	Surya	3.29	-	-	-
6	Gokak local	3.34	-	-	-
7	Malapur local	3.12	-	-	-
8	Taiwan naga	2.63	-	-	-
9	Pusa kranti	3.57	-	-	-
10	Pusa bhairav	2.10	-	-	-
11	1 x 2	3.67	-25.18**	-11.78	74.76**
12	1 x 3	4.12	21.89**	58.46**	96.19**
13	1 x 4	7.20	56.35**	73.08**	242.86**
14	1 x 5	4.60	23.49**	39.82**	119.05**
15	1 x 6	5.20	38.67**	55.69**	147.62**
16	1 x 7	5.86	60.99**	87.82**	179.05**
17	1 x 8	4.70	38.44**	78.71**	123.81**
18	1 x 9	5.50	42.30**	54.06**	161.90**
19	1 x 10	5.60	78.91**	166.67**	166.67**
20	2 x 3	5.42	31.39**	108.46**	158.09**
21	2 x 4	5.15	- 3.74	1.98	145.24**
22	2 x 5	4.49	0.45	36.47**	113.81**
23	2 x 6	3.57	-20.58**	6.89	70.00**
24	2 x 7	4.29	- 2.17	37.50**	104.28**
25	2 x 8	3.88	- 6.28	47.53**	84.76**
26	2 x 9	4.93	6.94	38.09**	134.76**
27	2 x 10	4.14	6.84	97.14**	97.14**
28	3 x 4	2.99	-21.83**	15.00	42.38**
29	3 x 5	3.66	24.28**	40.77**	74.28**
30	3 x 6	3.07	3.37	18.08	46.19**

Contd..

Table 25 (contd..)

1	2	3	4	5	6
31	3 x 7	4.83	68.88**	85.77**	130.00**
32	3 x 8	3.33	27.34**	28.08**	58.57**
33	3 x 9	5.16	67.26**	98.46**	145.71**
34	3 x 10	2.85	21.28	35.71*	35.71*
35	4 x 5	4.16	- 0.24	26.44**	98.09**
36	4 x 6	5.06	20.62**	51.50**	140.90**
37	4 x 7	4.79	17.26**	53.53**	128.09**
38	4 x 8	4.24	10.42	61.22**	101.90**
39	4 x 9	4.47	3.71	25.21**	112.86**
40	4 x 10	4.28	19.72**	103.81**	103.81**
41	5 x 6	3.52	6.18	5.39	67.62**
42	5 x 7	5.01	56.32**	60.58**	138.57**
43	5 x 8	2.63	-11.15	0.0	25.24
44	5 x 9	3.94	14.87	19.76*	87.62**
45	5 x 10	3.08	14.28	46.67**	46.67**
46	6 x 7	4.87	50.77**	56.09**	131.90**
47	6 x 8	3.52	17.92*	33.84**	67.62**
48	6 x 9	1.95	-43.56**	-41.62**	- 7.14
49	6 x 10	4.47	64.34**	112.86**	112.86**
50	7 x 8	3.32	15.48	26.23*	58.09**
51	7 x 9	3.38	1.05	8.33	60.95**
52	7 x 10	4.62	77.01**	120.00**	120.00**
53	8 x 9	2.55	-17.74*	- 3.04	21.43
54	8 x 10	2.46	4.02	17.14	17.14
55	9 x 10	3.39	19.58*	61.43**	61.43**
C.D (0.05)		0.592	0.513	0.592	0.592
C.D (0.01)		0.784	0.679	0.784	0.784

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

crosses (Table 26).

Fifteen crosses exhibited positive significant heterosis over mid parent. Eight crosses showed negative significant heterosis over their mid parent. The heterosis ranged between -26.27 (1 x 2) and 27.03 (2 x 7) per cent over mid parent.

Nine crosses showed positive significant heterosis over better parent, while 17 crosses exhibited negative significant heterosis over better parent. The heterosis over better parent varied from -33.01 (1 x 2) to 23.68 (2 x 7) per cent.

Thirtyseven crosses exhibited negative highly significant heterosis over best parent. The heterosis over best parent ranged between -35.48 (5 x 8) and 2.15 (4 x 5) per cent.

4.5.2.18 Total phenols content in dry fruit

The mean total phenol content in dry fruit varied from 0.254 (Higna Dorla) to 0.547 (Pusa Kranti) among parents and 0.123 (4 x 7) to 0.881 (7 x 9) per cent among crosses (Table 27).

Sixteen crosses exhibited negative highly significant heterosis over mid parent and 24 crosses showed positive highly significant heterosis over mid parent. The heterosis over mid parent ranged between -68.70 (4 x 7) and

Table 26. Mean performance of parents, F_1s, magnitude of heterosis over mid parent, better parent, and top parent for dry matter per cent in brinjal

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	9.3	-	-	-
2	Hignadorla	7.6	-	-	-
3	Gare local	7.6	-	-	-
4	SM 135	8.4	-	-	-
5	Surya	8.2	-	-	-
6	Gokak local	7.7	-	-	-
7	Malapur local	7.2	-	-	-
8	Taiwan naga	7.4	-	-	-
9	Pusa kranti	7.7	-	-	-
10	Pusa bhairav	8.6	-	-	-
11	1 x 2	6.23	-26.27**	-33.01**	-33.01**
12	1 x 3	8.50	0.59	- 8.60**	- 8.60**
13	1 x 4	9.4	6.21*	1.07	1.07
14	1 x 5	8.6	- 1.71	- 7.53**	- 7.53**
15	1 x 6	9.4	10.59**	1.07	1.07
16	1 x 7	8.5	3.03	- 8.60**	- 8.60**
17	1 x 8	8.5	1.80	- 8.60**	- 8.60**
18	1 x 9	8.4	- 1.18	- 9.68**	- 9.68**
19	1 x 10	9.2	2.79	- 1.07	- 1.07
20	2 x 3	7.6	0.0	0.0	-18.28**
21	2 x 4	9.4	17.50**	11.90**	1.07
22	2 x 5	9.2	16.45**	12.19**	- 1.07
23	2 x 6	8.3	8.50**	7.79**	-10.75**
24	2 x 7	9.4	27.03**	23.68**	1.07
25	2 x 8	7.7	2.67	1.32	-17.20**
26	2 x 9	6.5	-15.03**	-15.58**	-30.11**
27	2 x 10	8.5	4.94	- 1.16	- 8.60**
28	3 x 4	9.4	17.50**	11.90**	1.07
29	3 x 5	8.4	6.33**	2.44	- 9.68**
30	3 x 6	7.7	0.65	0.0	-17.20**

Contd..

Table 26 (Contd..)

1	2	3	4	5	6
31	3 x 7	6.6	-10.81**	-13.16**	-29.03**
32	3 x 8	8.2	9.33**	7.89**	-11.83**
33	3 x 9	6.5	-15.03**	-15.58**	-30.11**
34	3 x 10	8.6	6.17*	0.0	- 7.53**
35	4 x 5	9.5	14.46**	13.09**	2.15
36	4 x 6	7.5	- 6.83**	-10.71**	-19.35**
37	4 x 7	7.6	- 2.56	- 9.52**	-18.28**
38	4 x 8	8.8	11.39**	4.76	- 5.38**
39	4 x 9	8.2	1.86	- 2.38	-11.83**
40	4 x 10	8.5	0.0	- 1.16	- 8.60**
41	5 x 6	6.4	-19.50**	-21.95**	-31.18**
42	5 x 7	8.7	12.99**	6.10*	- 6.45**
43	5 x 8	6.0	-23.07**	-26.83**	-35.48**
44	5 x 9	7.4	- 6.92**	- 9.76**	-20.43**
45	5 x 10	8.2	- 2.38	- 4.65	-11.83**
46	6 x 7	7.3	- 2.01	- 5.19*	-21.50**
47	6 x 8	7.6	0.66	- 1.30	-18.28**
48	6 x 9	7.4	- 3.90	- 3.90	-20.43**
49	6 x 10	7.8	- 4.29	- 9.30**	-16.13**
50	7 x 8	8.6	17.01**	16.22**	- 7.53**
51	7 x 9	7.5	0.67	- 2.60	-19.35**
52	7 x 10	8.6	8.87**	0.0	- 7.53**
53	8 x 9	7.4	- 1.99	- 3.90	-20.43**
54	8 x 10	7.7	- 3.75	-10.46**	-17.20**
55	9 x 10	8.5	4.29	- 1.16	- 8.60**
C.D (0.05)		0.466	0.404	0.466	0.466
C.D (0.01)		0.617	0.534	0.617	0.617

*, ** = Significant at 5 and 1 per cent level of probability, respectivly.

91.92 (8 x 10) per cent.

Eight and 33 crosses showed highly significant negative and positive heterosis, respectively over better parent. The heterosis over better parent varied from -65.74 (4 x 7) to 140.87 (8 x 10) per cent.

Thirtyseven and four crosses exhibited highly significant positive and negative heterosis, respectively over best parent. The heterosis over best parent ranged between -81.57 (4 x 7) and 246.85 (7 x 9) per cent.

4.5.2.19 Ortho-dihydroxy phenols content in dry fruit

The mean ortho-dihydroxy phenols content in dry fruits ranged between 0.039 (Gare Local) and 0.059 (Taiwan Naga) per cent among parents and 0.012 (2 x 6) and 0.081 (9 x 10) among crosses (Table 28).

Twentysix crosses exhibited negative significant heterosis over mid parent and 12 crosses showed positive significant heterosis over mid parent. The heterosis over mid parent varied from -76.70 (2 x 6) to 54.28 (9 x 10) per cent.

Twentythree crosses exhibited negative significant heterosis over better parent, while 18 crosses showed positive significant heterosis over better parent. The heterosis over better parent ranged between -74.47 (2 x 6) and 72.34 (9 x 10) per cent.

Table 27. Mean performance of parents, F_1s, magnitude of heterosis over mid parent, better parent and top parent for total phenols (%) in brinjal.

Sl. No.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	0.292	-	-	-
2	Hignadorla	0.254	-	-	-
3	Gare local	0.366	-	-	-
4	SM 135	0.359	-	-	-
5	Surya	0.325	-	-	-
6	Gokak local	0.529	-	-	-
7	Malapur local	0.427	-	-	-
8	Taiwan naga	0.345	-	-	-
9	Pusa kranti	0.547	-	-	-
10	Pusa bhairav	0.521	-	-	-
11	1 x 2	0.453	65.93**	78.35**	78.35**
12	1 x 3	0.326	-0.91	11.64**	28.35**
13	1 x 4	0.397	22.17**	35.96**	56.30**
14	1 x 5	0.242	-21.55**	-17.12**	- 4.72
15	1 x 6	0.365	-11.08**	25.00**	43.70**
16	1 x 7	0.493	37.13**	68.83**	94.09**
17	1 x 8	0.429	34.69**	46.92**	68.90**
18	1 x 9	0.386	- 7.98**	32.19**	51.97**
19	1 x 10	0.320	-21.28**	9.59**	25.98**
20	2 x 3	0.354	14.19**	39.37**	39.37**
21	2 x 4	0.174	-43.23**	-31.49**	-31.50**
22	2 x 5	0.255	-11.92**	0.39	0.39
23	2 x 6	0.384	- 1.91	51.18**	51.18**
24	2 x 7	0.311	- 8.66**	22.44**	22.44**
25	2 x 8	0.476	58.93**	87.40**	87.40**
26	2 x 9	0.484	20.85**	90.55**	90.55**
27	2 x 10	0.245	-36.77**	- 3.54	- 3.54
28	3 x 4	0.397	9.52**	10.58**	56.30**
29	3 x 5	0.258	-25.32**	-20.61**	1.57
30	3 x 6	0.440	- 1.67	20.22**	73.23**

Contd..

Table 27 (Contd..)

1	2	3	4	5	6
31	3 x 7	0.584	47.29**	59.56**	129.92**
32	3 x 8	0.379	6.61**	9.85**	49.21**
33	3 x 9	0.185	-59.47**	-49.45**	-27.16**
34	3 x 10	0.176	-60.32**	-51.91**	-30.70**
35	4 x 5	0.467	36.55**	43.69**	83.86**
36	4 x 6	0.471	6.08**	31.20**	85.43**
37	4 x 7	0.123	-68.70**	-65.74**	-51.57**
38	4 x 8	0.598	69.89**	73.33**	135.43**
39	4 x 9	0.349	-22.96**	- 2.78	37.40**
40	4 x 10	0.544	23.64**	51.53**	114.17**
41	5 x 6	0.431	0.94	32.61**	69.68**
42	5 x 7	0.453	20.48**	39.38**	78.35**
43	5 x 8	0.429	28.06**	32.00**	68.89**
44	5 x 9	0.569	30.50**	75.08**	124.01**
45	5 x 10	0.682	56.50**	103.69**	160.63**
46	6 x 7	0.663	38.70**	55.27**	161.02**
47	6 x 8	0.392	-10.30**	13.62**	54.33**
48	6 x 9	0.469	-12.82**	-11.34**	84.64**
49	6 x 10	0.515	- 1.90	- 1.15	102.76**
50	7 x 8	0.475	23.06**	37.68**	87.01**
51	7 x 9	0.881	80.90**	106.32**	246.85**
52	7 x 10	0.628	32.49**	47.07**	147.24**
53	8 x 9	0.780	74.89**	126.09**	207.09**
54	8 x 10	0.831	91.92**	140.87**	227.16**
55	9 x 10	0.346	-35.20**	-33.59**	36.22**
C.D (0.05)		0.086	0.074	0.086	0.086
C.D (0.01)		0.113	0.098	0.113	0.113

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

Table 28. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for orthodihydro-xyphenols (%) in dry fruits of brinjal.

Sl. no.	Parents and crosses	Mean value	Mean per cent heterosis over		
			MP	BP	TP
1	2	3	4	5	6
1	White Madhapuri	0.045	-	-	-
2	Hignadorla	0.047	-	-	-
3	Gare local	0.039	-	-	-
4	SM 135	0.052	-	-	-
5	Surya	0.042	-	-	-
6	Gokak local	0.056	-	-	-
7	Malapur local	0.047	-	-	-
8	Taiwan naga	0.059	-	-	-
9	Pusa kranti	0.058	-	-	-
10	Pusa bhairav	0.047	-	-	-
11	1 x 2	0.057	23.91**	26.66**	46.15**
12	1 x 3	0.042	0.00	7.59*	7.69*
13	1 x 4	0.052	7.22*	15.55**	33.33**
14	1 x 5	0.031	-28.73**	-26.19**	-20.51**
15	1 x 6	0.053	4.95*	17.78**	35.90**
16	1 x 7	0.048	4.34	6.67*	23.08**
17	1 x 8	0.049	- 5.77	8.89**	25.64**
18	1 x 9	0.050	- 2.91	11.11**	28.20**
19	1 x 10	0.029	-36.96**	-35.55**	-25.64**
20	2 x 3	0.050	16.28**	28.20**	28.21**
21	2 x 4	0.016	-67.68**	-65.96**	-58.97**
22	2 x 5	0.013	-70.79**	-69.04**	-66.67**
23	2 x 6	0.012	-76.70**	-74.47**	-69.23**
24	2 x 7	0.038	-19.15**	-19.15**	- 2.56
25	2 x 8	0.026	-50.94**	-44.68**	-33.33**
26	2 x 9	0.015	-71.43**	-68.08**	-61.54**
27	2 x 10	0.013	-72.34**	-72.34**	-66.67**
28	3 x 4	0.016	-64.83**	-58.97**	-58.97**
29	3 x 5	0.015	-62.96**	-61.54**	-61.54**
30	3 x 6	0.032	-32.63**	-17.95**	-17.95**

Contd..

Table 28 (Contd..)

1	2	3	4	5	6
31	3 x 7	0.048	11.63**	23.08**	23.07**
32	3 x 8	0.016	-67.35**	-58.97**	-58.97**
33	3 x 9	0.036	-25.77**	- 7.69*	- 7.69*
34	3 x 10	0.040	- 6.98*	2.56	2.56
35	4 x 5	0.058	23.40**	38.09**	48.72**
36	4 x 6	0.038	-29.63**	-26.92**	- 2.56
37	4 x 7	0.016	-67.68**	-65.96**	-58.97**
38	4 x 8	0.050	- 9.90**	- 3.85	28.20**
39	4 x 9	0.046	-16.36**	-11.54**	17.95**
40	4 x 10	0.056	13.13**	19.15**	43.59**
41	5 x 6	0.038	-22.45**	- 9.52**	- 2.56
42	5 x 7	0.051	14.61**	21.43**	30.77**
43	5 x 8	0.045	-10.89**	7.14*	15.38**
44	5 x 9	0.036	-28.00**	-14.28**	- 7.69*
45	5 x 10	0.043	- 3.37	2.38	10.26**
46	6 x 7	0.035	-32.04**	-25.53**	-10.26**
47	6 x 8	0.064	11.30**	14.28**	64.10**
48	6 x 9	0.043	-24.56**	-23.21**	10.26**
49	6 x 10	0.040	-22.33**	-14.89**	2.56
50	7 x 8	0.026	-50.94**	-44.68**	-33.33**
51	7 x 9	0.075	42.86**	59.57**	92.31**
52	7 x 10	0.051	8.51**	8.51*	30.77**
53	8 x 9	0.058	- 0.85	0.00	48.72**
54	8 x 10	0.055	3.77	17.02**	41.02**
55	9 x 10	0.081	54.28**	72.34**	107.69**
C.D (0.05)		0.040	0.034	0.040	0.040
C.D (0.01)		0.052	0.045	0.052	0.052

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

In all 17 crosses showed negative significant heterosis over best parent, while 23 crosses exhibited positive significant heterosis over best parent. The heterosis over best parent ranged between -69.23 (2 x 6) and 107.69 (9 x 10) per cent.

4.5.2.20 <u>Total sugars content in dry fruit</u>

The mean total sugar content in dry fruits varied from 1.033 ([illegible] 135) to 2.661 per cent (Pusa Bhairav) among parents and 0.409 (1 x 5) to 3.098 per cent (5 x 7) among crosses (Table 29).

In all 15 crosses exhibited positive significant heterosis over mid parent, while 23 crosses showed negative highly significant heterosis over mid parent. The heterosis over mid parent ranged between -79.48 (2 x 10) and 99.61 (5 x 7) per cent.

Nine crosses showed positive significant heterosis over better parent, while 29 crosses exhibited negative significant heterosis over better parent. The heterosis over better parent varied from -83.80 (2 x 10) to 99.17 (5 x 6) per cent.

A cross (5 x 7) exhibited highly significant positive heterosis over top parent and 35 crosses showed negative significant heterosis over best parent. The heterosis over best parent ranged between -84.63 (1 x 5) and 16.42 (5 x 7) per cent.

Table 29. Mean performance of parents, F_1's, magnitude of heterosis over mid parent, better parent and top parent for total sugars (%) in dry fruits of brinjal

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White madhapuri	1.528	-	-	-
2	Hignadorla	1.540	-	-	-
3	Gare local	1.578	-	-	-
4	SM 135	1.033	-	-	-
5	Surya	1.446	-	-	-
6	Gokak local	1.452	-	-	-
7	Malapur local	1.658	-	-	-
8	Taiwan naga	2.445	-	-	-
9	Pusa kranti	1.077	-	-	-
10	Pusa bhairav	2.661	-	-	-
11	1 x 2	0.552	-64.02**	-64.15**	-79.26**
12	1 x 3	0.790	-49.13**	-49.94**	-70.31**
13	1 x 4	0.702	-45.18**	-54.06**	-73.62**
14	1 x 5	0.409	-72.49**	-73.23**	-84.63**
15	1 x 6	0.906	-39.19**	-40.71**	-65.95**
16	1 x 7	0.846	-46.89**	-48.97**	-68.21**
17	1 x 8	0.935	-52.93**	-61.76**	-64.86**
18	1 x 9	0.572	-56.08**	-62.56**	-78.50**
19	1 x 10	0.515	-75.41**	-80.65**	-80.65**
20	2 x 3	0.657	-57.86**	-58.36**	-75.31**
21	2 x 4	0.431	-66.50**	-72.01**	-83.80**
22	2 x 5	0.594	-60.21**	-61.43**	-77.68**
23	2 x 6	1.182	-20.99**	-23.25**	-55.58**
24	2 x 7	0.837	-47.65**	-49.52**	-68.54**
25	2 x 8	1.244	-37.56**	-49.12**	-53.25**
26	2 x 9	1.579	20.67**	2.53	-40.66**
27	2 x 10	0.431	-79.48**	-83.80**	-83.80**
28	3 x 4	0.933	-28.53**	-40.87**	-64.94**
29	3 x 5	1.346	-10.98	-14.70**	-49.42**
30	3 x 6	0.941	-37.89**	-40.37**	-64.64**

C8ntd..

Table 29 (Contd..)

1	2	3	4	5	6
31	3 x 7	1.345	-16.87**	-18.88**	-49.45**
32	3 x 8	0.695	-65.45**	-71.57**	-73.88**
33	3 x 9	1.344	1.24	-14.83**	-49.49**
34	3 x 10	1.159	-45.32**	-56.44**	-56.44**
35	4 x 5	1.345	8.51	- 6.98	-49.45**
36	4 x 6	1.831	47.36**	26.10**	-31.19**
37	4 x 7	1.354	0.63	-18.33**	-49.12**
38	4 x 8	1.401	-19.44**	-42.70**	-47.35**
39	4 x 9	1.756	66.44**	63.04**	-34.01**
40	4 x 10	1.257	-31.94**	-52.76**	-52.76**
41	5 x 6	2.892	99.58**	99.17**	8.68
42	5 x 7	3.098	99.61**	86.85**	16.42**
43	5 x 8	2.801	43.97**	14.56**	5.26
44	5 x 9	2.142	69.80**	32.49*	-19.50**
45	5 x 10	2.318	12.88**	-12.89*	-12.89*
46	6 x 7	2.728	75.43**	64.53**	2.52
47	6 x 8	2.627	34.82**	7.44	- 1.28
48	6 x 9	2.489	96.84**	71.42**	- 6.46
49	6 x 10	2.863	39.22**	7.59	7.59
50	7 x 8	2.293	11.77*	-6.22	-13.83*
51	7 x 9	2.463	80.11**	48.55**	- 7.44
52	7 x 10	2.043	- 5.39	-23.22**	-23.22**
53	8 x 9	2.705	53.61**	10.63	1.65
54	8 x 10	2.569	0.63	- 3.46	- 3.46
55	9 x 10	2.139	14.45**	-19.62**	-19.62**
C.D (0.05)		0.524	0.454	0.524	0.524
C.D (0.01)		0.693	0.600	0.693	0.693

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

4.5.2.21 Reducing sugars content in dried fruits

The mean reducing sugars content in dried fruits ranged between 0.143 (White Madhapuri) and 0.843 per cent (Gokak Local) among parents. While, the crosses varied from 0.125 (3 x 10) to 1.915 per cent (5 x 8) reducing sugars in dry fruit (Table 30).

Twentythree and 15 crosses exhibited highly significant positive and negative heterosis, respectively over mid parent. The heterosis varied from -72.50 (3 x 10) to 260.64 (5 x 8) per cent over mid parent.

Twentyone crosses showed significant negative heterosis over better parent, while 19 crosses exhibited highly significant positive heterosis over better parent. The heterosis ranged between -83.51 (3 x 10) and 250.73 (5 x 8) per cent over better parent.

Fifteen crosses exhibited highly significant positive heterosis over best parent in desired direction, while 28 crosses showed negative significant heterosis over best parent. The heterosis over best parent varied from -85.17 (3 x 10) to 127.16 (5 x 8) per cent.

4.5.2.22 Crude protein content in dried fruits

The average crude protein content in dried fruits varied from 16.61 (Malapur Local) to 24.69 per cent (Gare Local) among the parents and 12.96 (6 x 8) to 27.55 per

Table 30. Mean performance of parents, F_1s, magnitude of heterosis over mid parent, better parent and top parent for reducing sugars (%) in dry fruits of brinjal.

Sl. no.	Parents and crosses	Mean value	Per cent heterosis over MP	Per cent heterosis over BP	Per cent heterosis over TP
1	2	3	4	5	6
1	White Madhapuri	0.143	-	-	-
2	Hignadorla	0.611	-	-	-
3	Gare local	0.151	-	-	-
4	SM 135	0.276	-	-	-
5	Surya	0.516	-	-	-
6	Gokak local	0.843	-	-	-
7	Malapur local	0.762	-	-	-
8	Taiwan naga	0.546	-	-	-
9	Pusa kranti	0.531	-	-	-
10	Pusa bhairav	0.758	-	-	-
11	1 x 2	0.158	-58.09**	-74.14**	-81.26**
12	1 x 3	0.182	23.81	20.53	-78.41**
13	1 x 4	0.241	15.03	-12.68	-71.41**
14	1 x 5	0.141	-57.21**	-72.67**	-83.27**
15	1 x 6	0.195	-60.45**	-76.87**	-76.87**
16	1 x 7	0.258	-42.98**	-66.14**	-69.39**
17	1 x 8	0.188	-45.43**	-65.57**	-77.70**
18	1 x 9	0.301	-10.68	-43.31**	-64.29**
19	1 x 10	0.199	-55.83**	-73.75**	-76.39**
20	2 x 3	0.209	-45.14**	-65.79**	-75.21**
21	2 x 4	0.429	- 3.27	-29.79**	-49.11**
22	2 x 5	0.356	-36.82**	-41.73**	-57.77**
23	2 x 6	0.558	-23.25**	-33.81**	-33.81**
24	2 x 7	0.297	-56.74**	-61.02**	-64.77**
25	2 x 8	0.821	41.92**	34.37**	- 2.61
26	2 x 9	0.878	53.76**	43.70**	4.15
27	2 x 10	0.265	-61.28**	-65.04**	-68.56**
28	3 x 4	0.379	77.52**	37.32**	-55.04**
29	3 x 5	0.707	111.99	37.01**	-16.13*
30	3 x 6	0.693	39.44**	-17.79*	-17.79*

Contd..

Table 30 (Contd..)

1	2	3	4	5	6
31	3 x 7	0.465	1.86	-38.98**	-44.84**
32	3 x 8	0.525	50.64**	- 3185	-37.72**
33	3 x 9	0.195	-42.81**	-63.28**	-76.87**
34	3 x 10	0.125	-72.50**	-83.51**	-85.17**
35	4 x 5	0.497	25.50**	- 3.68	-41.04**
36	4 x 6	0.511	- 8.67	-39.38**	-39.38**
37	4 x 7	0.333	-35.84**	-56.30**	-60.50**
38	4 x 8	0.387	- 5.84	-29.12**	-54.09**
39	4 x 9	0.601	48.95**	13.18	-28.71**
40	4 x 10	0.346	-33.07**	-54.35**	-58.96**
41	5 x 6	1.157	70.27**	37.25**	37.25**
42	5 x 7	1.156	80.91**	51.71**	37.13**
43	5 x 8	1.915	260.64**	250.73**	127.16**
44	5 x 9	1.076	105.54**	102.64**	27.64
45	5 x 10	1.327	108.32**	75.06	57.41**
46	6 x 7	1.868	132.77**	121.59**	121.59**
47	6 x 8	1.566	125.48**	85.76**	85.76**
48	6 x 9	1.556	126.49**	84.58**	84.58
49	6 x 10	1.247	55.78**	64.51**	47.92**
50	7 x 8	1.660	153.82**	117.85**	96.92**
51	7 x 9	1.456	125.21**	91.08**	72.72**
52	7 x 10	1.172	54.21**	53.81**	39.03**
53	8 x 9	1.159	115.23**	112.27**	37.48**
54	8 x 10	1.473	125.92**	94.33**	74.73**
55	9 x 10	1.171	81.69**	54.48**	38.91
C.D (0.05)		0.393	0.340	0.393	0.393
C.D (0.01)		0.520	0.451	0.520	0.520

*, ** - Significant at 5 and 1 per cent level of probability, respectively

cent (3 x 4) among crosses (Table 31).

Out of 45, eight crosses exhibited highly significant positive and 24 crosses had significant negative heterosis over mid parent. The heterosis ranged between -36.64 (6 x 8) and 22.61 (3 x 4) per cent over mid parent.

Four crosses showed positive significant heterosis over better parent, while 28 crosses exhibited highly significant negative heterosis over better parent. The heterosis ranged between -46.75 (6 x 8) and 15.65 (2 x 5) per cent over better parent.

A cross (3 x 4) showed highly significant positive heterosis over best parent, while 42 crosses exhibited highly significant negative heterosis over best parent. The heterosis over best parent varied from -47.51 (6 x 8) to 11.58 (3 x 4) per cent.

4.5.3 Combining ability

The analysis of variance (ANOVA) for combining ability is presented in Table 32 for 22 characters.

Both GCA and SCA mean squares were highly significant for all the characters except stem girth where only GCA component was highly significant. The estimates of GCA mean squares were greater in magnitude than the corresponding SCA mean squares for all the characters except days to flower, keeping quality index and rind

Table 31. Mean performance of parents, F_1's magnitude of heterosis over mid parent, better parent and top parent for crude protein (%) in dry fruits of brinjal.

Sl. no:	Parents and crosses	Mean value	Per cent heterosis over MP	BP	TP
1	2	3	4	5	6
1	White madhapuri	19.23	-	-	-
2	Higna dorla	19.55	-	-	-
3	Gare local	24.69	-	-	-
4	SM 135	20.25	-	-	-
5	Surya	17.68	-	-	-
6	Gokak level	16.57	-	-	-
7	Malapur local	16.61	-	-	-
8	Taiwan naga	24.34	-	-	-
9	Pusa kranti	19.29	-	-	-
10	Pusa bhairav	19.55	-	-	-
11	1 x 2	16.63	-14.23**	-14.94**	-32.64**
12	1 x 3	19.41	-11.61**	-21.38**	-21.38**
13	1 x 4	16.41	-16.46**	-18.57**	-33.21**
14	1 x 5	17.53	- 5.01	- 8.84**	-28.99**
15	1 x 6	15.12	-15.53**	-21.37**	-38.76**
16	1 x 7	16.25	- 9.32**	-15.50**	-34.18**
17	1 x 8	16.40	-24.72**	-32.62**	-33.58**
18	1 x 9	14.65	-23.94**	-24.05**	-40.66**
19	1 x 10	16.81	-13.31**	-14.01**	-31.91**
20	2 x 3	19.52	-11.75**	-20.94**	-20.94**
21	2 x 4	21.95	10.30**	8.39*	-11.10**
22	2 x 5	22.61	21.46**	15.65**	- 8.42**
23	2 x 6	21.36	18.27**	9.26**	-13.49**
24	2 x 7	17.45	- 3.48**	-10.74**	-29.32**
25	2 x 8	17.10	-22.08**	-29.74**	-30.74**
26	2 x 9	19.29	- 0.67	- 1.33	- 21.87**
27	2 x 10	19.84	1.48	1.48	-19.64**
28	3 x 4	27.55	22.61**	11.58**	11.58**
29	3 x 5	20.84	- 1.63	-15.59**	-15.59**
30	3 x 6	25.21	22.20**	2.11	2.11

Contd..

Table 31 (Contd..)

1	2	3	4	5	6
31	3 x 7	22.50	8.96**	- 8.87**	- 8.87**
32	3 x 8	18.82	-23.23**	-23.77**	-23.77**
33	3 x 9	24.86	13.05**	0.69	0.69
34	3 x 10	18.97	-14.24**	-23.17**	-23.17**
35	4 x 5	14.83	-21.80**	-26.76**	-39.93**
36	4 x 6	20.54	11.57**	1.43	-16.81**
37	4 x 7	17.10	-7.22**	-15.55**	-30.74**
38	4 x 8	16.63	-25.41**	-31.68**	-32.64**
39	4 x 9	19.37	- 2.02	- 4.34	-21.55**
40	4 x 10	17.95	- 9.80**	-11.36**	-27.30**
41	5 x 6	14.74	-13.93**	-16.63**	-40.30**
42	5 x 7	18.88	10.12	6.79	-23.53**
43	5 x 8	16.80	-20.04**	-30.98**	-31.96**
44	5 x 9	18.24	- 1.32	- 5.44	-26.12**
45	5 x 10	16.93	- 9.05	-13.40**	-31.43**
46	6 x 7	17.39	4.82	4.70	-29.57**
47	6 x 8	12.96	-36.64**	-46.75**	-47.51**
48	6 x 9	15.12	-15.67**	-21.62**	-38.76**
49	6 x 10	20.13	11.46**	2.97	-18.47**
50	7 x 8	16.81	-17.90**	-30.94**	-31.91**
51	7 x 9	19.61	9.25	1.66	-20.57**
52	7 x 10	18.91	4.59	- 3.27	-23.41**
53	8 x 9	15.03	-31.10**	-38.25**	-39.12**
54	8 x 10	17.10	-22.08**	-29.74**	-30.74**
55	9 x 10	19.08	- 1.75	- 2.40	-22.72**
C.D (0.05)		0.918	0.795	0.918	0.918
C.D (0.01)		1.215	1.052	1.215	1.215

*, ** - Significant at 5 and 1 per cent level of probability, respectively.

thickness. Further, the predictability ratio was near to unity (0.90 and above) for 10 characters namely, number of fruits per plant (0.96), plant height (0.90), stem girth (0.90), fruit weight (0.91), fruit length (0.97), fruit girth (0.95), stalk length of fruit (0.96), seed weight per fruit (0.90), total sugars content (0.93) and reducing sugars content (0.95). The predictability ratio between 0.75 to 0.89 and 0.50 to 0.74 were observed for eight and three characters, respectively. Keeping Quality index exhibited the lowest predictability ratio of 0.48.

4.5.4 Combining ability effects

The estimates of general and specific combining ability effects of 10 parents and 45 crosses, respectively for 22 characters have been presented in Tables 33 and 34.

4.5.4.1 Days to flower

The parents Gare Local, Surya, Taiwan Naga and Pusa Bhairav exhibited highly significant negative gca effects in desired direction, while parents White Madhapuri, Higna Dorla, Malapur Local and Gokak Local showed highly significant positive gca effects. The remaining two parents namely, SM 135 and Pusa Kranti showed non-significant gca effects. The magnitude of gca effects ranged between -2.444 (Taiwan Naga) and 3.75 (White Madhapuri).

Among 45 crosses, 22 crosses exhibited significant negative sca effects in desired direction, while 11 crosses

Table 32. Analysis of variance (mean squares) for combining ability for 22 characters in brinjal.

Sl. no.	Characters	Source			Predictability ratio
		GCA	SCA	Error	
1	Days to flower	48.6173**	49.7055**	0.9733	0.66
2.	Fruityield per plant	80172.64**	68939.72**	2537.04	0.70
3.	Number of fruits per plant	137.0103**	10.0363**	0.5905	0.96
4	Plant height	371.6235**	82.3671**	5.5262	0.90
5	Plant spread	102.6255**	29.7528**	4.7516	0.87
6	Primary branches	0.8852**	0.3516**	0.1422	0.83
7	Secondary branches	3.6753**	2.2376**	0.7373	0.77
8	Stem girth	0.3813**	0.0886	0.0685	0.90
9	Fruit weight	2752.8029**	530.4413**	23.9039	0.91
10	Fruit length	34.2774**	1.8875**	0.1132	0.97
11	Fruit girth	23.9002**	2.4577**	0.3909	0.95
12	Stalk length of fruit	2.3720**	0.2113**	0.1200	0.96
13	Fruit density	0.0034**	0.0015**	0.0002	0.82
14	Keeping quality index	2.5361**	5.4248**	0.5296	0.48
15	Rind thickness	0.0057**	0.0063**	0.0005	0.64
16	Seed weight per fruit	3.2692**	0.7249**	0.0445	0.90
17	Dry matter (%)	1.5525**	0.7826**	0.0276	0.80
18	Total phenols(%)	0.8780**	0.3987**	0.0009	0.81
19	Orthodihydroxy phenols (%)	0.0879**	0.0533**	0.0002	0.77
20	Total sugars (%)	11.4028**	1.8279**	0.0349	0.93
21	Reducing sugars(%)	11.4967**	1.1742**	0.0196	0.95
22	Crude protein (%)	11.7358**	3.1207**	0.1071	0.88
-	Degrees of reeedom	9	45	108	-

*, ** - Significant at 5 and 1 per cent probability, respectively

showed significant positive sca effects. Remaining 12 crosses exhibited non-significant sca effects. The sca effects varied from -12.24 (2 x 10) to 9.87 (1 x 4).

4.5.4.2 Fruit yield per plant

The parents Gokak Local and Pusa Bhairav exhibited highly significant positive gca effects, while White Madhapuri, Higna Dorla, SM 135 and Malapur Local showed significant negative gca effects. Four parents namely, Gare Local, Surya, Taiwan Naga and Pusa Kranti exhibited non-significant gca effects. Amount of gca effects varied from -91.14 (SM-135) to 154.83 (Gokak Local).

Fifteen crosses each exhibited significant positive, significant negative and non-significant sca effects. The cross 1 x 7 was the best specific combination with the highest sca effects of 614.03, while cross 8 x 10 recorded the lowest sca effects (-322.50).

4.5.4.3 Number of fruits per plant

The parents Gare Local, Surya, Gokak Local and Pusa Bhairav exhibited highly significant positive gca effects. Among these, Pusa Bhairav had the highest gca effect of 7.417, while, the remaining six parents showed the highly significant negative gca effects. The magnitude of gca effects varied from -4.28 (Malapur Local) to 7.42 (Pusa Bhairav).

Table 33. The comparative gca performance of parents for 22 characters in brinjal.

Sl. No.	Parents / Characters	White Madhapuri	Higna dorla	Gare local	SM 135	Surya	Gokak local
1	2	3	4	5	6	7	8
1	Days to flower	3.75**	1.8611**	-1.9722**	0.1667	-2.0556**	0.8889**
2	Fruit yield/plant	-65.5889**	-85.644**	-9.533	-91.144**	26.022	154.828**
3	Number of fruits per plant	- 1.222**	- 1.833**	1.6389**	- 3.444**	1.805**	2.028**
4	Plant height	7.889**	- 9.75**	-8.833**	0.00	3.694**	3.778**
5	plant spread	0.3056	- 1.3611*	- 6.0556**	- 1.6389**	2.0833**	1.1667
6	Primary branches	0.60**	0.0444	0.0722	- 0.0667	-0.0111	-0.1222
7	Secondary branches	0.7667**	0.1278	- 0.5389*	- 0.2333	-0.2611	0.4056
8.	Stem girth	0.1378	- 0.2678	- 0.3289**	0.0376	0.0211	0.0267
9.	Fruit weight	-9.0389**	- 9.0111**	-14.9833**	7.9333**	-4.8722**	1.9056
10.	Fruit length	-1.9150**	- 2.2844**	- 1.6789**	-0.4733**	-0.6428**	1.5183**
11.	Fruit girth	0.5150**	0.8911**	0.3011	1.3567**	-0.7267**	0.1067
12.	Stalk length of fruit	0.0322	- 0.5539**	- 0.6206**	0.0072	-0.1983*	0.4239**
13.	Fruit density	0.0196**	0.0237**	0.0159**	0.0037	0.0062	-0.0057

Contd..

Table 33(Contd..)

1	2	3	4	5	6	7	8
14.	Keeping quality index	0.5448**	0.8120**	0.1309	-0.0458	-0.1877	-0.4580**
15.	Rind thickness	-0.0321**	-0.0202**	0.0051	0.0204**	0.0034	0.0251**
16.	Seed weight per fruit	0.8404**	0.5137**	-0.3374**	0.6457**	-0.2549**	-0.2285**
17.	Dry matter (%)	0.5498**	-0.1021*	-0.0677	0.5171**	0.0590	-0.2929**
18.	Total phenols (%)	-0.2310**	-0.3937**	-0.3212**	-0.1816**	-0.0941**	0.2158**
19.	Orthodihydroxy phenols (%)	0.0651**	-0.1705**	-0.1014**	-0.0128**	-0.0506	0.0161**
20.	Total sugars(%)	-1.5775**	-1.2984**	-0.7896**	-0.6626**	0.5198**	0.8872**
21.	Reducing sugar(%)	-1.7570**	-0.5658**	-1.1226**	-0.8138**	0.5682**	1.0203**
22.	Crude protein (%)	-1.1255**	0.5456**	2.4149**	0.3830**	-0.5748**	-0.6898**

Contd..

Table 33 (Contd..)

Sl. No.	Parents / Characters	Malapur local	Taiwan naga	Pusa Kranti	Pusa bhairav	SE (gi)	SE (gi-gj)	C.D gi (0.05)	C.D. gi (0.01)
1	2	9	10	11	12	13	14	15	16
1	Days to flower	1.3333**	-2.4444**	-0.0278	-1.500**	0.2702	0.4028	0.5355	0.7094
2	Fruit yield/plant	-34.144*	-23.922	12.744	116.383**	13.7941	20.5631	27.34	36.22
3	Number of fruits per plant	- 4.278**	- 0.583**	-1.528**	7.417**	0.2104	0.3137	0.4171	0.5524
4	Plant height	3.528**	1.306*	-0.9167	-0.694	0.6438	0.9597	1.2761	1.6904
5	Plant spread	4.1944**	1.6389**	2.0278**	-2.3611**	0.597	0.8899	1.1833	1.5675
6	Primary branches	0.100	-0.3722**	0.100	-0.344**	0.1033	0.1540	0.2047	0.2712
7	Secondary branches	0.6833**	-0.7889**	0.4056	-0.5667*	0.2351	0.3505	0.4661	0.6173
8	Stem girth	0.2100**	-0.0511	0.1933**	0.0211	0.0717	0.1069	0.1421	0.1882
9	Fruit weight	29.600**	-1.1222	18.6278**	-19.0389**	1.3390	1.9960	2.6540	3.5157
10	Fruit length	0.7961**	2.9044**	1.3433**	0.4322**	0.0922	0.1374	0.1827	0.2421
11	Fruit girth	1.9039**	-2.5822**	0.2956	-2.0211**	0.1712	0.2552	0.3394	0.4495
12	Stalk length of fruit	0.2739**	0.8044**	0.1711	-0.3400**	0.0949	0.1414	0.1880	0.2492
13	Fruit density	-0.0118**	-0.0291**	-0.0146**	-0.0079*	0.0039	0.0059	0.0078	0.0102

Contd..

Table 33(contd..)

1	2	9	10	11	12	13	14	15	16
14.	Keeping quality index	0.4001*	-0.2256	-0.4741*	-0.4955*	0.1993	0.2971	0.3951	0.5233
15.	Rind thickness	-0.0027	-0.0168**	0.0346**	-0.0168**	0.0059	0.0088	0.0117	0.0155
16.	Seed weight per fruit	0.2098**	-0.7316**	-0.1896**	-0.4677**	0.0578	0.0862	0.1146	0.1518
17.	Dry matter (%)	-0.1610**	-0.3252**	-0.5027**	0.3257**	0.0455	0.0679	0.0903	0.1195
18.	Total phenols(%)	0.2446**	0.2857**	0.2813**	0.1946**	0.0084	0.0125	0.0166	0.0221
19.	Orthodihydroxy phenols (%)	0.0335**	0.0592**	0.1098**	0.0516**	0.0038	0.0056	0.0074	0.0099
20.	Total sugars(%)	0.7115**	1.0156**	0.5364**	0.6577**	0.0511	0.0762	0.1014	0.1342
21.	Reducing sugar(%)	0.7576**	0.9021**	0.6283**	0.3827**	0.0384	0.0572	0.0761	0.1008
22.	Crude protein(%)	-0.1037	-0.6448**	-0.1531	-0.0518	0.0896	0.1336	0.1776	0.2352

*, ** - Significant at 5 and 1 per cent levels of probability, respectively.

Table 34. Estimates of sca for 22 characters in brinjal.

Sl. no. (1)	Character / Cross (2)	Days to flower 3	Fruit yield 4	Number of fruits 5	Plant height 6
1	1 x 2	5.1768**	-73.4697	-0.9747	2.2551
2	1 x 3	-0.6566	-137.9141**	-3.447**	0.0051
3	1 x 4	9.8712**	- 85.9697	-0.0303	-1.1616
4	1 x 5	1.0934	- 24.4697	2.0530**	-1.8561
5	1 x 6	-1.8510*	-106.6086*	-1.5025*	3.0606
6	1 x 7	-1.2955	614.0303**	3.803**	7.3106**
7	1 x 8	-4.5177**	387.1414**	4.4419**	5.5328*
8	1 x 9	-0.9343	-203.858**	1.3864	2.7551
9	1 x 10	-3.4621**	56.1692	- 5.2247**	2.8662
10	2 x 3	2.8990**	204.475**	0.8308	13.9773**
11	2 x 4	-1.2399	24.4192	1.9141**	-7.8561**
12	2 x 5	-3.0177**	- 87.7475	-1.3359	-4.5505*
13	2 x 6	-1.9621*	-51.553	0.4419	-6.3005**
14	2 x 7	-1.4066	-124.581**	1.4141*	-10.3838**
15	2 x 8	-2.6288**	7.5303	0.3864	4.5051*
16	2 x 9	0.2879	464.197**	-1.0025	2.0606
17	2 x 10	-12.2399**	37.558	-1.6136*	3.8384
18	3 x 4	-5.4066**	18.975	3.7753**	-17.4394**
19	3 x 5	-9.1843**	-263.858**	-5.4747**	-7.4672**
20	3 x 6	-11.1288**	199.336**	3.9697	-4.5505*
21	3 x 7	-4.9066**	- 28.358	-0.0581	-0.3005
22	3 x 8	-7.4621**	-211.581**	-5.0859**	2.9217
23	3 x 9	5.7879**	548.752**	3.8586**	7.4773**
24	3 x 10	4.5934**	91.447	4.9141**	5.9217**
25	4 x 5	-6.9899**	- 54.914	1.6086*	-11.6338**
26	4 x 6	-0.2677	-213.719**	-4.6136**	2.2828
27	4 x 7	-0.0455	-237.414**	-1.3081	7.5328**
28	4 x 8	-8.9343**	179.364**	-0.3359	19.4217**
29	4 x 9	2.6490**	220.697**	2.2753**	8.6439**
30	4 x 10	1.4545	462.058**	-2.3359**	17.4217**

Contd..

Table 34 (Contd..)

1	2	3	4	5	6
31	5 x 6	-0.0455	446.114**	0.8030	16.9217**
32	5 x 7	-2.4893**	130.086**	1.4419*.	8.8384**
33	5 x 8	1.9545*	-95.470*	-1.9192**	8.7273**
34	5 x 9	-10.7955**	-80.803	-0.6414	5.9495**
35	5 x 10	6.3434**	253.225**	4.0808**	6.3939**
36	6 x 7	-5.4343**	-89.386	-0.7803	3.7551
37	6 x 8	-4.6566**	347.301**	3.8586**	2.9773
38	6 x 9	5.9268**	-233.275**	-1.5303*	4.8662*
39	6 x 10	1.3990	425.752**	7.5253**	2.6439
40	7 x 8	5.8990**	143.03**	1.1641	1.8939
41	7 x 9	-8.5177**	-135.636**	-0.5581	-1.5505
42	7 x 10	5.9545**	-252.275**	-7.5025**	-1.1061
43	8 x 9	-5.7399**	-114.525*	2.0808**	-10.6616**
44	8 x 10	-5.2677**	-322.497**	-1.5303*	- 7.5505**
45	9 x 10	-8.3510**	-181.164**	0.0808	- 7.9949**
SE (Sii)		0.9087	46.3965	0.7078	2.1654
C.D(0.05)		1.8013	91.9662	1.4030	4.2922
C.D(0.01)		2.3859	121.8186	1.8584	5.6855
S.E(Sij)		0.8146	41.5905	0.6345	1.9411
S.E(Sii-Sjj)		1.1392	58.1611	0.8873	2.7145
S.E(Sij-Sik)		1.3358	68.20	1.0404	3.1830
S.E(Sij-Skl)		1.2736	65.0261	0.9920	3.0349

Contd..

Table 34 (Contd..)

Sl. no.	Character / Cross	Plant spread	Primary branches	Secondary branches	Stem girth
1	2	7	8	9	10
1	1 x 2	-5.2475*	-0.5354	-2.4823**	0.2076
2	1 x 3	7.1136**	0.4369	1.5177	0.2020
3	1 x 4	-1.9697	-0.4242	-0.7879	-0.2313
4	1 x 5	3.6414	0.5202	-2.4268**	-0.3480
5	1 x 6	2.8914	-0.0354	2.5732	0.3798
6	1 x 7	-4.1364*	0.0758	1.9621*	-0.3369
7	1 x 8	-3.2475	0.8813*	-0.2323	0.2576
8	1 x 9	1.3636	0.4091	0.5732	-0.0535
9	1 x 10	6.7525**	0.8535*	0.2121	-0.3480
10	2 x 3	8.7803**	0.6591	1.1566	0.5409*
11	2 x 4	6.0303**	0.4646	1.1843	-0.0258
12	2 x 5	2.3081	-0.2576	-0.7879	-0.1424
13	2 x 6	-5.7753**	0.1869	0.8788	-0.2146
14	2 x 7	-1.8030	-0.0354	-0.3990	-0.1313
15	2 x 8	1.4192	-0.2298	0.4066	-0.3369
16	2 x 9	7.3636**	-0.0354	-1.1212	0.4187
17	2 x 10	2.7525	-0.2576	2.1843**	-0.4758
18	3 x 4	-5.9419**	-0.5631	-2.4823**	-0.2980
19	3 x 5	-5.9975**	-0.6187	-1.1212	-0.2146
20	3 x 6	-1.4141	-0.5076	-1.7879*	-0.0869
21	3 x 7	2.5581	0.6035	1.9343*	-0.2035
22	3 x 8	-4.2197*	-0.9242**	-0.5934	-0.6091*
23	3 x 9	1.7247	-0.0631	1.5455	-0.3869
24	3 x 10	0.4470	0.3813	0.8510	0.6520**
25	4 x 5	-4.4141*	0.1869	-0.0934	0.0854
26	4 x 6	2.8359	0.6313	0.9066	0.0798
27	4 x 7	6.1414**	0.0758	-0.0379	0.4298
28	4 x 8	0.0303	-0.7854*	0.7677	0.0242
29	4 x 9	3.9747	0.7424*	1.5732*	0.1798
30	4 x 10	8.6970**	-0.1465	0.5455	0.0187

Contd..

Table 34 (Contd..)

1	2	7	8	9	10
31	5 x 6	5.4470**	0.2424	1.9343*	-0.1035
32	5 x 7	2.0859	0.3535	1.3232	0.1798
33	5 x 8	7.6414**	0.1591	1.7955*	0.3076
34	5 x 9	-4.7475*	0.3535	1.6010*	0.3965
35	5 x 10	2.9747	0.1313	0.5732	0.4354
36	6 x 7	0.3359	0.7980*	-0.3434	-0.0258
37	6 x 8	-2.4419	0.2702	0.7955	0.1687
38	6 x 9	-2.8308	-1.8687**	-3.7323**	-0.2091
39	6 x 10	5.5581**	0.2424	0.2399	0.0965
40	7 x 8	11.1970**	0.0480	0.1843	0.1854
41	7 x 9	-1.8586	0.2424	-0.0101	0.0742
42	7 x 10	-1.8030	-1.3131**	-2.7045**	0.1131
43	8 x 9	-7.3030**	0.0480	0.4621	-0.1313
44	8 x 10	-6.5808**	0.1591	-0.2323	-0.2258
45	9 x 10	-1.6364	-0.3131	-0.7601	-0.3369
S.E(Sii)		2.0079	0.3474	0.7909	0.2411
C.D(0.05)		3.9837	0.6886	1.5677	0.4779
C.D(0.01)		5.2719	0.9121	2.0768	0.6330
S.E(Sij)		1.7999	0.3114	0.7090	0.2161
S.E(Sii-Sjj)		2.5170	0.4355	0.9915	0.3022
S.E(Sij-Sik)		2.9515	0.5107	1.1626	0.3544
S.E(Sij-Skl)		2.8141	0.4869	1.1085	0.3379

Contd..

Table 34 (contd..)

Sl. no.	Character / Cross	Fruit weight	Fruit length	Fruit girth	Stalk length of fruit
1	2	11	12	13	14
1	1 x 2	-24.1136**	0.0679	-2.8467**	-0.7008*
2	1 x 3	-10.8081*	1.8290**	1.0033	0.5326
3	1 x 4	19.9419**	1.0902**	1.3477*	-0.0952
4	1 x 5	22.0808**	-0.7737*	1.9311**	0.7437*
5	1 x 6	5.9697	-0.5015	0.5311	-0.2119
6	1 x 7	56.6086**	2.0207	0.3338	0.5381
7	1 x 8	-16.3359**	-1.5876**	0.7533	-0.1924
8	1 x 9	- 0.0859	-2.0265**	2.1422**	-0.1258
9	1 x 10	- 12.4192**	-2.8487**	-1.5078*	-0.5813
10	2 x 3	6.8308	-0.2682	0.1672	0.9520**
11	2 x 4	-17.4192**	-0.4737	-1.3884*	0.1909
12	2 x 5	-12.6136**	-1.0376**	1.2283*	-0.3035
13	2 x 6	-0.0581	-3.0654**	-2.0717**	-0.4258
14	2 x 7	-19.7525**	-0.9432**	0.0311	-0.5091
15	2 x 8	12.9697	-0.4182	1.3172*	-0.4730
16	2 x 9	62.2197**	2.9763**	2.3394**	0.2604
17	2 x 10	-3.1136	-0.7793*	1.1894*	-0.0285
18	3 x 4	-22.7803	-0.5126	-2.1384**	-0.4424
19	3 x 5	- 2.6919	1.3568**	0.4449	0.1298
20	3 x 6	-19.0859**	0.0957	1.3116*	-0.5924
21	3 x 7	16.2197**	-0.0821	0.3811	-0.1091
22	3 x 8	2.9419	-1.7237**	1.3672*	-0.4063
23	3 x 9	46.5253**	0.9707**	1.4561*	0.5604
24	3 x 10	- 9.4747*	-1.2515**	-1.2939*	-0.2619
25	4 x 5	-22.2247**	0.8179**	-1.4439*	-0.3646
26	4 x 6	-15.0025**	-0.1432	2.2894*	0.1465
27	4 x 7	-20.6970**	-0.9210**	0.5255	0.1298
28	4 x 8	44.0253**	0.4040	0.0449	0.7326*
29	4 x 9	- 6.3914	-1.0348**	0.1338	0.2992
30	4 x 10	30.6086**	0.9429**	1.4838*	0.2104

Contd..

Table 34 (Contd..)

1	2	11	12	13	14
31	5 x 6	32.4697**	1.2596**	0.7394	0.5854
32	5 x 7	- 0.8914	0.7818*	-0.7912	-0.0980
33	5 x 8	6.1641	0.8735**	0.6283	0.2048
34	5 x 9	- 4.2525	-0.4321	1.5505**	-0.4619
35	5 x 10	0.7475	-0.4876	-0.6328	0.0159
36	6 x 7	- 8.6692	0.2540	0.2755	0.1465
37	6 x 8	11.3864*	0.7124*	-0.2384	0.4826
38	6 x 9	- 8.3636	1.2068**	-4.3162**	0.1159
39	6 x 10	-2.0303	0.2513	3.0005**	0.2937
40	7 x 8	1.6919	0.7679*	-0.4356	-0.4341
41	7 x 9	-11.3914*	0.0957	-0.0467	-0.3674
42	7 x 10	22.2753**	1.7402**	0.2366	1.1104**
43	8 x 9	-35.3359**	-2.0126**	-2.2939**	0.4020
44	8 x 10	23.6641**	1.9985**	0.3561	-0.5202
45	9 x 10	-20.0859**	0.3596	-0.2217	-0.2869
46					
SE (Sii)		4.5036	0.3099	0.5759	0.3190
C.D(0.05)		8.9269	0.6144	1.1426	0.6325
C.D(0.01)		11.8246	0.8137	1.5121	0.8378
S.E(Sij)		4.0371	0.2778	0.5163	0.2860
S.E(Sii-Sjj)		5.6455	0.3885	0.7200	0.4000
S.E(Sij-Sik)		6.62	0.4556	0.8466	0.4690
S.E(Sij-Skl)		6.3119	0.4344	0.8072	0.4472

Contd..

Table 34 (Contd..)

		Fruit density	Keeping quality index	Rind thickness	Seed weight per fruit
1	2	15	16	17	18
1	1 x 2	0.0508**	-0.0134	0.0469*	-1.7434**
2	1 x 3	-0.0548**	0.5344	0.0350	-0.4456*
3	1 x 4	-0.0626**	1.4844*	0.0764**	1.6513**
4	1 x 5	0.0449**	-1.1903	0.0267	-0.0881
5	1 x 6	0.0536**	-1.4467*	0.1017**	0.5522**
6	1 x 7	-0.0503**	2.2019**	0.0894**	0.7472**
7	1 x 8	0.0102	1.0719	0.0236	0.5419**
8	1 x 9	-0.0109	-0.4706	0.0122	0.7999**
9	1 x 10	0.0158	0.1674	-0.0097	1.1513**
10	2 x 3	-0.0123	0.2805	-0.0403*	1.1811**
11	2 x 4	-0.0267*	1.8272**	0.0678**	-0.0687
12	2 x 5	-0.0726**	2.3091**	0.0514*	0.1719
13	2 x 6	-0.0273*	-0.3673	-0.0803**	-0.7745**
14	2 x 7	0.0688**	-0.6620	0.0308	-0.4928*
15	2 x 8	-0.0206	-0.5153	0.0217	0.0352
16	2 x 9	-0.0284*	-0.1478	0.0269	0.5466**
17	2 x 10	-0.0251	1.7636**	0.0517*	0.0313
18	3 x 4	-0.0756**	0.3816	-0.0475*	-1.3776**
19	3 x 5	0.0519**	-1.1098	-0.0239	0.1897
20	3 x 6	-0.0162	2.1872**	0.0411*	-0.4234*
21	3 x 7	0.0166	-0.8709	0.1056**	0.8983**
22	3 x 8	-0.0062	-1.1509	0.0831**	0.3397
23	3 x 9	-0.0273*	-3.3801**	0.0317	1.6244**
24	3 x 10	-0.0073	1.2180	0.0131	-0.4109*
25	4 x 5	-0.0092	0.6536	-0.0658**	-0.2934
26	4 x 6	-0.0139	4.6738**	-0.0475*	0.5769**
27	4 x 7	0.0422**	-0.4776	0.0003	-0.1248
28	4 x 8	0.0061	-1.6709	-0.0122*	0.2633
29	4 x 9	-0.0117	-1.1834	-0.0236	-0.0520
30	4 x 10	-0.0217	-4.572**	-0.0689**	0.0394

Contd..

Table 34 (Contd..)

1	2	15	16	17	18
31	5 x 6	- 0.0164	- 5.4842**	0.0461*	-0.0592
32	5 x 7	- 0.0370**	- 5.4956**	0.0339	0.9891**
33	5 x 8	- 0.0102	1.7311*	0.0314	-0.4428*
34	5 x 9	- 0.0009	- 1.6081*	0.0333	0.3186
35	5 x 10	-0.0009	- 1.4166*	0.1514**	-0.2601
36	6 x 7	- 0.0183	2.2580**	-0.0244	0.8227**
37	6 x 8	- 0.0145	- 3.4353**	0.0631**	0.4141*
38	6 x 9	- 0.0356**	- 2.0112**	0.0917**	-1.6912**
39	6 x 10	- 0.0256	- 0.1731	-0.0003	1.1069**
40	7 x 8	- 0.0017	- 0.9367	0.0042	-0.2242
41	7 x 9	- 0.0128	- 0.6892	-0.0872**	-0.6995**
42	7 x 10	- 0.0328*	- 0.8012	-0.0792**	0.8152
43	8 x 9	0.0017	2.6408**	0.0069	-0.5948**
44	8 x 10	0.0177	- 0.7812	0.1150**	-0.4001*
45	9 x 10	0.0333*	0.1997	-0.0097	-0.0187
S.E (Sii)		0.0133	0.6704	0.0199	0.1944
C.D (0.05)		0.0263	1.3288	0.0395	0.3854
C.D (0.01)		0.0349	1.7602	0.0522	0.5704
S.E(Sij)		0.0119	0.6009	0.0179	0.1743
S.E(Sii-Sjj)		0.0166	0.8403	0.0250	0.2437
S.E(Sij-Sik)		0.0195	0.9854	0.0293	0.2858
S.E(Sij-Skl)		0.0186	0.9395	0.0279	0.2725

Contd..

Table 34 (Contd..)

Sl. no.	Chara- cter / Cross	Dry matter (%)	Total phe- nols (%)	O.D.H. phe- nols (%)	Total sugar (%)	Redu- cing su- gar (%)	Crude protein (%)
1	2	19	20	21	22	23	24
1	1 x 2	-2.5364**	0.7958**	0.3279**	0.2537	0.1643	-0.9591**
2	1 x 3	-0.0375	0.1357**	0.0694**	0.5810**	0.8915**	-0.7601*
3	1 x 4	0.2511	0.3340**	0.1048**	0.1660	0.9594**	-0.9082**
4	1 x 5	-0.0275	-0.5421**	-0.1514**	- 2.1664	-1.0917**	0.8429**
5	1 x 6	1.0911**	-0.2091**	0.0966**	-0.7262**	-1.1614**	-0.9121**
6	1 x 7	0.0558	0.3228**	0.0109	-0.7388**	-0.5227**	-0.5982*
7	1 x 8	0.2567	0.0094	0.0025	-0.7692**	-1.0879**	0.0496
8	1 x 9	0.2908	-0.1775**	-0.0438**	-1.4994**	-0.1588	-1.8287**
9	1 x 10	0.2925	-0.4101**	-0.2866**	-1.8437**	-0.4948**	-0.2268
10	2 x 3	-0.3722*	0.4337**	0.4030**	-0.1458	-0.1208	-2.3446**
11	2 x 4	0.8997**	-0.7273**	-0.2382**	-1.1548**	0.6974**	1.3907**
12	2 x 5	1.2278**	-0.3074**	-0.2714**	-1.6795**	-1.0109**	2.8085**
13	2 x 6	0.6331**	0.0413	-0.3555**	-0.2273	-0.6187**	2.0702**
14	2 x 7	1.6111**	-0.3435**	0.1132**	-1.440**	-1.4976**	-1.3559**
15	2 x 8	0.0253	0.3748**	-0.1045**	-0.1957	0.4352**	-1.0882**
16	2 x 9	-1.1339**	0.4126**	-0.3759**	1.1008**	0.8816**	0.0502
17.	2 x10	0.1811	-0.6531**	-0.3736**	-2.4752**	-1.2987**	0.3454
18	3 x 4	0.8653**	0.4259**	-0.3067**	0.1171	1.0326**	3.2547**
19	3 x 5	1.3233**	-0.3606**	-0.2846**	0.0537	0.9509**	-0.2875
20	3 x 6	0.7353**	0.2205**	-0.0303*	-1.4100**	0.4448**	2.8109**
21	3 x 7	-1.3900**	0.7684**	0.1727**	-0.1417	-0.1608	0.3947
22	3 x 8	0.5608**	-0.1243**	-0.3787**	-2.3241**	-0.0523	-1.6641**
23	3 x 9	-1.1250**	-1.1849**	-0.0723	0.0314	-1.4062**	2.0442**
24	3 x 10	0.2533	-1.1569**	0.0502**	-0.5746**	-1.6645**	-2.1605**
25	4 x 5	0.8386**	0.5064**	0.2939**	-0.0769	-0.1443	-2.7822**
26	4 x 6	-0.8394**	0.2131**	-0.0322*	0.6733**	-0.5366**	1.6461**
27	4 x 7	-0.8614**	-1.7437**	-0.4415**	-0.2467	-1.0599**	-1.4633**
28	4 x 8	0.5594**	0.6436**	0.0891**	-0.4341*	-099508**	-1.2755**
29	4 x 9	0.1503	0.4006**	-0.0139	0.8554**	0.2027	0.2795
30	4 x 10	-0.4047**	-0.5288**	0.1713**	-0.4562**	-0.6240**	-0.8753**

Contd..

Table 34 (contd..)

1	2	19	20	21	22	23	24
31	5 x 6	-0.0483**	-1.6181**	0.0106	1.5043**	0.1573	-1.7694**
32	5 x 7	0.7167**	0.0209	0.1696**	2.0229**	0.4201**	0.8278**
33	5 x 8	-2.0592**	-0.1251**	0.0556**	1.2035**	2.0552**	-0.1844
34	5 x 9	-2.2817**	0.4483**	-0.1231**	0.4797**	0.3303*	0.4072
35	5 x 10	-0.22	0.8760**	0.0414**	0.6954**	1.2343**	-0.6875*
36	6 x 7	-0.3447*	0.5216**	-0.1184**	1.0245**	1.6507**	-0.1705
37	6 x 8	0.1461	-0.5971**	0.2288**	0.5424**	0.8368**	-3.1728**
38	6 x 9	0.0703	-0.2597**	-0.0882**	0.7720**	1.0596**	-1.8878**
39	6 x 10	-0.3214*	0.0154	-0.0673**	1.3153**	0.5783**	1.7942
40	7 x 8	1.0675**	-0.2662**	-0.3085**	0.1024	1.2942**	-0.6555*
41	7 x 9	0.0450	1.1695**	0.2883 **	0.8843**	1.1166**	0.9361**
42	7 x 10	0.3467*	0.4152**	0.0591**	-0.0517	0.6466**	0.3247
43	8 x 9	0.1025	0.8115**	0.0691**	1.0335**	0.2208	-2.061**
44	8 x 10	-0.4358**	1.0619**	0.0830**	0.6712**	1.2581	- 0.4875
45	9 x 10	0.5883**	-0.7951**	0.3273**	0.3334	0.7716**	0.5009
SE (Sii)		0.1532	0.0282	0.0126	0.1720	0.1291	0.3014
CD (0.05)		0.3036	0.0558	0.0250	0.3410	0.2559	0.5974
C.D(0.01)		0.4022	0.0740	0.0331	0.4516	0.3390	0.7913
SE(Sij)		0.1373	0.0252	0.0113	0.1542	0.1157	0.2702
SE(Sii-Sji)		0.1920	0.0353	0.0158	0.2156	0.1618	0.3778
SE(Sij-Sik)		0.2251	0.0414	0.0186	0.2529	0.1897	0.4430
SE(Sij-Skl)		0.2147	0.0395	0.0177	0.2411	0.1809	0.4224

*, ** - Significant at 5 and 1 per cent probability, respectively

Among the crosses, 16 and 12 crosses showed significant positive and negative sca effects, respectively, while the remaining 17 crosses exhibited non-significant sca effects. The cross 6 x 10 was the best specific combination with maximum sca effect of 7.525, while cross 7 x 10 showed least sca effects (-7.502).

4.5.4.4 Plant height

The parents White Madhapur, Surya, Gokak Local and Malapur Local exhibited highly significant and Taiwan Naga showed significant positive gca effects, while Higna Dorla and Gare Local exhibited highly significant negative gca effects. Among these, White Madhapuri and Higna Dorla had the maximum positive (7.889) and negative (-9.75) gca effects, respectively. The remaining three parents were non-significant for their gca effects.

Total 16, 11 and 18 crosses exhibited significant positive, significant negative and non-significant sca effects, respectively. The crosses 4 x 8 and 3 x 4 showed the maximum sca effects of 19.422 and -17.4394 towards positive and negative directions, respectively.

4.5.4.5 Plant spread

The parents Surya, Malapur Local, Taiwan Naga and Pusa Kranti showed highly significant positive gca effects. The remaining four and two parents exhibited significant negative and non-significant gca effects, respectively. The magnitude of gca effects varied from -6.056 (Gare Local) to 4.19 (Malapur Local).

Total 11, 10 and 24 crosses exhibited significant positive, significant negative and non-significant sca effects, respectively. The sca effects ranged between -7.30 (8 x 9) and 11.20 (7 x 8).

4.5.4.6 Number of primary branches per plant

White Madhapuri exhibited highly significant positive gca effects of 0.60, while Taiwan Naga (0.37) and Pusa Bhairav (-0.34) showed negative highly significant gca effects. Remaining seven parents were non-significant in their gca effects.

The crosses 1 x 8 (0.88), 1 x 10 (0.85), 4 x 9 (0.74) and 6 x 7 (0.798) exhibited significant positive sca effects, while crosses 3 x 8 (-0.92), 4 x 8 (-0.785), 6 x 9 (-1.869) and 7 x 10 (-1.313) showed negative significant sca effects. The remaining 37 crosses exhibited non-significant sca effects.

4.5.4.7 Number of secondary branches per plant

The parents, White Madhapuri (0.767) and Malapur Local(0.683) exhibited highly significant gca effects, while Gare Local (-0.539), Taiwan Naga (-0.789) and Pusa Bhairav (-0.567) showed significant negative gca effects.

The remaining five parents were non-significant in their gca effects (Table 33).

Eight, six and 31 crosses exhibited positive significant, negative significant and non-significant sca effects, respectively. The magnitude of sca effects varied from -3.732 (6 x 9) to 2.573 (1 x 6) (Table 34).

4.5.4.8 Stem girth

The parents Malapur Local (0.210) and Pusa Kranti (0.193) exhibited highly significant positive gca effects, while Higna Dorla (-0.268) and Gare Local (-0.329) showed highly significant negative gca effects. Remaining six parents were non-significant in their gca effects.

The crosses 2 x 3 (0.541) and 3 x 10 (0.652) exhibited positive significant sca effects, while 3 x 8 (-0.609) showed negative significant sca effects. The remaining 42 crosses were non-significant in their sca effects.

4.5.4.9 Average weight per fruit

Three parents namely SM 135 (7.933), Malapur Local (29.60) and Pusa Kranti (18.628) exhibited highly significant positive gca effects. Five and two parents showed highly significant negative and non-significant gca effects, respectively.

Total 13, 16 and 16 crosses exhibited positive significant, negative significant and non-significant sca effects, respectively. The sca effects varied from -33.336 (8 x 9) to 62.22 (2 x 9).

4.5.4.10 Average length of fruit

The five parents exhibited highly significant positive and negative gca effects. The gca effects varied from -2.284 (Higna Dorla) to 2.904 (Taiwan Naga).

Total 16, 13 and 16 crosses showed positive significant, negative significant and non-significant sca effects, respectively. The sca effects ranged between -3.065 (2 x 6) and 2.976 (2 x 9).

4.5.4.11 Average girth of fruit

Total four, three and three parents showed highly significant positive, highly significant negative and non-significant gca effects, respectively. The gca effects varied from -2.582 (Taiwan Naga) to 1.904 (Malapur Local).

Total 14, 9 and 22 crosses exhibited significant positive, significant negative and non-significant sca effects, respectively. The sca effect varied from -4.316 (6 x 9) to 3.00 (6 x 10).

4.5.4.12 Average stalk length of fruit

Four parents namely, Higna Dorla (-0.554), Gare Local (-0.621), Surya (-0.198) and Pusa Bhairav (-0.34) exhibited negative significant gca effects in desired direction, while three parents showed highly significant positive and non-significant gca effects.

The cross 1 x 2 showed significant negative sca effects, while four crosses namely, 1 x 5, 2 x 3, 4 x 8 and 7 x 10 exhibited significant positive sca effects. The remaining 40 crosses were non-significant for sca effects.

4.5.4.13 Density of fruit

White Madhapuri(0.0196), Higna Dorla (0.0237) and Gare Local (0.0159) exhibited highly significant positive gca effects, while four and three parents showed negative significant and non-significant gca effects, respectively.

Total 7, 12 and 26 crosses exhibited significant positive, significant negative and non-significant sca effects, respectively. The sca effects varied from -0.0756 (3 x 4) to 0.0688 (2 x 7).

4.5.4.14 Keeping quality index of fruit

The parents namely, Gokak Local (-0.458), Pusa Kranti (-0.474) and Pusa Bhairav (-0.495) exhibited negative significant gca effects, while White Madhapuri (0.545), Higna Dorla (0.812) and Malapur Local (0.40) showed, positive significant gca effects. The remaining four parents were non-significant for their gca effects.

Total 11, 8, and 26 crosses exhibited positive significant, negative significant and non-significant sca effects, respectively. The sca effects varied from -5.496 (5 x 7) to 4.674 (4 x 6).

4.5.4.15 Rind thickness of fruit

Parents SM 135, Gokak Local and Pusa Kranti showed highly significant positive gca effects, while White Madhapuri, Higna Dorla, Taiwan Naga and Pusa Bhairav exhibited negative highly significant gca effects. Remaining three parents showed non-significant gca effects.

Total 15, 8 and 22 crosses exhibited positive significant, negative significant and non-significant sca effects. The sca effects ranged between -0.0872 (7 x 9) and 0.1514 (5 x 10).

4.5.4.16 Average seed weight per fruit

Six and four parents showed negative and positive highly significant gca effects, respectively. The gca effect varied from -0.732 (Taiwan Naga) to 0.840 (White Madhapuri).

Twelve crosses exhibited significant negative sca effects in desired direction, while 16 and 17 crosses showed positive significant and non-significant sca effects, respectively. The sca effect varied from -1.743 (1 x 2) to 1.651 (1 x 4).

4.5.4.17 Dry matter content of fruit

Three parents namely, White Madhapuri (0.550), SM 135 (0.517) and Pusa Bhairav (0.326) exhibited highly significant positive gca effects, while five and two parents showed negative significant and non-significant gca effects, respectively.

Fifteen crosses exhibited significant positive sca effects, while 14 crosses showed significant negative sca effects. Remaining 16 crosses exhibited non-significant sca effects. The sca effects varied from -2.536 (1 x 2) to 1.611 (2 x 7).

4.5.4.18 Total phenols content in dried fruits

Five parents each showed highly significant negative gca in desired direction and highly significant positive gca effects. The gca effects varied from -0.394 (Nigna Dorla) to 0.286 (Taiwan Naga).

Nineteen crosses exhibited significant negative sca effects in desired direction, while 21 crosses showed positive significant sca effects. Five crosses exhibited non-significant sca effects. The sca effects ranged between -1.744 (4 x 7) and 1.169 (7 x 9).

4.5.4.19 Ortho dihydroxy phenol content in dried fruits

Four parents namely, Nigna Dorla, Gara Local, SM 135 and Surya exhibited negative highly significant gca effects in desired direction, while remaining six parents showed positive highly significant gca effects. The gca effects varied from -0.1705 (Nigma Doria) to 0.1098 (Pusa Kranti).

Twentyone crosses showed negative significant sca effects in desired direction, while 20 crosses exhibited positive significant sca effects. Remaining four crosses showed non-significant sca effects. The sca effects ranged between -0.4415 (4 x 7) and 0.4030 (2 x 3).

4.5.4.20 Total sugar content in dried fruits

Six parents namely, Surya, Gokak Local, Malapur Local, Taiwan Naga, Pusa Kranti and Pusa Bhairav exhibited positive highly significant gca effects. Remaining four parents exhibited negative highly significant gca effects. The gca effects varied from -1.5775 (White Madhapuri) to 1.0156 (Taiwan Naga).

Sixteen crosses exhibited positive significant sca effects, while 15 crosses showed negative significant sca effects. Fourteen crosses indicated non-significant sca effects. The sca effects ranged between -2.475 (2 x 10) and 2.023 (5 x 7).

4.5.4.21 Reducing sugar content in dried fruits

Six parents namely, Surya (0.568), Gokak Local (1.02), Malapur Local (0.758), Taiwan Naga (0.902), Pusa Kranti(0.628) and Pusa Bhairav (0.383) exhibited positive highly significant gca effects, while remaining four parents showed negative highly significant gca effects.

Twentyone crosses exhibited positive significant sca effects, while 15 crosses showed negative significant sca effects. Nine crosses indicated non-significant sca effects. The sca effects varied from -1.6645 (3 x 10) to 2.0552(5 x 8).

4.5.4.22 <u>Total crude protein content in dried fruits</u>

Three parents namely, Hagna Dorla (0.5456), Gaze Local (2.415) and SM 135 (0.383) exhibited positive highly significant gca effects. Four and three parents showed negative highly significant and non-significant gca effects, respectively.

Eleven crosses exhibited positive significant sca effects, while 21 crosses showed negative significant sca effects. Remaining 13 crosses indicated non-significant sca effects. The sca effect varied from -3.1728 (6 x 8) to 3.2547 (3 x 4).

4.6 <u>Inheritance of Qualitative characters</u>

The results of the inheritance of 28 qualitative characters studied in two crosses of brinjal namely, Pusa Purple Cluster x Krishna Kati (cross I) and Pusa Purple Cluster x White Madhapuri (cross II) are presented below.

The characters of parents, F_1, BC_1 (F_1 x dominant parent) and segregation frequencies of phenotypic classes in F_2 and BC_2 (F_1 x recessive parent) are presented in Table 43 for cross I and Table 44 for cross II, respectively. The expected frequencies of phenotypic segregation based on the assumed phenotypic ratio, the calculated chi-square values and their probability values at respective degrees of freedom indicating the goodness of fit of observed frequencies to the assumed ratios were computed for each character. The segregation ratios obtained for different characters are as under.

4.6.1 Pigmentation on main stem

Pusa Purple Cluster (PPC) had purple pigmentation on main stem, whereas Krishna Kati (KK) and White Madhapuri (WM) had uniform green colour of main stem. The F_1 and BC_1 had purple pigmentation on main stem in both the crosses.

Phenotypic segregation observed for this character in F_2 and BC_2, showed a goodness of fit to 162:94 and 1:3 ratios of purple vs green, respectively in cross I. It indicated that purple pigmentation on main stem involves action of four genes, in cross I.

In cross II, F_2 and BC_2 showed a goodness of fit to 45:19 and 3:5 ratios of purple vs green pigmentation on main stem, respectively. It revealed that purple pigmentation on main stem involves the action of three genes in cross II.

4.6.2 Pigmentation on branches

The PPC had purple pigmentation on branches, whereas KK and WM had uniformly green. Phenotypic segregation observed for this character in F_2 and BC_2, showed a goodness of fit to 45:19 and 3:5 ratios of purple vs green, respectively in both the crosses. It indicated the involvement of three genes for this character in both the crosses.

4.6.3 Pigmentation on basal leaf midrib

The PPC had purple pigmentation on midrib of basal leaf, while KK had uniformly green midrib in cross I. Phenotypic segregation observed for this character in F_2 and BC_2, showed a goodness of fit to 45:19 and 3:5 ratios of purple vs green colouration of midrib of basal leaf, respectively. It revealed the involvement of three genes for purple pigmentation of basal leaf midrib in cross I.

4.6.4 Basal leaf vein colour

The PPC had purple basal leaf vein, while KK and WM had uniform green basal leaf vein. Phenotypic segregation observed for this character in F_2 and BC_2 showed a goodness of fit to 162:94 and 1:3 ratios, respectively of purple vs green leaf vein colour of basal leaf in cross I. It indicated that four genes governed the purple colouration of basal leaf vein in cross I.

In cross II, F_2 and BC_2 showed a goodness of fit to ratios 45:19 and 3:5, respectively of purple vs green colouration on basal leaf vein. It revealed three genes for purple colouration on basal leaf vein in cross II.

4.6.5 Pigmentation on basal leaf petiole

The PPC had purple pigmentation on basal leaf petiole, while KK had uniform green basal leaf petiole. F_2 and BC_2 showed a goodness of fit to 45:19 and 3:5 ratios, respectively of purple vs green colouration of basal leaf petiole. It revealed involvement of three genes for purple pigmentation of basal leaf petiole in cross I.

4.6.6 Terminal leaf lamina colour

The PPC had purple pigmentation on terminal leaf lamina, while KK and W4 had uniform green terminal leaf lamina. A segregation ratios of 147:109 and 5:11 of purple vs green leaf lamina showed a goodness of fit in F_2 and BC_2, respectively in both crosses. It indicated the action of four genes for terminal leaf lamina purple colour in both crosses.

4.6.7 Terminal leaf midrib colour

The PPC had purple pigmentation on terminal leaf midrib, while KK had uniform green terminal leaf midrib. A segregation ratios of 147:109 and 5:11 of purple vs green terminal leaf midrib showed a goodness of fit in F_2 and BC_2, respectively. It revealed action of four genes for purple midrib of terminal leaf in cross I.

4.6.8 Terminal leaf vein colour

The PPC had purple pigmentation on terminal leaf vein, while KK and WM had uniform green terminal leaf vein.

Segregation in F_2 and BC_2 showed a goodness of fit to 147:109 and 5:11 ratio of purple vs green, respectively in cross I. It indicated action of four genes for purple colouration of terminal leaf vein in cross I.

In cross II, phenotypic segregation ratios of 45:19 and 3:5 showed a goodness of fit in F_2 and BC_2, respectively. It revealed the action of three genes for purple colouration of terminal leaf vein.

4.6.9 Pigmentation on terminal leaf petiole

The PPC had purple pigmentation on terminal leaf petiole, but in KK, it was uniform green. The segregation ratios of 45:19 and 3:5 showed a goodness of fit in F_2 and BC_2, respectively for purple vs green petiole colour of terminal leaf. It revealed action of three genes for this character in cross I.

4.6.10 Pigmentation on pedicel of flower

The PPC had purple and KK had uniform green pedicel colour of flower. F_2 and BC_2 showed a goodness of fit to the segregation ratios of 189:67 and 7:9 purple vs green, respectively. It indicated action of four genes, for this character in cross I.

4.6.11 Pigmentation on calyx of flower

The PPC had purple calyx, while KK had uniform green calyx. F_2 and BC_2 showed a goodness of fit to the phenotypic segregation ratios of 45:19 and 3:5 purple vs green, respectively. It revealed the action of three genes for purple colour of flower calyx in cross I.

4.6.12 Pigmentation on petal of flower

The PPC had purple colour petals, while KK had white colour petals. A segregation ratio of 189:67 and 7:9 purple vs white petals in F_2 and BC_2, respectively showed a goodness of fit. It indicated action of four genes for purple colour of petals in cross I.

4.6.13 Pigmentation on petal line

The PPC had purple petal lines, while KK had white petal lines. F_2 and BC_2 showed a goodness of fit to the segregation ratios of 189:67 and 7:9 purple vs white Petal lines, respectively. It revealed the action of four genes for petal line purple colour in cross I.

4.6.14 Pubescence and thorn on pedicel of flower

The PPC had pubescence on pedicel, while KK had absence of pubescence on pedicel. F_2 and BC_2 showed a goodness of fit to 81:175 and 1:15 ratio of presence vs absence of pubescence, respectively. It indicated the action of four genes for presence of pubescence on pedical in cross I.

In cross II, thorns are present on pedicel in WM and it was absence in PPC. F_2 and BC_2 segregation showed a goodness of fit to 195:61 and 9:7 ratio of presence vs absence of thorn, respectively. It revealed the action of four genes for presence of thorn on pedisel of flower in cross II.

4.6.15 Pubescence and thorn on flower calyx

In cross I, PPC had pubescence, while KK had absence of pubescence on flower calyx. F_2 and BC_2 segregation showed a goodness of fit to 147:109 and 5:11 ratio of presence vs absence of pubescence on calyx of flower, respectively. It indicated the action of four genes for presence of pubescence in calyx of flower in cross I.

In cross II, WM had presence of thorn on calyx of flower, while it was absent in PPC. F_2 and BC_2 showed a goodness of fit to 195:61 and 9:7 ratio, respectively for presence vs absence of thorn. It indicated the action of four genes for presence of thorn on calyx of flower in cross II.

4.6.16 <u>Colour of pubescence on floral parts</u>

The PPC had purple pubescence on pedicel and calyx of flower, while KK had absence of pubescence on floral parts. The segregation ratio of 54:10 and 3:5 showed a goodness of fit in F_2 and BC_2, respectively for purple vs green pubescence. It indicated action of three genes for purple colour of pubescence on floral parts in cross I.

4.6.17 <u>Fruit colour</u>

The PPC, KK and WM had purple, green and white fruit colour, respectively. Purple colour was dominant over both green and white colour of fruit as exhibited in F_1 of both crosses. There was no segregation in BC_1 generation of both crosses for fruit colour as all plants showed purple colour fruits in crosses I and II.

Tetragenic ratio of 129 purple:127 green and 5 purple:11 green showed a goodness of fit in F_2 and BC_2 respectively. It indicated the operation of one basic, one inhibitory and two anti-inhibitory complementary genes for this character.

In cross II, segregation ratio of 195 purple: 61 white and 9 purple:7 white showed a goodness of fit in F_2

and BC_2, respectively. This suggests the involvement of two duplicate, one inhibitory and one anti-inhibitory genes for fruit colouration.

4.6.18 Stalk colour of fruit

The PPC had purple fruit stalk, while KK had green stalk. Purple colour was dominant over green as observed in F_1. All BC_1 plants had purple fruit stalk. The ratio of 129 purple:127 green and 5 purple:11 green showed a goodness of fit in F_2 and BC_2. Tetragenic ratio revealed one basic, one inhibitory and two anti-inhibitory complementary genes for this character in cross I.

4.6.19 Pigmentation on calyx of fruit

The PPC had purple colour, while KK had green calyx of fruit. F_1 indicated purple to be dominant over green fruit calyx. BC_1 had all purple calyx colour. F_2 and BC_2 showed a goodness of fit to the ratios of 129 purple: 127 green and 5 purple: 11 green, respectively. This indicated the action of four genes for calyx colour of fruit.

4.6.20 Fruiting habit

The PPC, fruits were found in clusters, while KK had nonclustered fruiting. F_1 and BC_1 showed nonclustered fruiting. The ratio of 81 noncluster: 175 cluster and 1 noncluster:15 cluster showed a goodness of fit in F_2 and BC_2.

respectively. It indicated four genes for this character.

4.6.21 Pubescence and thorn on fruit stalk

The PPC had pubescence on fruit stalk, while KK had absence of pubescence. F_1 and BC_1 plants had pubescence on their fruit stalk. The segregation ratio of 27:37 and 1:7 showed goodness of fit in F_2 and BC_2, respectively for presence vs absence of pubescence on fruit stalk. This suggests the action of three complementary genes for this character in cross I.

In cross II, WM had presence of thorn on fruit stalk, while it was absent in PPC. F_1 and BC_1 had presence of thorn on fruit stalk. The segregation ratio of 195 present:61 absence and 9 present:7 absence of thorn on fruit stalk showed a goodness of fit in F_2 and BC_2, respectively. It suggested the action of four genes for control of this trait in cross II.

4.6.22 Pubescence and thorn on fruit calyx

The PPC and KK had presence and absence of pubescence on fruit calyx, respectively. F_1 and BC_1 had presence of pubescence on fruit calyx in cross I. F_2 and BC_2 showed a goodness of fit to 147 presence: 109 absence and 5 presence: 11 absence of pubescence on fruit calyx, respectively. This suggested the action of four genes for this character in cross I.

In cross II, PPC and WM had absence and presence of thorn on fruit calyx, respectively. F_1 and BC_1 plants had presence of thorn on fruit calyx. The segregation ratios of 195 presence:61 absence and 9 presence:7 absence of thorn on fruit calyx showed a goodness of fit in F_2 and BC_2, respectively. It revealed the action of four genes for this character.

4.6.23 Colour of pubescence on fruit parts

The PPC had purple coloured pubescence on stalk and calyx of fruit, while KK had absence of pubescence. F_1 and BC_1 plants had purple coloured pubescence in cross I. Segregation in F_2 and BC_2 showed goodness of fit to the ratios of 3 purple: 1 green and 1 purple:1 green, respectively. It suggested that purple colour of pubescence on stalk and calyx of fruit was governed by a single dominant gene.

4.6.24 Thorns on stem, petiole and midrib

The WM and PPC had presence and absence of thorn on stem, petiole and midrib, respectively. F_1 and BC_1 had thorns on all these parts. F_2 and BC_2 showed a goodness of fit to the segregation ratios; 195 presence: 61 absence and 9 presence: 7 absence of thorn on all above parts, respectively. It suggested the action of four genes for presence of thorn on stem, petiole and midrib in cross II.

4.6.25 Thorns on leaf vein

The WM and PPC had presence and absence of thorn on leaf vein, respectively. F_1 and BC_1 plants had thorn on leaf vein in cross II. The segregation ratios of 117 presence:139 absence and 3 presence: 13 absence of thorn on leaf vein showed goodness of fit in F_2 and BC_2, respectively. This indicated the involvement of four genes for thorns on leaf vein.

4.6.26 Fruit shape

The PPC had elongated fruits, while WM had round fruits. F_1 and BC_1 showed elongated fruits. F_2 and BC_2 segregation indicated a goodness of fit to 39 elongated: 25 round and 3 elongated: 5 round for fruit shape, respectively. It revealed the action of three gene for this character.

Table 43. Characters of parents, F_1, back cross with dominant parent (BC_1) and phenotypic segregation of characters in F_2 and test cross (BC_2) in cross I.

Sl. no.	Character	P_1 (Pusa purple cluster)	P_2 Krishna kati	F_1 ($P_1 \times P_2$)	BC_1 ($P_1 \times P_2$/ P_1) or P_2 F_1 x dominant parent)	Phenotypic segregation in F_2 generation: Expected ratio	Phenotypic segregation	X^2	P	Phenotypic segregation in test cross (BC2): Expected ratio	Phenotypic segregation	X^2	P
1.	Main stem colour	Purple	Green	Purple	All purple	162:94	275:148	0.5452	0.1–0.5	1:3	66:255	3.373	0.85–0.1
2.	Branches colour	"	"	"	"	45.19	290:133	0.6235	0.1 –0.5	3:5	104:217	3.5640	0.05–0.1
3.	Basal leaf mid-rib colour	"	"	"	"	45:19	281:142	3.053	0.05–0.1	3:5	104:217	3.5640	0.05–0.1
4.	Basal leaf vein colour	"	"	"	"	162:94	268:155	0.001	0.95–0.98	1:3	66:255	3.3738	0.05–0.1
5.	Basal leaf petiole colour	"	"	"	"	45:19	289:134	0.8029	0.1 –0.5	3:5	104:217	3.5640	0.05–0.1
6.	Terminal leaf lamina colour	"	"	"	"	147:109	249:174	0.3605	0.5 –0.9	5:11	85:236	3.3999	0.05–0.1
7.	Terminal leaf midrib colour	"	"	"	"	147:109	260:163	2.8292	0.05–0.1	5:11	85:236	3.3999	0.05–0.1
8.	Terminal leaf vein colour	"	"	"	"	147:109	249:174	0.3605	0.5 –0.9	5:11	85:236	3.3999	0.05–011
9.	Terminal leaf Petiole colour	"	"	"	"	285:196	297:126	0.002	0.95–0.98	3:5	104:217	3.5640	0.05–0.1
10.	Pedicel colour of flower	"	"	"	"	189:67	238:100	0.0319	0.5 –0.9	7:9	107:156	1.0043	0.1 –0.5
11.	Flower calyx colour	"	"	"	"	45:19	268:119	0.2091	0.5– 0.9	3:5	83:178	3.6171	0.05–0.1
12.	Flower petal colour	"	White	"	"	189:67	269: 98	0.1443	0.5– 0.9	7:9	106:155	1.0437	0.1 –0.5
13.	Petal line colour	"	"	"	"	189:67	269: 98	0.1443	0.5– 0.9	7:9	106:155	1.0437	0.1 –0.5
14.	Pubescence on flower pedicel	Present	Absent	Present	All present	81:175	135:248	2.3043	0.1– 0.5	1:15	11:236	1.3606	0.1 –0.5
15.	Pubescence on flower calyx	"	"	"	"	147:109	231:152	1.3096	0.1– 0.5	5:11	68:183	3.6426	0.05–0.1
16.	Colour of of pubescence on floral parts	Purple	"	Purple	All purple	54:10	188: 45	2.4043	0.1– 0.5	3: 5	27: 35	0.9677	0.1 –0.5
17.	Fruit colour	"	Green	"	"	129:127	184:169	0.4245	0.5– 0.9	5:11	52:156	3.7818	0.05–0.1
18.	Stalk colour of fruit	"	"	"	"	129:127	182:170	0.2431	0.5– 0.9	5:11	52:155	3.6196	0.05–0.1
19.	Calyx colour of fruit	"	"	"	"	129:127	181:171	0.1493	0.5– 0.9	5:11	52:155	3.6196	0.05–0.1
*20.	Fruiting habit	Cluster	Non-cluster	Non-cluster	All non-cluster	81:175	98:254	2.3496	0.1– 0.5	1:15	19:191	2.8051	0.05–0.1
21.	Pubescence on fruit stalk	Present	Absent	Present	All present	27:37	154:198	0.3523	0.05–0.1	1: 7	17:190	3.4790	0.05–0.1
22.	Pubescence on Fruit calyx	"	"	"	"	147:109	195:157	0.5899	0.1 –0.5	5:11	52:155	3.6196	0.05–0.1
23.	Colour of fruit pubescence	Purple	"	Purple	"	3:1	151: 48	0.0820	0.5– 0.9	1: 1	17:19	0.1110	0.5 –0.9

*BC_1 for this trait was $P_1 \times P_2//P_2$ and BC_2 was $P_1 \times P_2//P_1$

Table 44. Characters of parents, F_1, back cross with dominant parent (BC_1) and phenotypic segregation of characters in F_2 and test cross (BC_2) generations in cross II.

Sl. no.	Character	P_1 Pusa purple cluster	P_3 White Madhapuri	F_1 ($P_1 \times P_3$)	BC1 F_1 x dominant parent	Phenotypic segregation in F_2 generation: Expected ratio	Phenotypic segregation in F_2 generation: Phenotypic segregation	χ^2	P	Phenotypic segregation in test cross(BC_2): Expected ratio	Phenotypic segregation	χ^2	P
1.	Main stem colour	Purple	Green	Purple	All purple	45:19	790:302	2.1602	0.1 - 0.5	3:5	372:616	0.0096	0.9 - 0.95
2.	Branches colour	"	"	"	"	45:19	790:302	2.1602	0.1 - 0.5	3:5	372:617	0.0096	0.9 - 0.95
3.	Basal leaf vein colour	"	"	"	"	45:19	775:317	0.2274	0.5 - 0.9	3:5	391:597	1.8148	0.1 - 0.5
4.	Terminal leaf lamina colour	"	"	"	"	147:109	650:442	1.9702	0.1 - 0.5	5:11	287:701	2.2286	0.1 - 0.5
5.	Terminal leaf vein colour	"	"	"	"	45:19	790:302	2.1602	0.1 - 0.5	3:5	400:588	3.7581	0.05 - 0.1
6.	Thorn on stem	Absent	Present	Present	All present	195:61	839:253	0.2618	0.5 - 0.9	9:7	139:115	0.2402	0.5 - 0.9
7.	Thorn on petiole	"	"	"	"	195:61	834:258	0.0244	0.5 - 0.9	9:7	139:115	0.2402	0.5 - 0.9
8.	Thorn on leaf midrib	"	"	"	"	195:61	834:258	0.0244	0.5 - 0.9	9:7	139:115	0.2402	0.5 - 0.9
9.	Thorn on leaf vein	"	"	"	"	117:139	474:618	2.3208	0.1 - 0.5	3:13	55:199	1.4056	0.1 - 0.5
10.	Thorn on flower pedicel	"	"	"	"	195:61	837:255	0.1365	0.5 - 0.9	9:7	158:96	3.6597	0.05 - 0.1
11.	Thorn on flower calyx	"	"	"	"	195:61	837:255	0.1365	0.5 - 0.9	9:7	158:96	3.6597	0.05 - 0.1
12.	Thorn on fruit stalk	"	"	"	"	195:61	689:219	0.0423	0.5 - 0.9	9:7	158:96	3.6597	0.05 - 0.1
13.	Thorn on fruit calyx	"	"	"	"	195:61	701:217	0.0181	0.5 - 0.9	9:7	158:96	3.6597	0.05 - 0.1
14.	Fruit colour	Purple	White	Purple	All purple	195:61	703:196	2.033	0.1 - 0.5	9:7	496:375	0.1713	0.5 - 0.9
15.	Fruit shape	Elongated	Round	Elongated	All elongated	39:25	542:366	0.6949	0.1 - 0.5	3:5	312:551	0.6681	0.1 - 0.5

CHAPTER - V

DISCUSSION

V. DISCUSSION

Improvement of productivity in any crop depends on the existence of genetic variation for the desired traits. Such basic variability studies on different morphological and fruit characters are of immense utility for further improvement of brinjal. Several workers have reported hybrid vigour for yield and yield contributing traits in brinjal. A thorough understanding of the nature and magnitude of different types of gene action, identification of potential parents and crosses for fruit quality along with yield are very important. However, very few or scanty reports exist on genetics of fruit quality parameters in brinjal. The consumer's preference depends upon the qualitative characters like colour, shape and thorns on calyx. The knowledge of the pattern of inheritance of these qualitative characters is also important to improve consumers acceptance and market preferences of fruits of potential cultivars and hybrids in brinjal. Three different experiments were carried out to meet the said objectives.

5.1.1 Genetic variability

The material utilised in the study consisted of 76 genotypes collected from different geographical regions within India (Table 1). Various plant morphological and fruit parameters were recorded along with fruit yield. To quantify the variations, different genetic parameters were worked out at phenotypic as well as genotypic levels for each of these characters. As is evident from Table 2, the variation was highly significant for all the 15 traits under study.

The diversity of genetic variation indicated by the higher genotypic coefficient of variation was the highest in case of number of fruits per plant followed by fruit yield per plant. However, fruit density and days to flower were found to be the characters with least genotypic coefficient of variation as compared to the other characters. All the other characters exhibited genotypic coefficient of variation in the range of 9.52 (number of primary branches) to 45.14 (seed weight per fruit). It thus indicated the presence of reasonably good amount of genetic variation for different morphological and fruit characters in the material studied (Table 3).

The amount of genetic variation alone will not give much information to the breeder unless it is supplemented with the heritability estimates which gives a measure of the heritable portion of the total variation. The genotypic coefficient of variation (GCV) along with heritability estimate could provide a better picture of the amount of genetic advance to be expected by phenotypic selection (Burton and Devane, 1953). It may be noted here that broad sense heritability estimates were found between 45.44 (primary branches) and 97.06 per cent (fruit weight) in the present investigation.

Further, in order to have a clear predictability of the breeding value, information merely on heritability is just insufficient. Johnson *et al*. (1955) indicated that heritability in conjunction with genetic advance is more effective and reliable in predicting the result and the effect of selection. Therefore, broad sense heritability values would be more meaningful and useful when accompanied by high genetic gain. It may be worthwhile to mention here that genetic advance over mean varied from 8.11 (fruit density) to 114.12 per cent (number of fruits per plant) in the present study.

High GCV accompanied by high estimates of heritability and genetic advance over mean (%) were observed for number of fruits per plant, fruit yield per plant and seed weight per fruit, while moderate estimates of GCV accompanied by high heritability and high genetic advance were found in case of fruit weight and fruit length (Table 3). It indicated that simple selection will be effective for the improvement of above traits. Similar observations were reported by Prasad and Prakash (1974) for number of seeds per fruit, Peter and Singh (1974) for equatorial perimeter, weight and number of fruits in brinjal, Mishra and Roy (1976) for fruit weight, number of fruits and fruit yield per plant, Singh and Singh (1980b) for fruit yield and number of fruits and Chadha and Sidhu (1983) for fruit yield, number of fruits and fruit weight in brinjal.

In all the above mentioned traits, high heritability values were found to be associated with high genetic advance, it may be inferred that by and large, these characters were under the control of additive type of gene action. On similar analogy, the characters where high heritability value is associated with low genetic advance can be presumed to be governed by non-additive gene action or to the presence of high genotypic environment interaction. This was indicated in respect of days to flowering and fruit density, where the high heritability was coupled with low genetic advance over mean. Chadha and Sidhu (1983), Dhankhar and Singh (1983) Chadha and Paul (1984) and Mishra and Mishra (1990b) reported similar findings for days to flower. In the remaining characters moderate gcv, moderate to high heritability and moderate estimates of genetic advance over mean revealed that reasonably good progress can be achieved in respect of characters like plant height, plant spread, primary branches, secondary branches, fruit girth, stalk length of fruit, rind thickness and keeping quality index through selection. Mishra and Mishra (1990b) reported similar observations for plant height, number of branches and fruit girth, while Hiremath and Rao (1974) reported high heritability and high genetic advance for seed weight per fruit and rind thickness.

5.1.2 Correlations

Fruit yield is a complex trait resulting from the interplay of various related morphological and fruit characters. The association analysis is quite useful to understand the interrelationship of a complex trait like yield with less complex characters so that selection strategies can be chalked out using indirect selection for these less complex associated characters for achieving gains in fruit yield. Genotypic correlation provides an estimate of inherent association between genes controlling any two characters.. Hence, it is of greater significance and can be effectively used in formulating effective selection schemes. The phenotypic and genotypic correlation coefficients were worked out for 15 characters with a view to understand the relationship between any two characters (Table 4).

Fruit yield per plant indicated the highest significant positive correlation with number of fruits per plant followed by fruit length and fruit weight. Similar observations were reported by Singh and Singh (1981) and Naik and Vijiarungam (1980). A strong positive association between the number of fruits and fruit yield per plant has been reported by many workers (Srivastava and Sachan, 1973a; Singh and Nandpuri, 1974; Hiremath and Rao, 1974; Sinha, 1983; Chadha and Paul, 1984; Sharma et al., 1985; Mishra and Mishra, 1990a; Kumar et al., 1990; Randhawa et al., 1989 and Mainar et al., 1990). The varieties having maximum number of fruits per plant are generally observed to be high yielders. Number of fruits per plant had significant positive association with fruit length but negative significant association with fruit girth and non-significant negative association with fruit weight. Fruit weight had positive highly significant correlation with fruit length and fruit girth. It suggests that optimum size of the fruit that is, in terms of length, girth and weight of fruit is to be considered for increased number of fruits per plant. Similar observations were earlier reported by Chadha and Sidhu(1983) and Dhankhar and Singh (1983).

Further, the keeping quality index showed significant negative association with fruit yield, fruit weight, fruit length and fruit girth. It revealed that simultaneous improvement in keeping quality of fruit could be possible with increase in yield as lower values of keeping quality index is desirable quality of fruit in brinjal. The other important quality parameters were stalk length and fruit density which showed appreciable positive and negative association with fruit yield, respectively, while rind thickness and seed weight per fruit had weak positive association with fruit yield. It suggests that simultaneous improvement of yield along with reduced stalk length of fruit and seed weight per fruit and increased fruit density may be difficult due to undesirable association of these traits with fruit yield. Hiremath and Rao (1974) reported that rind thickness was negatively correlated with fruit yield while Nak and

Vijiarungam (1980) observed positive correlation between fruit yield and number of seeds per fruit. There are no published reports on remaining fruit quality parameters in brinjal.

Among the other plant morphological characters, days to flower exhibited significant positive association with seed weight per fruit and non-significant but positive association with fruit density, rind thickness, keeping quality index, secondary branches and plant height which were of higher magnitude. Similarly, there was appreciable amount of negative association between days to flower and fruit weight, fruit length and fruit girth. Chadha and Sidhu (1983) reported negative significant association between number of days to first harvest and fruit length, while Dhankhar and Singh (1983) observed negative significant association between days to 50 per cent flowering and fruit length.

Plant height showed significant positive association with plant spread, primary branches and stalk length of fruit. Similarly, plant spread exhibited significant positive association with primary branches, secondary branches and fruit weight. Dhankhar and Singh (1983) reported significant positive correlation between plant height and number of branches in normal crop of brinjal.

The stalk length of fruit exhibited significant positive association with primary branches, fruit weight and fruit length. It reveals that genotypes with reduced stalk length of fruit which is one of the quality features of fruit in brinjal, can be had with an optimum size of fruit.

Similarly, reduced length of fruit will increase density of fruit as revealed by significant negative association between these two characters. Appreciable positive and negative correlation of rind thickness with fruit girth and fruit length, respectively suggests that reduced fruit length and increased fruit girth are associated with increased rind thickness of fruit in brinjal. The seed weight per fruit had significant positive association with fruit girth and rind thickness. Thus, reduction in seed weight will be possible along with the optimum fruit girth and rind thickness for improved fruit quality. Published reports on inter-relationships among these fruit quality parameters and with other plant morphological characters are not available. Present findings may, therefore, be useful in selection of genotypes for improved fruit quality in brinjal.

Other positive significant associations indicated by primary branches with stalk length of fruit and secondary branches with fruit density, while negative significant associations revealed by primary branches with fruit density and seed weight per fruit and secondary branches with fruit length. The above observations revealed that simultaneous improvement of fruit quality parameters like stalk length of fruit, fruit density and rind thickness, keeping quality index of fruit and seed weight per fruit may pose problem in breeding programme due to complex interrelationship between these characters and other plant morphological and fruit characters in brinjal.

5.1.3 Path coefficient analysis

Though correlation analysis indicates the association pattern of the component traits with fruit yield, they simply represent the overall influence of a particular trait on fruit yield rather than providing cause and effect relationship. The path analysis as suggested by Dewey and Lu (1959) helps to resolve these correlations further and throws more light on the way in which the component traits interact to influence fruit yield which enables the breeders to specifically identify important component traits of fruit yield. Path analysis was therefore, implied for computing the direct and indirect effects of morphological, fruit traits and fruit quality related parameters measured at genotypic level on fruit yield. From Table 5, it is observed that number of fruits per plant, fruit length and fruit weight had significant positive correlations with fruit yield but their direct effect on yield was negligible. However, days to flower, primary branches and stalk length of fruit exhibited high positive direct effects on fruit yield followed by number of fruit and rind thickness in that order of importance. Fruit weight, fruit length and fruit girth exhibited high negative direct effects on fruit yield followed by keeping quality index, plant height, secondary branches, fruit density and plant spread.

Number of fruits contributed to fruit yield indirectly through days to flower and fruit length. Fruit weight, fruit length and fruit girth exhibited maximum negative direct effects on fruit yield. The indirect contributions of fruit weight through fruit length, fruit girth and stalk length of fruit was positive and appreciable on fruit yield. Similarly, indirect contribution of fruit length was positive through days to flower and fruit weight on fruit yield.

Though the direct effect of days to flower was maximum on fruit yield, the indirect maximum contribution of number of fruits, seed weight per fruit and fruit weight was observed through days to flower on fruit yield. Similarly, indirect contributions of fruit density, fruit girth, rind thickness and fruit weight was maximum through primary branches on fruit yield.

Similarly, indirect maximum contribution of days to flower through number of fruits, fruit length, fruit girth, stalk length of fruit and seed weight per fruit , is suggestive of the importance of this trait in breeding programme.

The negative significant correlation of keeping quality index observed, may be due to maximum indirect negative contribution through fruit girth and stalk length on fruit yield.

The path analysis reveals that the direct contribution of days to flower and primary branches was maximum on fruit yield. However, appreciable indirect contribution of fruit weight, fruit length and fruit girth suggests the importance of above traits in improvement of yield in brinjal.

The residual effect was appreciable (0.1589). This indicated that the variability in fruit yield was not fully accounted by the traits considered for path analysis. Khurana et al. (1988) observed the highest direct effect of leaf area, number of branches and stem weight on fruit yield in brinjal, while Mishra and Mishra (1990a) reported that fruits per plant, fruit weight and branches per plant were the most important characters contributing towards yield.

Singh and Singh (1981) reported direct effect of fruit diameter and number of fruits per branch on fruit yield, whereas Sinha (1983) found maximum direct effect of number of fruits, fruit length and circumference ratio on fruit yield. But the studies of Sharma et al. (1985) showed fruit number to be the most important direct contributor to fruit yield. Vadivel and Bapu (1989b) revealed the direct effect of number of fruits per plant, number of branches, plant height and fruit weight in descending order on fruit yield. Number of fruits per plant had negative indirect effect through fruit length and fruit weight on fruit yield. From the foregoing discussion, it is notable that direct and indirect contributions of component characters differ widely depending on the set of genotypes considered for study.

Path analysis thus revealed that direct contribution of days to flower, primary branches and stalk length of fruit were of higher magnitude on fruit yield. However, indirect positive contribution of fruit weight, fruit length and fruit girth were appreciable to effect yield. The direct and indirect contribution of days to flower were observed maximum on fruit yield.

5.1.4 Diversity analysis

Genetic relationships among cultivars can be measured by similarity or dissimilarity of any number of quantitative characters assuming that the differences between characters of genotypes reflect the genetic divergence of genotypes. Genetic relationship among large number of genotypes can be summarised using Mahalanobis's D^2 statistics to place phenotypically similar and therefore presumably genotypically similar cultivars in group. Thus, formation of different groups depends on the variability present in the material. Different groups from such categorisation provide a structure for the sampling of cultivars for genetic and plant breeding studies. Genetic divergence among cultivars have been shown to be useful for analysis of cultivar variability (Cox et al., 1985) and for the prediction of variance for some character in F_2 and subsequent inbreeding generations (Cowen and Frey, 1987). The principal objective of the present exercise was to estimate the magnitude of genetic diversity present in 75 genotypes based on 15 plant morphological and fruit related characters and select potential parents for further studies. Hence, data on these characters were subjected to D^2 analysis (Mahalanobis, 1936).

The magnitude of D^2 values of all the possible pairs of comparison between 75 varieties ranged from 21.485 to 2080.369, suggesting the presence of ample variability in respect of the traits under investigation. These 75 genotypes were grouped in seven clusters using Tocher's method (Rao, 1952) employed on the Mahalanobis's generalized distance (D^2) values. The cluster I accounted for as many as 59 genotypes followed by clusters II and III which had five and four genotypes, respectively. There were three clusters that is, IV, V and VI having two genotypes in each. The cluster VII had a single genotype. However, the grouping pattern indicated that many genotypes from different geographical regions tended to fall in the same cluster. This observation is in line with the observations of Tambe (1984). He classified 25 genotypes of brinjal into five clusters based on 16 characters. Sidhu and Chadha (1988) recognised five distinct morphological groups in 39 varieties of brinjal by total yield per plant and number of days to first harvest based on metroglyph and index score analysis. Lal and Srivastava (1978) reported four clusters from 42 varieties of brinjal, while Singh and Prasad (1991) reported eight clusters based on 12 characters from six parents and their 15 F_1s in brinjal.

One of the important objectives of D^2 analysis is to identify diverse clusters and select genotypes, from them for hybridisation. More diverse the parents within a reasonable range, better are the chances of improving economic characters under consideration in the resulting offspring. It may be recalled that in this study, cluster number I which included 59 out of 75 genotypes indicated the lowest intra cluster distance (14.85) while cluster VI having only two genotypes exhibited the highest intra-cluster distance (25.42). Cluster number VI was also strikingly diverse from the rest of the clusters as evident from its very high intercluster D^2 values. Likewise, cluster IV that included genotypes Kalyanpur T_2 and Pusa Kranti as well as cluster number III which included four genotypes (Murki, Jalgaon local, Rushira and Aru-1) were relatively more diverse from others. Clusters II and V ranked next in respect of relative diversity from the other clusters. The high diversity of cluster VI may be attributed to high yield and its earliness which turned out to be the major contributors to the diversity observed in the material as observed by Sidhu and Chadha (1988). Secondly, the forces due to selection, both natural and artificial selection forces could have been the reasons for this high diversity. In respect of cluster IV, the genotypes had high values for days to flower, fruit weight, fruit girth and lowest keeping quality index, which probably caused it to be more diverse from others. The high diversity observed in respect of the cluster VII may be ascribed to its late flowering habit, lowest fruit yield, fruit number, fruit weight, and seed weight in comparison with the rest of the entries.

The clusters differed with respect to their *per se* performance. A close look at Table 8 reveals that the clusters excelled in respect of different characters. Cluster VI was most diverse with very high fruit yield per plant, earliest in days to flower, highest in fruit length and stalk length of fruit. Genotypes in cluster IV represented entries with good yield, late in days to flower, highest fruit weight and fruit girth and lowest in keeping quality index. Cluster III included genotypes with early flowering, good yield, more number of fruits per plant and lowest stalk length of fruit. cluster IV may therefore, be regarded as useful source of genes for fruit weight and good keeping quality index, while cluster III is good source of high fruit number and reduced stalk length of fruit. Cluster V is a good source of genotypes for yield and compact plant type (i.e., lowest plant height, plant spread, primary and secondary branches), while cluster II is a good source for rind thickness and seed weight per fruit. Cluster VII was characterised as late in flowering, with high fruit density and lowest seed weight per fruit.

Genotypes Higna Dorla, Gare Local, SM 135, Surya, Malapur Local and Taiwan Naga from cluster I, Gokak Local from cluster II, Pusa Kranti from cluster IV, Pusa Bhairav from cluster VI and White Madhapuri from cluster VII representing available diversity for plant morphological, and fruit related quality parameters were selected for further study. Among these selected genotypes, Malapur Local and Gokak local were the national recommended improved varieties, while the remaining were the popular varieties of different regions.

5.2 Heterosis, combining ability and gene action

The mean sum of squares due to parents vs hybrid was significant for days to flower, fruit yield per plant, number of fruits per plant, plant height, plant spread, secondary branches, fruit weight, fruit girth, fruit density, keeping quality index, rind thickness, seed weight per fruit, dry matter (%), total phenols (%), orthodihydroxy phenols, total sugars, reducing sugars and crude protein (%) indicating the existence of overall heterosis for these characters (Table 5).

Information on the nature of combining ability and gene effects influencing important characters is useful for the formation of appropriate selection scheme. The combining ability analysis gives an indication regarding the variances due to GCA and SCA, which represent a relative measure of additive plus additive x additive (fixable) and dominance plus other epistatic effects, respectively. Nevertheless, it has been the practise to use these variances components to infer on the nature of gene action. In the present study, the variances due to general combining ability (GCA) and specific combining ability (SCA) were highly significant for all 22 characters except stem girth where only GCA component was highly significant. This indicates that both additive and non-additive gene actions are important in the expression of all the characters under study except stem girth where only additive gene action was prominent. However, the preponderance of additive gene action is more than non-additive gene action for all the characters except days to flower, keeping quality index and rind thickness as revealed by the higher magnitude of GCA variance over respective SCA variances. All these reveal that heterosis can be exploited for characters like days to flower, keeping quality index and rind thickness to the maximum extent, while appreciable heterosis could be found for other characters also.

When the varieties represent a fixed set, as in the present study, the variance components do not apply to any random mating equillibrium population. Moreover, in a crop like brinjal, it is doubtful whether such random mating population ever existed. Hence, the approach used here has been to consider the set of parents used as the reference as well as the inference population about which conclusions are to be drawn. Predictability ratio was worked out for all the 22 characters as per Baker (1978). The closer this ratio is to unity, the greater the predictability based on general combining ability alone. The performance of a single-cross progeny can be adequately predicted based on the gca effects of parents if the SCA mean square is not significant. However, in the present study, the SCA mean square was observed to be highly significant for all characters except stem girth. Thus, predictability ratio (near to unity) will indicate higher role of additive effects in the material under study and vise-versa rather than performance of F_1 based on gca effects of parents. Out of a total of 22 characters, 18 characters exhibited predictability ratio nearer to unity (i.e., above 0.75). The predictability ratio for the remaining characters namely, days to flower, fruit yield, rind thickness and keeping quality index was less than 0.75 indicating a higher role of non-additive gene action in the expression of these characters.

Patil and Shinde (1985) observed greater importance of additive genetic variance for fruit girth and fruit weight

and non-additive effects for plant spread and fruit yield based on predictability ratio in brinjal. However, both GCA and SCA variances were highly significant for all the characters in their study. They further concluded that the most striking additive gene action for fruit girth, fruit weight, plant height, fruit length, number of primary and secondary branches and yield per plant was due to higher GCA over SCA variance. The present results are in general agreement with these findings.

Similarly, both additive and non-additive gene actions have been reported for different plant morphological and fruit characters in brinjal by earlier workers (Sidhu et al., 1980; Joarder et al., 1981; Dixit et al., 1982; Salehuzzaman and Alam, 1983; Singh, 1984; Gopinath and

Madalageri, 1986; Kumar and Ram, 1987; Singh and Mital, 1988; Singh and Kalda, 1989; Chadha and Sharma, 1989; Singh and Rai, 1990; Sawant et al., 1991; and Lawande et al., 1992). The discrepancies between the results in the present and previous studies might be due in part to the differences in testing system, environments and genotypes used.

There are very few reports on the gene action of important fruit quality traits in brinjal like stalk length of fruit, fruit density, keeping quality index, rind thickness of fruit, seed weight per fruit, dry matter, total phenols, orthodihydroxy phenols, total sugars, reducing sugars and crude protein content of fruits. In some of the studies dealing with fruit quality, Chadha et al. (1990a) reported both additive and non-additive gene effects for total phenols and ortho-dihydroxy phenols and Verma (1991) observed both additive and dominance gene effects for dry matter and protein content of fruit in brinjal.

5.2.1 Breeding implications

In general, additive effects were playing major role in the expression of various plant morphological, fruit attributes and quality related fruit components. However, the importance of both types of gene effects for the characters like days to flower, fruit yield and secondary branches and substantial non-additive effects for fruit quality related components like keeping quality index, rind thickness and orthodihydroxy phenols indicated that non-additive effects were also important especially when fruit yield and fruit quality are considered together. Thus, for yield and fruit related quality attributes, both additive as well as non-additive gene actions were playing equal role. As a sizable portion of genetic variation was additive in nature for yield as well as fruit quality components, significant improvement can be achieved by adopting simple selection procedures such as pedigree method in the segregating generations. However, it would mean only partial exploitation of the existing genetic variance in the material studied. In this context, methods like recurrent selection, diallel selective mating (Jensen, 1970) and biparental mating systems provide better opportunity for selection, recombination and accumulation of desired genes, which help in exploiting fixable as well as non-fixable type of gene effects (Singh et al., 1979). As brinjal is a self pollinated crop, recurrent selection or even diallel selective mating are difficult to implement. In this situation multiple crosses between the promising hybrids and/or parents may be made so that recombination of desired allele could be expected for yield as well as fruit quality in the subsequent generations. Based on these considerations, the modified pedigree method (Brim, 1966) appears to be well suited for improving fruit yield as well as fruit quality. Besides this, sizable non-additive components observed for fruit yield, its related traits, and fruit quality parameters could be exploited through F_1 hybrids.

5.2.2 Mean performance of parents

Ten parents selected for diallel mating design were divergent with regard to plant morphological, fruit attributes and fruit quality related parameters except primary branches and stem girth as revealed by highly significant differences between the parents (Table 9). Among the parents, Pusa Bhairav and Gokak Local were the highest in fruit yield per plant followed by Surya and Malapur Local (Table 11). The parent Pusa Bhairav (10) was the earliest in days to flower, highest in number of fruits per plant, and total sugar content in fruit, while it was lowest in weight of fruit and seed weight per fruit. Gokak Local (6) had the highest reducing sugar content in fruit and Surya (5) was the tallest, while Pusa Kranti (9) had highest primary branches, stem girth and plant spread.

With regard to fruit attributes, Malapur Local (7) had the highest weight and girth of fruit, while Taiwan Naga (8) had the highest length of fruit. With respect to the fruit quality parameters, Nigna Dorla (2) exhibited the maximum seed weight per fruit and lowest total phenol content in fruit. Madhapuri (1) had maximum fruit density and dry matter content of fruit, while best keeping quality index and rind thickness of fruit were observed in SM-135 (4). The parent Gare Local (3) showed the lowest stalk length and orthodihydroxy phenol, while it was high in crude protein content in fruit (Tables 10 to 31).

5.2.3 Mean performance of the hybrids

Of the 45 hybrids, 15 hybrids recorded significantly superior yield over higher yielding parents, Gokak Local and Pusa Bhairav. None of the crosses were good equally for all the characters under study that is, fruit yield and fruit quality related parameters. Among the top 15 hybrids, 4, 9 and 2 crosses were contributed by H x H, H x L and L x L parents (*per se* performance), respectively. It indicated that high *per se* performance in hybrids was maximum among crosses involving one parent with high and another parent with low *per se* performance of yield (i.e., H x L). However, the top two hybrids namely, 6 x 10 and 5 x 6 were from both parents with high *per se* performance accompanied with high gca effects for yield or other yield attributes. Similar observation was reported by Singh *et al.* (1982) who opined that parents can be selected on the basis of mean performance for some characters but for others, parental combining ability should be determined.

The *per se* performance of 15 higher yielding hybrids in respect of yield attributes and fruit quality related parameters indicated that among these were six hybrids early in days to flower; five hybrids higher in number of fruits per plant; eight hybrids higher in plant height; six hybrids higher in plant spread; two hybrids with best fruit weight; two hybrids with better fruit length; three hybrids with higher fruit girth; five hybrids with best keeping quality index in desired direction; eight hybrids with better rind thickness; one hybrid with better dry matter; two hybrids with reduced level of total phenols, four hybrids with best level of orthodihydroxy phenols in desired direction; three hybrids with better total sugar content and five hybrids with best level of reducing sugars (Table 35).

It may be noted here that among these, the top three high yielding hybrids (6 x 10, 5 x 6 and 3 x9) exhibited desired keeping quality index, rind thickness and orthodihydroxy phenol content in fruit. The hybrid 5 x 6 had low seed weight per fruit, better total sugars and reducing sugars content in fruit, while hybrid 6 x 10 exhibited better reduced level of total phenols, higher total and reducing sugars and better crude protein content in fruit. On the other hand, the hybrid 3 x 9 had desired total phenol content and crude protein content in fruit (Table 42).

Besides these, hybrids 2 x 4 and 3 x 4 showed significant improvement in yield, dry matter, orthodihydroxy phenol and crude protein content over better parent. The hybrid 3 x 4 was early, while hybrid 3 x 4 had better number of fruits, plant spread and reduced level of total phenols. This indicates that there was improvement in yield along with some yield attributes and fruit quality related parameters, simultaneously in hybrids.

5.2.4 Heterosis and genetics

Heterosis is a function of number of loci at which the parents carry different alleles and the magnitude and net direction of the non-additive effects within or between those loci in hybrid combinations (Jinks, 1983). Heterosis has been successfully exploited in several allogamous crops. However, in autogamous crop like brinjal, the possibility of its commercial exploitation is also practicable because of floral biology and the number of seeds in each fruit. It is imperative to have prior information about heterosis for the identification of potential crosses which can be exploited for commercial use or offer maximum chances of isolating transgressive segregants in recombination breeding. Many reports have appeared on heterosis for yield and yield attributes in brinjal. However, virtually no report exists on heterosis in respect of characters related to fruit quality. In the present study an attempt was made to estimate the extent of heterosis for fruit quality parameters as well as for fruit yield and yield attributes.

Information on number of crosses showing significant heterosis over best parent, better parent and mid parent values for different characters is given in Table 35. The number of crosses showing significant heterosis over mid parent indicated that the frequency and magnitude of heterosis towards desired direction were more for characters like days to flower, fruit yield, number of fruits per plant, plant height, plant spread, fruit weight, fruit length, fruit girth, rind thickness, dry matter content, orthodihydroxy phenols and reducing sugars content in fruits. This implies that increase in yield in hybrids could be attributed to heterosis for yield components like days to flower, number of fruits per plant, plant height, plant spread, fruit weight, fruit length and fruit girth. Present results are in line with that of Odland and Noll (1948), Mishra (1961), Patil and Shinde (1984).

Further, improvement of quality related characters like rind thickness, dry matter, orthodihydroxy phenols and reducing sugars in hybrids reveals that simultaneous improvement of these characters could be possible with increase in yield.

On the contrary, the plant characters like primary branches, secondary branches, stem girth and stalk length

Table 35. The hybrids showing significant heterosis for 22 characters in brinjal.

Sl. no.	Character	No. of crosses with significant heterosis over						Crosses
		TP		BP		MP		
		Positive	Negative	Positive	Negative	Positive	Negative	
1	2	3	4	5	6	7	8	9
1.	Days to flower	5	22	3	37	1	41	1x8, 1x10, 2x5, 2x8, 2x10, 3x4, 3x5, 3x6, 3x7, 3x8, 4x5, 4x8, 5x7, 5x8, 5x9, 6x7, 6x8, 7x9, 8x9, 8x10, 9x10, 5x6 (Over TP)
2.	Fruit yield/ plant	15	9	20	4	25	1	1x7, 1x8, 1x10, 2x3, 2x9, 3x6, 3x9, 3x10, 4x9, 4x10, 5x6, 5x7, 5x10, 6x8, 6x10 (Over TP)
3.	No. of fruits/ plant	0	43	6	19	20	8	1x8, , 3x6, 3x9, 4x9, 6x8, 8x9 (Over BP)
4.	Plant height	0	45	17	13	26	5	1x6, 1x7, 1x8, 2x3, 2x8, 3x8, 3x10, 4x6, 4x7, 4x8, 4x9, 4x10, 6x7, 6x8, 6x9, 6x10, 7x8 (Over BP)
5.	Plant spread	1	16	12	8	23	1	1x5, 1x8, 1x10, 2x3, 2x8, 2x10, 4x7, 4x10, 5x6, 5x7, 5x8, 7x8 (Over BP)
6.	Primary branches	0	4	0	3	3	3	1x5, 1x8, 1x10 (Over MP)
7.	Secondary branches	1	9	2	4	8	1	1x6, 5x8 (Over BP)
8.	Stem girth	0	9	0	4	0	1	-
9.	Fruit weight	2	36	10	15	21	3	1x7, 2x9 (Over TP)
10.	Fruit length	0	45	5	27	17	17	1x7, 3x5, 5x7, 6x9, 7x10 (Over BP)

Contd..

Table 35 contd..

1	2	3	4	5	6	7	8	9
11.	Fruit girth	0	34	6	15	20	4	2x9, 3x6, 1x3, 1x5, 1x9, 3x9 (Over BP)
12.	Stalk length of fruit	30	0	13	0	3	1	1 x 2 (over MP)
13.	Fruit density	0	40	0	34	3	28	1x5, 1x6, 2x7(Over MP)
14.	Keeping quality index	9	6	6	10	4	19	3x9, 4x10, 5x6, 5x7, 6x8, 6x9 (Over TP)
15.	Rind thickness	0	30	21	8	33	2	1x2, 1x3, 1x5, 1x6, 1x7, 1x8, 2x5, 2x8, 2x10, 3x5, 3x6, 3x7, 3x8, 3x10, 5x6, 5x7, 5x8, 5x10, 6x8, 6x9, 8x10 (Over BP)
16.	Seed weight of fruit	41	0	34	1	22	5	6x9 (Over BP)
17.	Dry matter (%)	0	37	9	17	15	8	2x4, 2x5, 2x6, 2x7, 3x4, 3x8, 4x5, 5x7, 7x8 (Over BP)
18.	Total phenols(%)	37	4	33	8	24	16	2x4, 3x9, 3x10, 4x7 (Over TP)
19.	Ortho dihydroxy phenols	23	17	18	23	12	26	1x5, 1x10, 2x4, 2x5, 2x6, 2x8, 2x9, 2x10, 3x4, 3x5, 3x6, 3x8, 4x7, 3x9, 5x9, 6x7, 7x8 (Over TP)
20.	Total sugars(%)	1	35	9	29	16	23	4x6, 4x9, 5x6, 5x7, 5x8, 5x9, 6x7, 6x9, 7x9 (Over BP)
21.	Reducing sugars(%)	15	28	19	21	23	15	5x6, 5x7, 5x8, 5x9, 5x10, 6x7, 6x8, 6x9, 6x10, 7x8, 7x9, 7x10, 8x9, 8x10, 9x10 (Over TP)
22.	Crude protein(%)	1	42	4	28	8	24	2x4, 2x5, 2x6, 3x4 (Over BP)

of fruit exhibited low frequency of heterotic hybrids and low magnitude of heterosis over mid parent. This indicates that these characters contributed least for increase in fruit yield in hybrids. The fruit quality related parameters like fruit density, total phenols, total sugars and crude protein content in fruit and seed weight per fruit exhibited higher frequencies of heterotic hybrids and high magnitude of heterosis towards undesired direction. It suggests that desirable level of these quality components with increase in yield in hybrids may be possible with specific cross combinations in breeding programme.

From the practical point of view, it would be worthwhile to compare the performance of hybrids with the best available variety in assessing the practical utilization of heterotic crosses. It is clear from Table 35 that 15 hybrids exhibited high magnitude of heterosis in fruit yield which showed significant heterosis over best parent, better parent and mid parent value. The potential crosses 1 x 8, 1 x 10, 3 x 6, 5 x 7, 6 x 8 and 5 x 6 exhibited significant heterosis over top parent for both fruit yield and days to flower. Five hybrids namely, 1 x 8, 3 x 6, 3 x 9, 4 x 9 and 6 x 8 showed significant heterosis over better parent for number of fruits along with fruit yield. The hybrids 1 x 7, 1 x 8, 2 x 3, 3 x 10, 4 x 9, 4 x 10, 6 x 8 and 6 x 10, and hybrids 1 x 8, 1 x 10, 2 x 3, 4 x 10, 5 x 6 and 5 x 7 exhibited high heterosis for plant height and spread, respectively along with fruit yield per plant over better parent. The hybrids 1 x 7 and 2 x 9 showed high heterosis for fruit weight and fruit yield over top parent. The hybrids 1 x 7 and 5 x 7 showed high heterosis for fruit length and fruit yield over better parent. The hybrids 2 x 9, 3 x 6 and 3 x 9 showed high heterosis for fruit girth and fruit yield over better parent. Five crosses namely, 3 x 9, 4 x 10, 5 x 6, 5 x 7 and 6 x 8 showed significant heterosis over top parent in desired direction for keeping quality index and fruit yield. Eight crosses namely, 1 x 7, 1 x 8, 3 x 6, 3 x 10, 5 x 6, 5 x 7, 5 x 10 and 6 x 8 had significant heterosis over better parent for rind thickness along with fruit yield. A cross 5 x 7 showed significant heterosis over better parent for dry matter along with fruit yield. The hybrids 3 x 9, and 3 x 10 had desired total phenols along with fruit yield over best parent. The crosses 6 x 10, 2 x 9, 3 x 6 and 3 x 9 exhibited significant heterosis over best parent in desired direction for ortho-dihydroxy phenols along with fruit yield. The crosses 4 x 9, 5 x 6 and 5 x 7 exhibited significant heterosis for total sugar and fruit yield over better parent. The hybrids 5 x 6, 5 x 7, 5 x 10, 6 x 8 and 6 x 10 exhibited significant heterosis over top parent for reducing sugars along with fruit yield. The hybrids 2 x 4 and 3 x 4 showed significant heterosis over better parents for crude protein and fruit yield.

The potential hybrids which exhibited significant heterosis for fruit yield along with different fruit quality parameters, could be exploited on commercial scale depending upon the regional priorities for different fruit qualities. Besides, these can be used in multiple crosses for simultaneous improvement of yield along with other fruit quality parameters through recombination breeding programme.

The results obtained in studies on heterosis, combining ability, predictability ratio, gca effects of parents and sca effects of crosses are all considered together to draw ultimate conclusions regarding the genetics of each of the yield components and fruit quality parameters. The confirmity or otherwise of the present results with those obtained by earlier workers has been examined. It has been shown that dominance is a component of breeding value (Herbert and Gallais, 1986). Variance of breeding value (additive genetic variance) does not always represent additive gene action. The GCA variance may also contain the dominance variance (Matzinger, 1963 and Singh and Paroda, 1984). Nevertheless, it has been the practice to use these variance components to infer the nature of gene action.

5.2.4.1 <u>Days to flower</u>

Heterosis over mid parent was highly significant in 42 out of 45 crosses (Table 10). Both GCA and SCA variances were highly significant but predictability ratio was less than unity (0.66) (Table 32). These facts clearly emphasise the predominance of non-additive gene action over additive in the inheritance of this character. Similar findings were earlier reported by Silvetti and Bruneli (1970), Peter and Singh (1974), Singh et al. (1979), and Singh and Mittal (1988).

Among the parents, Gara Local (3), Surya (5), Taiwan Naga (5) and Pusa Bhairav (10) were observed to be the good general combiners as revealed by highly significant negative gca effects by these parents (Table 33). Further, 33 crosses exhibited significant negative (22) and positive (11) sca effects indicating predominance of non-additive gene action for this character (Table 34).

Twentytwo crosses exhibited significant heterosis in desired direction over best parent, which were attributed due to significant sca effects in majority of these crosses suggesting the role of non-additive gene action in these crosses. The potential crosses were 1 x 8, 1 x 10, 3 x 6, 5 x 7, 6 x 8 and 5 x 6 in which one parent was with high gca effect and another parent was with low gca effect further suggesting the predominance of non-additive gene action over additive in these crosses.

Several workers have reported significant heterosis for early flowering, few among them are Dharmegowda et al. (1979b), Kohinkar (1980), Choudhary and Mishra (1988).

5.2.4.2 Fruit yield per plant

Heterosis over mid parent was significant in 26 crosses out of 45 (Table 11). Both GCA and SCA variances were highly significant but predictability ratio was less than unity (0.70) (Table 32). It suggests the importance of both additive and non-additive gene actions in the inheritance of this character. Similar results were reported earlier by many workers for this character, few among them are Joarder et al. (1981), Singh (1984), Kumar and Ram (1987), Singh and Mital (1988) and Singh and Gautam (1991).

Parents Gokak Local (6) and Pusa Bhairav (10) were the good general combiner for this character as exhibited by significant gca effects. Thirty crosses exhibited significant sca effects suggesting importance of non-additive gene action.

The potential crosses 1 x 7, 1 x 8, 1 x 10, 2 x 3, 2 x 9, 3 x 6, 3 x 9, 3 x 10, 4 x 9, 4 x 10, 5 x 6, 5 x 7, 5 x 10, 6 x 8 and 6 x 10 exhibited significant heterosis over best parent. The significant sca effects were recorded among these 13 hybrids. It can be inferred that in all these hybrids, non-additive gene effect were important, while two hybrids 1 x 10 and 3 x 10, additive gene action was predominant as revealed by non-significant sca effect.

Since 1930, innumerable reports have been made on significant heterosis for yield. Few among them are Patil and

Shinde (1984), Sidhu and Jadha (1985), Dixit and Gautam (1987) and Chadha *et al.* (1990b).

5.2.4.3 Number of fruits per plant

Twentyeight crosses exhibited significant positive (20) and negative (8) heterosis over mid parent (Table 12). Both GCA and SCA variances were highly significant and predi-ctability ratio was near to unity (0.96) (Table 32). All these facts reveal that both additive and non-additive gene action were important for this character. The results are in line with that of Dixit *et al.* (1984) and Kumar and Ram (1989).

The parents Pusa Bhairav (10), Gokak Local (6), Surya (5) and Gare Local (3) were observed to be the good general combiner as revealed by significant gca effect for this character (Table 33). Twentyeight crosses exhibited significant positive (16) and negative (12) sca effects suggesting the role of non-additive gene action (Table 34).

Seven crosses namely 1 x 8, 2 x 4, 3 x 6, 3 x 9, 4 x 9, 6 x 8 and 8 x 9 exhibited significant heterosis over better parent. In all these crosses sca effect were signi-ficant. It further infers that non-additive gene action was predominant in all these crosses. Since 1933 innumerable reports have been made on significant heterosis for number of fruits per plant. Few among them are Balmohan *et al.* (1983); Chadha and Sidhu (1982), Patil and Shinde (1984), Sidhu and

Chadha (1985), Dixit and Gautam (1987) and Chadha et al. (1990b).

5.2.4.4 Plant height

Thirtyone crosses indicated significant positive (26) and negative (5) heterosis over mid parent (Table 13). Both GCA and SCA variances were highly significant and predictability ratio was near to unity (0.90) (Table 32). All these facts reveal that non-additive gene action was more predominant over additive for this character. Similar results have been earlier reported by Singh et al. (1979), Chadha and Hegde (1987), Singh and Mital (1988) and Sawant et al. (1991).

Parents, White Madhapuri (1), Surya (5), Gokak Local (6), Malapur Local (7) and Taiwan Naga (8) observed to be the good combiner for this character which had showed significant positive gca effects (Table 33). Twentyseven crosses exhibited significant positive (16) and negative(11) sca effect indicating the role of non-additive gene actions for this character.

Seventeen crosses exhibited significant heterosis over better parent. Among these, 10 crosses showed significant sca effect indicating the role of non-additive gene action in these crosses, while in seven crosses, sca effects were non-significant indicating the importance of additive gene action in these crosses. The potential crosses exhibiting non-additive effects were 1 x 7, 1 x 8, 2 x 3, 3 x 10, 4 x 9, 4 x 10, while crosses 6 x 8 and 6 x 10 showed the additive gene action for this character.

Since 1931, many workers have reported significant heterosis for plant height. Few among them are Chadha and Sidhu (1982), Balmohan et al. (1983), Sidhu and Chadha (1985), Singh and Kumar (1988), Chadha et al. (1990b) and Shankaraiah and Rao (1990).

5.2.4.5 Plant spread

Twentyfour crosses exhibited significant positive (23) and negative (1) heterosis over mid parent (Table 14). Both GCA and SCA variances were highly significant and predictability ratio was near to unity (Table 32). All these facts reveals that non-additive gene was predominant over additive gene action for this character. Similar findings were reported earlier by Srivastava and Bajpai (1977), Sinde and Patil (1984), Patil and Shinde (1985) and Sawant et al. (1991).

Parents Surya (5), Malapur Local (7), Taiwan Naga (8), and Pusa Kranti (9) observed to be the good general combiner as revealed by significant positive gca effects by these parents (Table 33). Twentyone crosses exhibited significant sca effect for this character indicating the role of non-additive gene action (Table 34).

Twelve crosses showed significant heterosis over better parent. Among these eight crosses exhibited significant sca effects indicating non-additive gene action in these crosses, while four crosses indicated non-significant sca effect indicating additive gene action in these crosses. The potential crosses indicating additive gene action for this character were 1 x 8 and 5 x 7, while the crosses 1 x 10, 2 x 3, 4 x 10 and 5 x 6 indicated the non-additive gene action for this character.

The significant heterosis was reported by Choudhary and Mishra (1988) and Shankaraiah and Rao (1990) for this character.

5.2.4.5 Number of branches (Primary and secondary)

Six crosses out of 45 exhibited significant positive (3) and negative (3) heterosis over mid parent for primary branches, while nine crosses showed significant heterosis over mid parent for secondary branches (Tables 15 and 16). The GCA and SCA variances were highly significant and predictability ratio was near to unity for both these characters (Table 32). All these facts reveal predominance of additive gene action over non-additive for these characters. Similar results were earlier reported by Patil and Shinde (1985) and Singh and Kumar (1988) for number of branches which confirms the above findings.

Parent White Madhapuri (1) was observed to be the good combiner for primary and secondary branches, while Malapur Local (7) was good combiner for secondary branches as revealed by significant gca effect (Table 33). Eight crosses exhibited significant positive (4) and negative (4) sca effects for primary branches, while 14 crosses exhibited significant positive (8) and negative (6) sca effects for secondary branches indicating the role of non-additive gene action (Table 34) in these crosses.

The potential crosses 1 x 8 and 1 x 10 exhibited significant heterosis over mid parent and significant sca effects indicating role of non-additive gene action in these crosses for primary branches, while crosses 1 x 6 and 5 x 8 showed significant heterosis over better parent and significant sca effect indicating non-additive gene action for secondary branches in these crosses.

The significant heterosis for number of branches have been reported by many workers. Few among them are Sidhu and Chadha (1985), Choudhary and Mishra (1988), Singh and Kumar (1988), Shankaraiah and Rao (1990) and Chadha et al. (1990b).

5.2.4.7 Stem girth

Only one cross (3 x 8) exhibited significant negative heterosis over mid parent (Table 17). Only GCA variance was highly significant and predictability ratio was near to unity (Table 32) indicating the additive gene action in the inheritance of this character.

Parents Malepur Local (7) and Pusa Kranti (9) were observed to be the good combiner for this character as revealed by significant gca effects (Table 33). Three crosses exhibited significant sca effects (Table 3). In cross 3 x 8, sca effect was significant and exhibited heterosis in negative direction indicating non-additive gene action in this cross. There was no earlier reports either to contradict or confirm these findings. Therefore, these findings are claimed as first report for this character.

5.2.4.8 <u>Fruit characters (Weight, length and girth of fruit)</u>

Out of 45 crosses, significant heterosis over mid parent exhibited in 29, 34 and 24 crosses for fruit weight, fruit length and fruit girth, respectively (Tables 18, 19 and 20). The GCA and SCA variances were highly significant and predictability ratio was near to unity for all these characters (Table 32). All these facts clearly indicates that these characters are governed by both additive and non-additive gene actions. These results are in line with Dahiya *et al.* (1985). Dixit *et al.* (1984) and Patil and Shinde (1985) reported predominance of additive gene action for all these characters, while predominance of non-additive gene action was reported by Sidhu *et al.* (1980) for fruit length and Sinde and Patil (1984) for fruit weight.

The good general combiner was Malapur Local (7), Pusa Kranti (9) and Surya (5) for fruit weight, Taiwan Naga (8), Gokak Local (6) and Pusa Kranti (9) for fruit length and Malapur Local (7), SM 135 (4), Higna Dorla (2) and White Madhapuri (1) for fruit girth as indicated by their significant positive gca effects for above characters (Table 33).

Out of 45 crosses, 29, 29 and 23 crosses exhibited significant sca effects for fruit weight, fruit length and fruit girth, respectively indicating non-additive gene action for these fruit traits (Table 34).

The significant heterosis over better parent recorded in 10, 5 and 6 crosses for fruit weight, fruit length and fruit girth, respectively which was accompanied with significant sca effects in all these crosses indicating the role of non-additive gene action except in 3 x 8 and 5 x 8 for fruit weight, and 1 x 3 cross for fruit girth. The potential crosses among these, indicating non-additive gene action were 1 x 7, 2 x 9, 3 x 9 and 5 x 6 for fruit weight, 1 x 7 and 5 x 7 for fruit length and 2 x 9, 3 x 6 and 3 x 9 for fruit girth.

The significant heterosis has been reported by many workers for these characters. Few among them are Chadha et al. (1990b) for fruit weight, Sidhu and Chadha (1985) for fruit length and Dixit and Gautam (1987) for fruit girth which confirms the above findings.

5.2.4.9 Fruit Quality parameters

A very little work has been reported on fruit quality parameters in brinjal. Therefore, efforts were made to study the heterosis and gene action of important fruit quality components like stalk length, fruit density, keeping quality, index, rind thickness, seed weight per fruit, dry matter, total phenol, orthodihydroxy phenols, total sugar, reducing sugars and crude protein content in fruit.

The desired fruit quality is associated with low values for stalk length, keeping quality index, seed weight per fruit, total phenols and orthodihydroxy phenols. Chadha et al. (1980a) reported that phenols and orthodihydroxy phenols were the contributing factors for bitterness and discolouration of fruit. Total phenols were chiefly responsible for discolouration. Among these, orthodihydroxy phenols were the critical.

Higher values of remaining fruit quality parameters like fruit density, rind thickness, dry matter, total sugar, reducing sugars and crude protein content in fruit were desirable for improved fruit quality in brinjal. The fruit density and dry matter content are associated with cooking quality of the fruit. Rind thickness determines fleshyness of fruit. Sweetness is determined by total sugars and reducing sugars, while crude protein content is associated with nutritive value of the fruit. The proteins of brinjal fruit have high biological value (71%) and digestibility coefficient (75%).

5.2.4.9.1 <u>Stalk length of the fruit</u>

Out of 45 crosses, only four crosses exhibited significant negative (1) and positive (3) heterosis over mid parent (Table 21). The GCA and SCA variances were highly significant and predictability ratio was near to unity (Table 32). All these facts imply the importance of additive gene action in the inheritance of this character.

Parents Higna Dorla (2), Gare Local (3), Surya (5) and Pusa Bhairav were the good general combiner for this character as indicated by significant negative gca effects (Table 33). Only five crosses recorded the significant negative (1) and positive (4) sca effect indicating role of non-additive gene action in these crosses (Table 34). A cross 1 x 2 exhibited significant desired heterosis over mid, better and best parents and recorded significant sca effect indicating non-additive gene action for this character in the above cross. There were no earlier reports regarding heterosis and gene action. Therefore, the present findings are claimed to be the first report for this character.

5.2.4.9.2 Fruit density

Total 31 crosses exhibited significant negative (28) and positive (3) heterosis over mid parent (Table 22). The GCA and SCA variances were highly significant and predistability ratio was near to unity (Table 32). All these facts suggest that both additive and non-additive gene action were important in the inheritance of this character. Similar results were earlier recorded by Dharmegowda et al. (1979a).

Parents White Madhapuri (1), Higna Dorla (2) and Gare local (3) were the good combiner for this character as indicated by significant positive gca effect (Table 33). Nineteen crosses recorded the significant positive (7) and negative (12) sca effects indicating the role of non-additive gene action in these crosses (Table 34). Three crosses namely, 1 x 5, 1 x 6 and 2 x 7 exhibited desired heterosis over mid parent and sca effects were also significant in these crosses indicating non-additive gene action in these crosses for this character. Similar finding was earlier recorded by Dharmegowda et al. (1979b) for heterosis in this character.

5.2.4.9.3 Keeping quality index

Twentythree crosses recorded significant positive (4) and negative (19) heterosis over mid parent (Table 23). The GCA and SCA variances were highly significant but predistability ratio was less than unity (0.48) (Table 32).

All these facts suggest predominance of non-additive gene action over additive gene action for this character. Similar findings were earlier reported by Salimath (1979) which confirm the present results.

Parents Gokak local (6), Pusa Kranti (9) and Pusa Bhairav (10) were the good general combiners for this character, which showed significant negative gca effect (Table 33). Nineteen crosses showed significant positive (11) and negative (8) sca effect indicating the role of non-additive gene action in these crosses (Table 34). The crosses namely, 3 x 9, 4 x 10, 5 x 6, 5 x 7, 6 x 8 and 6 x 9 exhibited significant heterosis over best parent in desired direction and also recorded significant sca effect indicating non-additive gene action in these crosses for this character.

Salimath (1979) reported the significant heterosis over mid and better parent for keeping quality which confirms the above finding.

5.2.4.9.4 <u>Rind thickness of fruit</u>

Thirtyfive crosses recorded significant positive (33) and negative (2) heterosis over mid parent (Table 24). The GCA and SCA variances were highly significant but predictability ratio was less than unity (0.64) (Table 32). All these facts clearly emphasised the predominance of non-additive gene action over additive in the inheritance of this character.

Parents SM 135 (4), Gokak local (6) and Pusa Kranti (9) were good general combiners for this character which recorded significant gca effect for this character (Table 33). Twentythree crosses showed significant positive (15) and negative (8) sca effect indicating the role of non-additive gene action in these crosses for this character (Table 34).

Twentyone crosses exhibited significant heterosis over better parent. Among these, 13 crosses recorded significant sca effect indicating non-additive gene action in these crosses, while in eight crosses, sca effect was non-significant indicating additive gene action for this character. The potential crosses 1 x 8, 3 x 10 and 5 x 7 indicated additive gene action, while crosses 1 x 7, 3 x 6, 5 x 6, 5 x 10 and 6 x 10 showed non-additive gene action for this character.

There was no earlier reports on such studies for this character. Therefore, the present findings are claimed to be the first report.

3.2.4.9.5 Seed weight per fruit

Twentyseven crosses exhibited significant positive (22) and negative (5) heterosis over mid parent (Table 25). The GCA and SCA variances were highly significant and predictability ratio was near to unity (Table 22). It reveals the predominance of non-additive gene action over additive in the inheritance of this character. Present results are in line with Dharmagowda (1979a).

The parents Gare Local (3), Surya (5), Gokak Local (6), Taiwan Naga (8), Pusa Kranti (9) and Pusa Bhairav (10) were the good general combiners for this character, which showed highly significant negative gca effect (Table 33). Twentyeight crosses recorded significant positive (12) and negative (16) sca effect indicating the role of non-additive gene action in these crosses (Table 34).

Five crosses namely, 1 x 2, 2 x 6, 3 x 4, 6 x 9 and 8 x 9 showed significant heterosis over mid parent in desired direction and also recorded significant sca effect indicating non-additive gene action for this character in these crosses.

The significant heterosis was reported by Silvetti and Brunelli (1970), Popova et al. (1976), Dharmagowda et al. (1979b), Salimath (1979) and Shankaraiah and Rao (1990) for this character which confirms the present findings.

5.2.4.9.6 Dry matter content in fruit

Twentythree crosses exhibited significant positive (15) and negative (8) heterosis over mid parent (Table 26). The GCA and SCA variances were highly significant and predictability ratio was near to unity (0.80) (Table 32). It revealed preponderance of non-additive gene action over additive gene action for this character. Present findings are in line with Verma (1991).

Parents White Madhapuri (1), SM 135 (4) and Surya (5) were the good general combiner for this character which showed significant gca effect (Table 33). Twentynine crosses showed significant positive (15) and negative (14) sca effect indicating the role of non-additive gene action in these crosses (Table 34).

The crosses 2 x 4, 2 x 5, 2 x 6, 2 x 7, 3 x 4, 3 x 8, 4 x 5, 5 x 7 and 7 x 8 exhibited significant heterosis over better parent and significant sca effect indicating preponderance of non-additive gene action for this character in all these crosses. Among these, 2 x 4, 2 x 5, 2 x 6, 3 x 9 and 5 x 7 are the potential crosses.

The heterosis for dry matter in fruits was reported earlier by Mishra (1966) and Dahiya et al. (1984) which confirms the present finding.

5.2.4.9.7 Total phenol content in fruit

Forty crosses out of 45 recorded significant positive (24) and negative (16) heterosis over mid parent (Table 27). The GCA and SCA variances were highly significant and predictability ratio was near to unity (0.81) (Table 32). It suggests the importance of non-additive gene action over additive for this character. Chadha et al (1990a) reported the importance of both additive and non-additive gene action in the inheritance of this character in two crosses six generation mean analysis.

Parents White Madhapuri (1), Higna Dorla (2), Gaza Local (3), SM 135 (4) and Surya (5) were good general combiner in desired direction which indicated significant negative gca effect for this character (Table 33). A record number of 40 crosses exhibited significant positive (21) and negative (19) sca effect indicating the role of non-additive gene action for this character. The potential cross 2 x 4, 3 x 9, 3 x 10 and 4 x 7 exhibited significant heterosis over best parent in desired direction and also significant sca effect. It revealed that non-additive gene action was more predominant in all these crosses.

There was no report on heterosis for this character. The present findings are therefore, claimed to be the first report for heterosis in total phenols content in fruit.

5.2.4.9.8 Orthodihydroxy phenol content in fruit

Thirtyeight crosses indicated significant negative (26) and positive (12) heterosis over mid parent (Table 28). The GCA and SCA variances were highly significant and predictability ratio was less than unity (0.77) (Table 32). These facts clearly suggest the predominance of non-additive gene action over additive gene action in the inheritance of this character. Chadha et al. (1990a) reported the importance of additive and non-additive gene action in two crosses six gene action mean analysis for this character.

Parents Higna Dorla (2), Gaze Local (3), SM 135 (4) and Surya (5) were the good general combiner for this character as indicated by significant negative gca effect (Table 33). Fortyone crosses exhibited significant negative (21) and positive (20) sca effect indicating further the predominance of non-additive gene action (Table 34).

Seventeen crosses showed significant heterosis over the best parent in desired direction. Further, significant sca effect in all these crosses suggests non-additive gene action in these crosses for this character. Among these, the potential crosses were 1 x 10, 2 x 4, 2 x 9, 3 x 4, 3 x 6 and 3 x 9.

There was no earlier reports on heterosis for this character. Therefore, the heterosis for orthodihydroxy phenol content in fruit are claimed to be the first report.

5.2.4.9.9 Total sugar content in fruits

Thirtynine crosses exhibited significant positive (16) and negative (23) heterosis over mid parent (Table 29). The variances due to GCA and SCA were highly significant and Predictability ratio was near to unity (Table 32). All these facts clearly indicate the preponderance of non-additive gene action over additive gene action for this character. There were no earlier reports on the inheritance of this character. Therefore, present findings are claimed to be the first report for this character.

Parents Surya (5), Gokak Local (6), Malapur Local (7), Taiwan Naga (8), Pusa Kranti (9) and Pusa Bhairav (10) were the good general combiners for this character, which indicated significant positive gca effect (Table 33). Thirty-one crosses showed significant positive (16) and negative (15) sca effects indicating non-additive gene action in majority of crosses (Table 34).

Nine crosses exhibited significant heterosis over better parent. In all these crosses, the non-additive gene action was predominant as indicated by significant sca effect. Among these, the potential crosses were 4 x 9, 5 x 6 and 5 x 7. Duhiya *et al.* (1984) reported the heterosis for this character. These reports confirm the above finding .

5.2.4.9.10 Reducing sugar content in fruit

Thirtyeight crosses exhibited significant positive (23) and negative (15) heterosis over mid parent (Table 30). The variances due to GCA and SCA were highly significant and predictability ratio was near to unity (Table 32). All these facts suggest predominance of non-additive gene action over additive for this character. There was no earlier reports regarding gene action of this character.

Parents Surya (5), Gokak Local (6), Malapur Local (7), Taiwan Naga (8), Pusa Kranti (9) and Pusa Bhairav (10) were the good general combiners for this character as revealed by their significant gca effect (Table 33). Thirty-six crosses exhibited significant positive (28) and negative (15) sca effects indicating further importance of non-additive gene action in majority of the crosses.

Fifteen crosses exhibited the significant heterosis over best parent. Among these, non-additive gene action was predominant in 13 crosses as indicated by significant sca effect in these crosses. However, in two crosses 5 x 6 and 8 x 9, the additive gene action was predominant as revealed by non-significant sca effect in these crosses. Other potential crosses with non-additive gene action for this character were 5 x 7, 5 x 10, 6 x 8 and 6 x 10.

There was no earlier report on heterosis for this character. Therefore, both heterosis and predominance of non-additive gene action observed in present finding are the first report.

5.2.4.9.11 Crude protein content in fruit

Thirtytwo crosses exhibited significant positive (8) and negative (24) heterosis over mid parent (Table 31).

The variances due to GCA and SCA were highly significant and predictability ratio was near to unity (Table 32). These facts suggest predominance of non-additive gene action over additive for this character. Verma (1991) reported highly significant GCA and SCA variances for this character on similar line.

Parents Higna Dorla (2), Gara Local (3) and SM 135 (4) were the good general combiners for this character as revealed by significant gca effect (Table 33). Thirtytwo crosses exhibited significant positive (11) and negative (21) sca effect indicating further predominance of non-additive gene action in majority of these crosses (Table 34).

The potential crosses 2 x 4, 2 x 5, 2 x 6 and 3 x 4 showed significant heterosis over better parent, in which, the non-additive gene action was predominant as indicated by significant sca effects in these crosses.

There was no earlier report on heterosis for this character. Therefore, the heterosis for protein content in fruits is claimed to be the first report.

5.2.5 Overall combining ability of parents and hybrids and heterosis and per se performance of hybrid

It was observed that heterosis and combining ability effects were in desirable direction for some characters and in undesirable direction for others. Such observations are sense as component characters are correlated positively or negatively among themselves (Arunachalam and Bandyopadhyay, 1979). Hence, an attempt was made to ascertain the overall status of parents or crosses with respect to gca, sca and heterosis for fruit yield, other yield components and fruit quality related parameters. Method outlined by Arunachalam and Bandyopadhyay (1979) for computation of overall status of gca and sca and Arunachalam et al. (1984) for computation of overall better parent heterosis were followed as given in para 3.2.5.7 and 3.2.5.8, respectively.

5.2.5.1 Combining ability of parents and hybrids

Information on overall status of parents involved in diallel experiment for gca effects in respect of twenty-two quantitative characters is presented in Table 36.

The superiority of parents, when judged by their gca effects in desirable direction across 22 characters revealed that Surya (5), Pusa Kranti (9), Gokak Local (6) and Pusa Bhairav (10) were good general combiners for most yield attributes and fruit quality related parameters in order of magnitude. Dahiya et al. (1985) and Mishra and Mishra (1990b) reported Pusa Kranti as good combiner for most characters under their studies in support of above findings. The highest combiner, Surya though was not good combiner for fruit yield but it was good combiner for major yield components like days to flower, number of fruits, plant

Table 36. The score for gca status of parents for 22 characters in brinjal

Sl. no.	Parents / characters	White Madhapuri	Higna dorla	Gare local	SM 135	Surya	Gokak local	Malapur local	Taiwan naga	Pusa kranti	Pusa bhairav
1.	Days to flower	-1	-1	+1	0	+1	-1	-1	+1	0	+1
2.	Fruit yield	-1	-1	0	-1	0	+1	-1	0	0	+1
3.	No.of fruits	-1	-1	+1	-1	+1	+1	-1	-1	-1	+1
4.	Plant height	+1	-1	-1	0	+1	+1	+1	+1	0	0
5.	Plant spread	0	-1	-1	-1	+1	0	+1	+1	+1	-1
6.	Primary branches	+1	0	0	0	0	0	0	-1	0	-1
7.	Secondary branches	+1	0	-1	0	0	0	+1	-1	0	-1
8.	Stem girth	0	-1	-1	0	0	0	+1	0	+1	0
9.	Fruit weight	-1	-1	-1	+1	-1	0	+1	0	+1	-1
10.	Fruit length	-1	-1	-1	-1	-1	+1	+1	+1	+1	+1
11.	Fruit girth	+1	+1	0	+1	-1	0	+1	-1	0	-1
12.	Stalk length of fruit	0	+1	+1	0	+1	-1	-1	-1	0	+1
13.	Fruit density	+1	+1	+1	0	0	0	-1	-1	-1	-1
14.	Keeping quality index	-1	-1	0	0	0	+1	-1	0	+1	+1
15.	Rind thickness	-1	-1	0	+1	0	+1	0	-1	+1	-1
16.	Seed weight per fruit	-1	-1	+1	-1	+1	+1	-1	+1	+1	+1
17.	Dry matter(%)	+1	-1	0	+1	0	-1	-1	-1	-1	+1
18.	Total phenols (%)	+1	+1	+1	+1	+1	-1	-1	-1	-1	-1
19.	Orthodihydroxy-phenols(%)	-1	+1	+1	+1	+1	-1	-1	-1	-1	-1
20.	Total sugars(%)	-1	-1	-1	-1	+1	+1	+1	+1	+1	+1
21.	Reducing sugars(%)	-1	-1	-1	-1	+1	+1	+1	+1	+1	+1
22.	Crude protein(%)	-1	+1	+1	+1	-1	-1	0	-1	0	0
	Overall status	-5	-8	0	0	+6	+3	-1	-4	+4	+1

Mean status - 0.64

height and plant spread and maximum quality related components except crude protein. The second highest combiner, Pusa Kranti was good general combiner for major yield components like plant spread, stem girth, fruit weight and fruit length and quality components like keeping quality index of fruit, rind thickness, seed weight per fruit, total sugars and reducing sugar. The remaining high combiner, Gokak Local and Pusa Bhairav were only good combiners for fruit yield and other major yield components like number of fruit and fruit length and fruit quality components like keeping quality index, seed weight per fruit, total sugars and reducing sugar.

Among the poor combiners Gare Local (3) was good general combiner for maximum fruit quality components except sugars while Malapur Local (7) was good combiner for more number of yield components.

In general, the gca effects of overall 22 characters revealed that none of the parents was good combiner for all the characters. These results are in line with that of Sinde and Patil (1984).

Similarly, overall status of hybrids were worked out for sca effects in respect of 22 characters and pooled score across these characters is presented in Table 37 along with pooled gca effects score of parents. The crosses exhibited total score above mean score are categorised as high specific cross combination (H) and the remaining crosses are as low specific cross combinations (L). Likewise parents were also classified into high and low combiners based on their total gca effect score.

Accordingly, 20 hybrids categorised into high sca effects and remaining 25 hybrids as low sca effects. It is interesting to note that the top yielding three hybrids namely, 6 x 10, 5 x 6 and 3 x 9 recorded high sca effect (scores 6, 7 and 5, respectively). The top yielding hybrid 6 x 10 exhibited desired sca effects for fruit yield, number of fruits, plant spread, fruit girth, orthohydroxy phenols, total sugars, reducing sugars and crude protein content in fruit (Table 42). The hybrid 5 x 6 showed desired sca effects for fruit yield, plant height, plant spread, secondary branches, fruit weight, fruit length, keeping quality index, rind thickness and total sugars. Similarly, the highest yielding hybrid 3 x 9 exhibited desired sca effect for fruit yield, fruit number, plant height, weight, length and girth of fruit, keeping quality index, total phenols, orthodihydroxy phenols and crude protein. Remaining 17 hybrids with high sca effects exhibited similar desired sca effects for major yield attributes and fruit quality related parameters.

5.2.5.2 Heterosis and *per se* performance of hybrids

The overall heterosis over better parent and

Table 37. Overall gca status of parents and sca status of crosses across 22 traits in brinjal

Overall status	Overall score	Parents	Crosses
High	7	-	5 x6, 5 x 7, 6 x 8
	6	Surya	6 x 10
	5	-	3 x 9, 4 x 9, 5 x 9, 7 x 8
	4	Pusa kranti	2 x 8, 2x 9, 3 x 6
	3	Gokak local	3 x 5
	2	-	1 x 5, 2 x 4, 5 x 8
	1	Pusa bhairav	2 x 10, 5 x 10, 6 x 7, 6 x 9, 9 x 10
	0.81	Mean score	
Low	0	Garo local	1 x 6, 1 x 8, 2 x 5, 3 x 7
		SM 135	7 x 9, 8 x 10
	-1	Malapur(L)	1 x 7, 3 x 4, 4 x 7, 4 x 10, 1 x 3, 1 x 4, 1 x 9, 1 x 10, 2 x 6, 3 x 8, 4 x 8
	-3	-	2 x 7, 3 x 10
	-4	Taiwan naga	2 x 3, 4 x 5
	-5	White Madhapuri	1 x 2, 4 x 6
	-6	-	8 x 9
	- 7	-	7 x 10
	-8	Higna dorla	-

per se performance in comparison with best parent were worked out across 22 characters and presented in Tables 38 and 39, respectively.

Twenty-three hybrids exhibited overall high heterotic status over better parent, while remaining 22 hybrids showed low overall heterotic status. It is clear from Tables 37 and 38, that high sca contributed towards high heterosis in 15 out of 20 hybrids, that is, nearly 75 per cent. This indicates that major sca effects can be accounted in terms of heterosis in hybrids. On similar line, Singh and Kalda (1989) observed higher sca effect in the characters pointed towards the potential of hybrid vigour in brinjal.

High heterotic or high sca status has little application unless it is accompanied by high *per se* performance. A high and low status in respect of *per se* performance over all traits would be more meaningful if it is in comparison with the level of performance of best available variety rather than mean of the traits. Hence, the method adopted was based on the level of performance of hybrids for each character in comparison with the performance of best variety among the parents.

It is clear from Table 39 that 11 hybrids exhibited higher overall *per se* performance in comparison with

Table 38. Overall heterotic status of crosses based on the score over 22 characters in brinjal.

Overall status	Overall score	Crosses
High	10	6 x9
	9	5 x 6, 5 x 7
	8	2 x 4, 3 x 9
	7	1 x 5, 3 x 5, 3 x 8, 5 x 8, 6 x 8, 7 x 8
	6	1 x 7, 1 x 8, 2 x 8, 2 x 9, 3 x 4, 3 x 6, 4 x 9
	5	2 x 5, 3 x 10, 4 x 7, 4 x 10, 6 x 7
	4.98	Mean score
Low	4	1 x 6, 1 x 10, 2 x 3, 2 x 6, 2 x 10, 4 x 6, 4 x 8, 5 x 9, 5 x 10, 6 x 10, 7 x 9, 8 x 10
	3	1 x 3, 2 x 7, 8 x 9, 9 x 10
	2	1 x 2, 1 x 9, 3 x 7, 4 x 5, 7 x 10
	1	1 x 4

Table 39. Overall per se performance status across 22 traits as compared to best variety (TP).

Over all status	Overall score	Crosses
High	5	5 x 7
	4	3 x 9, 5 x 6, 6 x 8
	3	1 x 10, 2 x 9, 3 x 4, 3 x 6, 5 x 9, 6 x 7, 7 x 8
	2.18	Mean score
Low	2	1 x7, 1 x 8, 2 x 4, 2 x 5, 2 x 8, 2 x 10, 3 x 5, 3 x 8, 3 x 10, 4 x 7, 4 x 10, 5 x 8, 5 x 10, 6 x 9, 6 x 10, 7 x 9, 8 x 9, 8 x 10, 9 x 10
	1	1 x 5, 1 x 6, 2 x 3, 2 x 6, 3 x 7, 4 x 5, 4 x 8, 4 x 9, 7 x 10
	0	1 x 2, 1 x 3, 1 x 4, 1 x 9, 2 x 7, 4 x 6

best parent. Out of these, eight hybrids (72%) recorded both high sca and high heterosis over better parent. This indicates that high *per se* performance may be attributed with high overall sca along with heterotic status. These findings are in line with Patil and Shinde (1984). Among the remaining three high performing hybrids, the hybrid 3 x 4 had high heterotic status and low sca status, while reverse was the trend in hybrid 5 x 9. The hybrid 1 x 10 exhibited low status for both heterosis and sca.

However, for extracting high yielding pure lines from the heterotic hybrid, it is important that such hybrids should have high *per se* performance for fruit yield compared to cultivated variety of the region. Among the 11 hybrids showing high status of overall *per se* performance, seven hybrids namely, 1 x 10, 2 x 9, 3 x 6, 3 x 9, 5 x 6, 5 x 7 and 6 x 8 displayed significantly superior yield over best variety Gokak Local or Pusa Bhairav. Thus, it would be profitable to exploit these seven hybrids for isolation of high yielding and high fruit quality pure lines in breeding programme.

The overall high status of *per se* performance, and involvement of both the parent with high overall gca status in cross 5 x 6 and 5 x 9 imply that predominantly additive and additive x additive interactions were responsible for the improvement in most of traits in these hybrids.

However, high overall sca status indicated that substantial role was also played by dominance and other epistatic inter-action for most of traits. These hybrids have recorded high performance for fruit quality characters as well as yield and yield attributes. Such crosses have the potential to throw desirable transgressants in the segregating generations which the breeder can handle through pedigree method. However, for the exploitation of the full potential of these crosses, the conventional methodology needs some modification for exploi-ting both additive as well as non-additive genetic effects existing in these crosses.

The high overall performance, high overall heterotic status and involvement of one parent with high overall gca status in crosses 2 x 9, 3 x 6, 3 x 9, 5 x 7 and 6 x 8 indi-cated the involvement of predominantly non-additive effects (dominance, additive x dominance and other interactions) with significant additive effects in the expression of most traits. This was supported by significant high overall sca status in all these crosses. Lingham (1961) has given the detailed theoretical discussion to show utility of such crosses in breed-ing programme. These types of crosses can yield desirable transgressive segregants in further generations if the additive effect of one parent and complementary epistatic effects of other parent act in the same direction. For full exploitation of genetic variability existing in these hybrids, the conven-tional breeding methodology would require modification to capitalise predominant non-additive effects involved in the expression of yield, yield attributes and fruit quality related components. Instead of continuous selfing, alternative intermating between elite plants and selfing may be adopted to increase the span of selection. This would considerably increase the frequency of potential transgressive segregants in such material. The recurrent selection, diallel selective mating or bi-parental mating methods would be difficult to be exercised in brinjal. Alternatively, multiple crosses involving hybrids showing promise for different traits, could be helpful to capitalise a part of non-additive effects exists in the promising hybrids.

The hybrid 3 x 4 and 1 x 10 exhibited high per se performance but low sca effects. Such crosses may be utilized in isolating promising lines from their segregating population and building up new populations by combining the features observed in the respective populations.

Among the top three high yielding hybrids, two hybrids 5 x 6 and 3 x 9 had overall high per se performance and heterosis. But top most yielding hybrid 6 x 10 exhibited average overall per se performance and heterosis. Chadha and Sidhu (1982) observed that best performing F_1 hybrids were different from the best heterotic F_1 hybrids in majority of the characters which confirms the above result. An insight into the nature of heterosis, sca effects and gca status of parents for 22 characters of these three hybrids is presented in Table 42. The mean performance of these hybrids was already discussed in para 5.2.3 in respect of different characters. The comparative quality features among these three hybrids were reduced level of total phenol and orthodihydroxy phenols in hybrid 3 x 9 suggest that it will be less proned to discolouration. On the other hand, hybrids 6 x 10 and 5 x 6, showed increased level of total and reducing sugars. The crude proteins were high in hybrids 3 x 9 and 6 x 10. Looking at the desired improvement in yield and other quality related fruit parameters, these three hybrids appear to be promising for exploitation of heterosis.

5.2.5.3 <u>Combining ability of parents compared with heterosis, sca and *per se* performance</u>

Among the parents, Surya, Pusa Kranti, Gokak Local and Pusa Bhairav were observed to be high general combiners over all the traits. Based on overall gca status of the parents, the crosses showing high overall heterosis, sca and <u>per se</u> performance status were classified as HH (if both parents in a hybrid with high overall gca status), HL (if one parent with high and other with low overall gca status) and LL (if both the parents in hybrid with low overall gca status). The frequency of crosses with overall high heterotic, sca and <u>per se</u> performance status in different classes are presented in Table 40.

The frequency of crosses with overall high heterosis, gca status and *per se* performance were maximum in HL class of parents (i.e., one parent with high overall gca status and other with overall low gca status). The maximum frequency (56.9%) of overall high heterotic hybrids was observed in HL class of parent followed by LL class of parent (34.8%). These results are in line with Singh (1984), Dixit and Gautam (1987) and Sidhu and Chadha (1985).

The frequency of overall high gca was found maximum (45%) in HL class of parents followed by HH class of parents (35%). Similar observations were reported earlier by Srivastava and Bajpai (1977) and Singh and Kumar (1988).

On similar line overall high *per se* performance can be expected in HL class as revealed by the highest frequency (63.6%) of overall high *per se* performance in the crosses. The present study reveals that the crosses involving parents with high and low overall gca status will contribute maximum for overall high heterosis, gca effects and *per se* performance in hybrid for its commercial exploitation.

5.2.5.4 Heterosis in relation to genetic divergence and specific combining ability

The divergence between the parents was measured by the D^2 statistics based on 15 morphological and fruit characters in experiment I. The genetic distance (D) between

Table 40. Frequency of crosses with overall high heterosis, sca and per se performance fall in different classes.

Sl. no.	Particulars	Class of parental gca status in crosses		
		H x H	H x L	L x L
1.	Frequency of crosses with high overall heterosis over better parents	2 (8.7)	13 (56.9)	8 (34.8)
2.	Frequency of crosses with high overall sca effects	7 (35)	9 (45)	4 (20)
3.	Frequency of crosses with high overall performance compared to best variety	2 (18.2)	7 (63.6)	2 (18.2)

Figures in brackets are per cent value

parents of each cross was worked out based on their D^2 values which varied from 6.83 (4 x 5) to 37.09 (1 x 10). D values of 45 crosses was divided into four divergence classes considering minimum and the maximum D values among these crosses. Overall heterosis status over better parent and overall sca status of all crosses were grouped into high (H) and low (L) categories as per procedure outlined by Arunachalam *et al*. (1984). The frequency of heterotic crosses in relation to its sca and parental divergence is presented in Table 41.

Twentytwo high heterotic crosses out of 23 were observed in two and three divergence classes. The maximum high heterotic crosses (14) were observed in divergence class 2 (i.e., genetic distance between 11 to 20) followed by the class 3 (8 crosses) that is, genetic distance between 21 and 30, while the divergence class 1 (genetic distance below 10) and class 4 (genetic distance above 30) recorded 0 and 1 high heterotic crosses, respectively. It reveals that the optimum level of divergence between parents was observed in classes 2 and 3 (i.e., genetic distance between 11 and 30) to obtain high heterosis in F_1 generation. It further suggests that very low divergence class (1) and extremely divergence class (5) were not suitable to obtain heterotic combinations. Similar is the trend as regards sca effects in crosses. Eighteen crosses out of 20 crosses with high sca effect was found in 2 and 3 divergence classes. It reveals that the occurrence of differential frequencies of heterotic crosses in various divergence class was related to parental divergence

Table 41. Frequency of heterotic crosses in relation to its sca and parental divergence in brinjal.

DC	sca	H	L	Total
1	h	0	0	0
	l	0	1	1
2	h	9	1	10
	l	5	10	15
3	h	5	3	8
	l	3	4	7
4	h	1	1	2
	l	0	2	2
Total	h	15	5	20
	l	8	17	25

Where,

DC = Divergence class
sca = Overall sca status
h = Overall high sca status
l = Overall low sca status
H = Overall high heterotic status over better parent
L = Overall low heterotic status over better parent

Table 42. Mean performance, heterosis (%) over mid parent (MP), better parent (BP), Top parent (TP), sca effects and parental status of gca (P) for yield, yield attributes and fruit quality parameters in three top yielding hybrids in brinjal.

Sl. no.	Crosses / Characters	Gare local x Pusa kranti (3 x 9)	Surya x Gokak local (5 x 6)	Gokak local x Pusa bhairav (6 x 10)
1	2	3	4	5
1.	Days to flower (Nos.):			
	Mean	85	80	82
	MP	-6.08**	-11.45**	- 6.28**
	BP	-5.55**	- 9.81**	- 1.20
	TP	2.41	- 3.61*	- 1.20
	Sca	5.7879**	- 0.0455	1.3990
	P	H x L	H x L	H x L
2.	Fruit yield per plant (g):			
	Mean	1640	1715	1785
	MP	79.27**	66.12**	72.35**
	BP	68.64**	65.59**	72.35**
	TP	58.35**	65.59**	72.35**
	Sca	548.752**	446.114**	425.752**
	P	L x L	H x L	H x H
3.	Number of fruits:			
	Mean	20.00	20.70	33.00
	M.P	44.40**	17.28**	38.36**
	BP	12.99*	7.25	4.10
	TP	-36.91**	-34.70**	4.10
	Sca	3.8586**	0.8030	7.5253**
	P	H x L	H x H	H x H
4.	Plant height(cm):			
	Mean	74.3	101.00	82.3
	MP	16.37**	11.42**	21.65**
	BP	7.68	- 8.18**	15.43**
	TP	-32.45**	- 8.18**	-25.18**
	Sca	7.4773**	16.9217**	2.6439
	P	L x L	H x H	H x L

Contd..

Table(42 Contd..)

1	2	3	4	5
5. Plant spread (cm):				
	Mean	56.30	67.3	63.0
	MP	2.64	15.04**	21.15**
	BP	-12.98**	14.65**	7.32
	TP	-12.98**	4.02	- 2.63
	Sca	1.7247	5.4470**	5.5581**
	P	H x L	H x L	L x L
6. Number of primary branches:				
	Mean	4.00	4.00	3.70
	MP	- 6.98	14.28	5.71
	BP	- 6.98	8.11	0.00
	TP	- 6.98	-6.98	-13.95
	Sca	- 0.0631	0.2424	0.2424
	P	L x L	L x L	L x L
7. Secondary branches:				
	Mean	13.70	14.30	12.30
	MP	15.61	26.55**	6.96
	BP	5.38	16.26	0.00
	TP	3.01	7.52	- 7.52
	Sca	1.5455	1.9343*	0.2399
	P	L x L	L x L	L x L
8. Stem girth (cm):				
	Mean	4.90	5.30	5.50
	MP	- 8.41	0.95	0.92
	BP	-15.52*	1.85	0.00
	TP	-15.52*	-8.62	- 5.17
	Sca	- 0.3869	-0.1035	0.0965
	P	H x L	L x L	L x L

Contd..

Table 42(Contd..)

1	2	3	4	5
9.	Fruit weight(g):			
	Mean	169.30	148.70	100.00
	MP	48.70**	33.96**	4.88
	BP	16.76**	19.25**	- 19.81**
	TP	5.35	- 7.47	- 37.77**
	Sca	46.525**	32.4697**	- 2.0303
	P	H x L	L x L	L x L
10.	Fruit length (cm):			
	Mean	10.90	12.40	12.50
	MP	11.22**	17.53**	2.04
	BP	-15.50**	- 6.77	- 6.01
	TP	-34.34**	-25.30**	- 24.70**
	Sca	0.9707**	1.2596**	0.2513
	P	H x L	H x L	H x H
11.	Fruit girth (cm):			
	Mean	19.70	17.70	18.70
	MP	13.54**	12.74*	27.21**
	BP	10.67*	3.51	9.36
	TP	- 7.07	-16.51**	-11.36*
	Sca	1.4561*	0.7394	3.0085**
	P	L x L	L x L	L x L
12.	Stalk length of fruit(cm):			
	Mean	5.70	6.40	6.00
	MP	15.15	14.28	10.09
	BP	35.71**	28.00**	27.66**
	TP	35.71**	52.38**	42.86**
	Sca	0.5604	0.5834	0.2937
	P	H x L	H x L	H x L

Contd..

Table 42 (Contd..)

1	2	3	4	5
13.	Fruit density:			
	Mean	0.72	0.73	0.70
	MP	-10.00**	- 5.19*	- 7.89**
	BP	-14.28**	- 5.19*	- 9.09**
	TP	-14.28**	-13.09**	-16.67**
	Sca	- 0.0273	- 0.0164	- 0.0256
	P	H x L	L x L	L x L
14.	Keeping quality index:			
	Mean	12.00	9.50	15.10
	MP	-36.84**	-52.50**	-11.70
	BP	-34.06**	-46.93**	- 7.36
	TP	-23.57**	-39.49**	- 3.82
	Sca	- 3.3801**	- 5.4842**	- 0.1731
	P	H x L	H x L	H x H
15.	Rind thickness(cm):			
	Mean	0.82	0.82	0.76
	MP	13.89**	25.19**	14.28**
	BP	5.13	17.14**	8.57
	TP	- 3.53	- 3.53	-10.59**
	Sca	0.0317	0.0461*	- 0.0003
	P	H x L	H x L	H x L
16.	Seed weight per fruit(g):			
	Mean	5.16	3.52	4.47
	MP	67.26**	6.18	64.34**
	BP	98.46**	5.39	112.86**
	TP	145.71**	67.62**	112.86**
	Sca	1.0244**	- 0.0592	1.1069**
	P	H x H	H x H	H x H

Contd..

Table 42 (Contd..)

1	2	3	4	5
17.	Dry matter(%):			
	Mean	6.50	6.40	7.80
	MP	-15.03**	-19.50**	- 4.29
	BP	-15.58**	-21.95**	- 9.30**
	TP	-30.11**	-31.18**	-16.13**
	Sca	- 1.1250**	- 1.6181**	- 0.3214*
	P	L x L	L x L	H x L
18.	Total phenols (%):			
	Mean	0.185	0.431	0.515
	MP	- 59.47**	0.94	- 1.90
	BP	- 49.45**	32.61**	- 1.15
	TP	- 27.16**	69.68**	102.76**
	Sca	- 1.1849**	- 0.0483	0.0154
	P	H x L	H x L	L x L
19.	Orthodihydroxy phenols (%):			
	Mean	0.036	0.038	0.040
	MP	-25.77**	-22.45**	-22.33**
	BP	- 7.69*	- 9.52**	-14.89**
	TP	- 7.69*	- 2.56	2.56
	Sca	- 0.0723**	0.0106	- 0.0673**
	P	H x L	H x L	L x L
20.	Total sugars (%):			
	Mean	1.344	2.892	2.863
	MP	1.24	99.58**	39.22**
	BP	-14.83**	99.17**	7.59
	TP	-49.49**	8.68	7.59
	Sca	0.0314	1.5043**	1.3153**
	P	H x L	H x H	H x H

Contd..

Table 42 (Contd..)

1	2	3	4	5
21.	Reducing sugars (%):			
	Mean	0.195	1.157	1.247
	MP	-42.81**	70.27**	55.78**
	BP	-63.28**	37.25**	64.51**
	TP	-76.87**	37.25**	47.92**
	Sca	- 1.4062**	0.1573	0.5783**
	P	H x L	H x H	H x H
22.	Crude protein(%):			
	Mean	24.86	14.74	20.13
	MP	13.05**	-13.93**	11.46**
	BP	0.69	-16.63**	2.97
	TP	0.69	-40.30**	-18.47**
	Sca	2.0442**	- 1.7694**	1.7942**
	P	H x L	L x L	L x L
23.	Overall status:			
	Per se	H	H	A
	Heterosis	H	H	A
	Sca	H	H	H
	P	H x L	H x H	H x H
24.	Genetic distance between parents in a cross	27.08	20.00	27.74
25.	Colour of fruit and shape	Oval shape Purple colour	Oval shape Purple colour	Oblong shape Purple colour

and/or specific combining ability of the crosses. About 65 per cent of the total heterotic crosses had high sca to explain heterosis.

On similar line, Oganesyan (1976) reported that more the parents differed in yield, the less marked was the heterosis, maximum heterotic crosses (45%) in high x moderately high forms of combination followed by 20 per cent heterotic crosses in high x low yielding forms of combinations in brinjal.

5.3 Inheritance studies on qualitative characters

The brinjal plant offers the most excellent material for genetical studies, as the variations encountered in morphological and fruit characters are enormous. The anthocyanin pigmentation in many parts of the plant forms a complicated group of characters with unique system of gene interaction. The present investigation was taken up, involving a record number of 28 characters comprising pigmentation, spinyness on different parts of the plant and fruit related characters to understand the nature of their inheritance. In accordance with the objectives of the present investigation it would be appropriate to discuss the results under three main headings.

1. Pigmentation on different plant parts
2. Thorn and pubescence on different plant parts
3. Fruit characters

5.3.1 Pigmentation on different plant parts

5.3.1.1 Pigmentation on main stem

Purple pigmentation on main stem was found to be dominant over green colour in both the crosses. The F_2 segregation ratio of 162 purple: 94 green and 1 purple: 3 green ratio in BC_2 indicates the involvement of four genes with one basic and any two of the three complementary duplicate genes in expression of this character in cross I. In cross II, the segregation ratio of 45 purple:19 green and 3 purple:5 green observed in F_2 and BC_2, respectively could be explained with the involvement of three genes, one basic and two complementary duplicate genes. The number of genes governing this character varied in two crosses due to differences in genotypes.

SwamyRao (1970), Wanjari and Khapre (1977), Shariff and Habib (1977), Khapre et al. (1986 and 1987) reported monogenic dominance of purple stem over green, while two duplicate genes were reported by Nimbalkar and More (1980). Three genes governing stem colouration has also been reported by Nimbalkar and More (1981) segregating in ratio of 54 dark green to 10 light green; while a ratio of 49 green:15 violet green, involving two duplicate and one inhibitory genes were reported by More et al. (1982). Patil and More (1983) observed three complementary genes, segregating in ratio of 27 green with violet tinge: 37 green for this character. Present findings are contradictory to earlier reports. Therefore, four genes with a segregation ratio of 162:94 and 3 gene with a ratio of 45:19 are being reported for the first time.

5.3.1.2 Pigmentation on branches

Presence of purple pigmentation was found to be dominant over green colour of branches in both the crosses (Tables 43 and 44). The ratios of 45 purple:19 green and 3 purple:5 green in F_2 and BC_2 generations, respectively suggest the involvement of three genes; one basic gene and two complementary duplicate genes in the inheritance of this character. These findings are being reported for the first time and no published reports are available on the inheritance of this character.

5.3.1.3 Leaf midrib pigmentation

Purple pigmentation in basal leaf midrib segregated into 45 purple:19 green in F_2 and 3 purple:5 green in BC_2 indicating the existence of three genes in which one basic and two complementary duplicate genes for this character.

In terminal leaf midrib pigmentation however showed a segregation ratios of 147 purple:109 green and 5 purple: 11 green in F_2 and BC_2, respectively which could be explained with one basic gene, two inhibitory duplicate genes and one anti-inhibitory gene.

Three and four genes interactions for pigmentation in leaf midrib at basal and terminal leaf suggests that different sets of genes are operating for purple pigmentation of midrib in different stages of leaf development. Swamy Rao (1970) observed monogenic dominance of purple midrib over green which differ from present findings.

Such report to explain the inheritance of midrib pigmentation at different developmental stages could be considered as new, which would hopefully throw light in understanding several characters in terms of action of genes in development.

5.3.1.4 Pigmentation in leaf vein

Purple pigmentation in leaf vein was found to be dominant over green in both the crosses (Tables 43 and 44).

The pigmentation in basal leaf vein segregated into 162 purple:94 green in F_2 and 1 purple:3 green in BC_2 indicating the existence of four interacting genes namely, one basic gene and any two of the three complementary duplicate genes, while the pigmentation in terminal leaf vein showed the segregation ratio of 147 purple:109 green and 5 purple:11 green in F_2 and BC_2, respectively, which could be explained with the involvement of one basic gene, two inhibitory duplicate genes and one anti-inhibitory gene in cross I.

Four gene interaction differs for leaf vein at basal and terminal leaf indicating two different sets of genes for pigmentation during two different developmental stages of leaf.

In cross II pigmentation in basal leaf vein segregated into 45 purple:19 green in F_2 and 3 purple:5 green in BC_2 indicating the action of 3 genes, 1 basic gene and 2 complementary duplicate genes for expression of this character. The segregation ratios varies in two crosses for basal leaf vein due to genotypic differences in parents.

Nimbalkar and More (1980) observed duplicate gene action for vein colour with segregation ratio of 15 purple: 1 green, while Patil and More (1983) reported a ratio of 9 green:7 purple green in one cross and 9 purple green:7 green with violet tinge in another cross indicating complementary gene action for leaf vein pigmentation. Three or more gene interaction were reported by Khapre et al. (1986). The present findings are contrary to these observation. This kind of results are expected as the parents chosen are different.

5.3.1.5 Pigmentation in leaf petiole

Presence of purple pigmentation was dominant over green in the leaf petiole (Table 43). The ratios of 45 purple:19 green and 3 purple:5 green in F_2 and BC_2 respectively were obtained for pigmentation in basal and terminal leaf petiole. This indicates the action of three genes in which one basic gene and two complementary duplicate genes in determining this character.

SwamyRao (1970) observed monogenic dominance of purple petiole over green, while Nimbalkar and More (1980) reported two duplicate genes. A ratio of 57 dark green:7 light green was reported by Nimbalkar and More (1981) indicating one basic independent and two complementary genes for petiole colouration. Present findings are contradictory to these observations. Therefore, three gene ratio of 45:19 is claimed to be the new report for this character.

5.3.1.6 Pigmentation in leaf lamina

Presence of purple pigmentation was dominant over green in terminal leaf lamina (Tables 43 and 44). In the present study, the terminal leaf lamina colour was governed by four interacting genes namely, one basic gene, two inhibitory duplicate genes and one antiinhibitory gene giving the segregation ratio of 147 purple:109 green in F_2. This ratio was further confirmed with the ratio of 5 purple: 11 green in BC_2 in both the crosses.

Sheriff and Habib (1977) observed monogenic dominance of purple leaf over green. Nimbalkar and More (1981) reported a ratio of 162 dark green:94 light green indicating the action of four genes for leaf colour, while Patil and More (1983a) reported two complementary genes with a ratio of 9 dark green:7 green. Khapre et al. (1986) reported three or more interacting genes for purple shade on young leaves which confirms the above findings.

5.3.1.7 Pigmentation in flower pedicel, petal and petal line

Purple pigmentation was dominant over green in pedicel, while purple petal and petal line were dominant over white (Table 43).

The ratios of 189 purple: 67 green and 7 purple:9 green were evident in F_2 and BC_2, respectively in pedicel. Similar ratios were observed for petal and petal line colour (Purple vs White) indicating the action of four genes in which one basic gene and any one of the three complementary duplicate genes for pigmentation in pedicel, petal and petal line.

SwamyRao (1970) reported monogenic dominance of purple flower over green. Similarly Thakur et al. (1969) observed monogenic dominance of purple corolla over white. Khapre et al. (1986) observed interaction of three or more pairs of non-allelic genes for corolla colour which confirms the above findings for petal colour in the present study. However, four genes interaction for pedicel colour can be claimed as first report.

5.3.1.8 Pigmentation in calyx of flower

Purple pigment in calyx of flower was dominant over green (Table 43). The ratio of 45 purple:19 green and 3 purple:5 green were obtained in F_2 and BC_2, respectively for this character. This indicates that one basic and two complementary duplicate genes would act to govern this character. Khapre et al. (1986) reported the interaction of three or more pairs of non-allelic genes to govern calyx colour which confirm the above findings.

5.3.2 Thorn and pubescence on different plant parts

5.3.2.1 Thorn on stem, petiole and midrib

The presence of thorn on stem, petiole and midrib was found to be dominant over its absence (Table 44). The ratios of 195 presence:61 absence and 9 presence:7 absence of thorn were observed in F_2 and BC_2, respectively. This indicates the involvement of four genes namely, two duplicate genes, one inhibitory gene and one anti-inhibitory gene in the expression of these characters.

Thakur et al. (1969) reported monogenic dominance of spines over spineless. Rangaswamy and Kadambavanasundaram (1973) observed monogenic dominance of prickled over non-prickled condition on petiole, leaf surface and stem. Shariff and Habib (1977) recorded monogenic dominance of spines over spineless on leaf and stem. Nimbalkar and More (1980 and

1981a) observed monogenic dominance for presence of spines on stem and petiole over its absence. Monogenic segregation for spineness also reported by More et al. (1982) and Patil and More (1983b) for stem, leaf and petiole. However, Khapre et al. (1985) reported three gene control of spininess on leaves and three complementary genes for stem and leaves in another study (Khapre et al., 1987a).

The involvement of two duplicate genes and inhibitory genes of different action for spininess on stem, petiole and midrib have been shown to exist for the first time in the present investigation.

5.3.2.2 Thorn on leaf vein

Four genes were found to govern the presence of thorn on leaf vein as shown by the ratios of 117 present: 139 absent and 3 present:13 absent in F_2 and BC_2, respectively (Table 44). The four genes could be explained with the involvement of two complementary genes, one inhibitory gene and one anti-inhibitory gene for this character. Nimbalkar and More (1980) reported a single dominant gene for spines on leaf vein. Present finding is contradictory to this report. Hence, the tetragenic ratio of 117:139 is claimed to be the first report for this character.

5.3.2.3 Thorn and pubescence on pedicel and calyx of flower

The presence of thorn on pedicel and calyx of flower was dominant over its absence (Table 44). The ratios of 195 presence:61 absence in F_2 and 9 present:7 absence of thorn in BC_2 indicate action of four genes namely, two duplicate genes, one inhibitory gene and one anti-inhibitory gene for thornyness on pedicel and calyx of flower.

Similarly, the presence of pubescence on pedicel and calyx of flower was observed to be dominant over its absence (Table 43). The ratios of 81 present:175 absent of pubescence in F_2 and 1 present:15 absence of pubescence in BC_2 reveal the action of four complementary genes for pubescence on pedicel of flower. While the pubescence on calyx segregated into 147 present:109 absent in F_2 and 5 present:11 absent in BC_2 which could be explained with the involvement of one basic gene, two inhibitory duplicate genes and one anti-inhibitory gene for this character. Kharpe *et al.* (1987a) observed two complementary and one inhibitor genes controlling spined calyx. Therefore, the tetragenic ratio reported here is claimed to be the first report for these characters.

5.3.2.4 Colour of pubescence on pedicel and calyx of flower and stalk and calyx of fruit

A presence of purple pigmentation in pubescence of pedicel and calyx was dominant over green (Table 43). The pigmentation in pubescence of pedicel and calyx of flower segregated into 54 purple:10 green in F_2 and 3 purple: 5 green in BC_2 indicating the action of three genes namely, any two of the three complementary duplicate genes for this character.

While pubescence colour of fruit stalk and calyx showed monogenic dominance of purple pigmentation over green. These observations were further confirmed with the ratios of 3 purple:1 green in F_2 and 1 purple:1 green in BC 2 for pubescence pigmentation of stalk and calyx of fruit. There are no published reports either to contradict or the support these findings. Therefore, these findings are claimed to be the first report.

The observed variation in ratios of pigmentation in pubescence suggests that different genes were involved during developmental process of pubescence in flower and fruit parts.

5.3.3 Fruit characters

The consumer's preference depends upon the important fruit characters like colour of fruit, spininess and colour of fruit stalk and calyx and fruit shape. Besides, fruit shape and clustering habit of fruits are associated with fruit weight and number of fruits per plant which are the main components of yield.

looking to their importance, inheritance of these fruit characters were studied.

5.3.3.1 Pigmentation in stalk and calyx of fruit

The presence of purple pigmentation in stalk and calyx was found to be dominant over its absence. The ratios of 129 purple:127 green in F_2 and 5 purple:11 green in BC_2 indicated the action of four genes - one basic gene, one inhibitory gene and two anti-inhibitory complementary genes for pigmentation in stalk and calyx.

The difference in ratios of early and late developmental stages of these plant parts indicate that different sets of genes were controlling pigmentation in these plant parts at two different stages that is, flower and fruit. Khapre *et al.* (1986) reported three or more pairs of non-allelic genes to govern calyx colour. Such report to explain the inheritance of pigmentation in these parts at different developmental stages could be considered as new.

5.3.3.1 Thorn and pubescence on stalk and calyx of fruit

The presence of thorn and pubescence on stalk and calyx of fruit was observed to be dominant over its absence. A perusal of the Table 44 revealed that thorn on stalk and calyx of fruit segregated into 195 present:61 absent in F_2 and 9 present:7 absent in BC_2 indicating action of four genes - two duplicate genes, one inhibitory gene and one anti-inhibitory gene for these characters.

The segregating ratios of 27 present:37 absent in F_2 and 1 present:7 absence of pubescence in BC_2 in stalk of fruit in cross I indicated the action of three complementary genes for this character (Table 43). The segregation ratios of 147 presence:109 absence and 5 presence:11 absence of pubescence in fruit calyx in F_2 and BC_2, respectively indicated the action of four genes namely, one basic gene, two inhibitory duplicate genes and one anti-inhibitory genes for this character.

Khapre et al. (1987a) reported two complementary and one inhibitory gene action for spined calyxes. Therefore, four gene ratio in the inheritance of this character is being reported here for the first time.

5.3.3.3 Colour of fruit

The purple fruit colour was observed to be dominant over green and white fruit colour. The fruit colour segregated into 129 purple:127 green in F_2 and 5 purple:11 green in BC_2 in cross I, indicating the action of four genes namely, one basic, one inhibitory and two anti-inhibitory complementary genes for this character.

The segregating ratios of 195 purple:61 white and 9 purple:7 white in F_2 and BC_2, respectively in cross II, indicated the action of two duplicate genes, one inhibitory gene and one anti-inhibitory gene for fruit colour in cross-II. The variation in ratios could be because of the parental genotypic differences.

Monogenic inheritance of different fruit colour had been reported by many workers (SwamyRao, 1970; Choudhari, 1972 and 1977; RangaSwamy and Kadambavanasundaram, 1973 and More et al., 1982), while two complementary genes for fruit colour were reported by Thakur et al. (1969). Patil and More (1983) observed one complementary and two duplicate genes and in another study, one complementary and two duplicate complementary genes for fruit colour (Patil and More, 1983a). Khapre et al. (1987) reported three non-allelic genes for young fruit colour. The present findings differ from earlier reports. Hence, four gene ratios reported here are claimed to be first report for fruit colouration.

5.3.3.4 Fruiting habit

Non-clustered fruiting habit was found to be dominant over clustered fruiting habit. The segregating ratios of 81 non-cluster:175 cluster and 1 noncluster: 15 cluster in F_2 and BC_2, respectively indicate the action of four complementary genes for this character. The dominance of non-clustered fruiting habit in the present findings is in line with that of Rao et al. (1969), while the action of four complementary genes for fruiting habit is in line with Khapre *et al.* (1987b).

Fukusawa (1964) reported trigenic control of fruiting pattern, while SwamyRao (1970) and Rangaswamy and Kadambavanasundaram (1973) reported monogenic control of fruiting pattern.

5.3.3.5 Fruit shape

The elongated fruit shape was observed to be dominant over round fruit shape (Table 44). The segregating ratios of 39 elongated:25 round in F_2 and 3 elongated: 5 round were observed indicating the action of three genes namely, one basic gene, one inhibitory gene and one anti-inhibitory gene in the inheritance of fruit shape.

SwamyRao (1970) reported monogenic dominance of elongated fruit shape over round. Rangaswamy and Kadambavanasundaram (1973) observed partial dominance of long fruit over round fruit shape, while Choudhari (1977) reported single gene dominance of round fruit over long oval and short oval types of fruit. Sheel *et al.* (1981) reported three loci for control of fruit shape. Nimbalkar and More (1981a) reported the four gene action with a ratio of 162 oblong:94 oval in F_2, while Patil and More (1983a) observed a ratio of 45 oblong:19 round indicating one complementary and two duplicate complementary genes for this character. Inhibitory genes of different action for fruit shape have been shown to exist for the first time in the present finding for this character.

5.4 Strategies for improvement in yield and fruit quality in brinjal

The main objective in any breeding programme would be to produce high yielding varieties and hybrids with better fruit quality. As brinjal fruits are consumed as a vegetable in various culinary preparations, the quality preferences differr regionwise. Besides, fruit colour, spininess of calyx as well as stalk of the fruit are also preferred in some region. Therefore, it is particularly important that resultant variety should have high potential for yield as well as relevant fruit quality parameters specific to the region. The challenge to improve yield along with all the desirable fruit quality parameters through selection is complex. To date, the efforts devoted in improving the fruit quality in brinjal are limited. Only one report is available in which attempt was made to study inheritance of few quality parameters in brinjal (Chadha et al., 1990 and Verma, 1991). No efforts seem to have been made so far to study the inheritance of important fruit quality parameters like stalk length of fruit and reducing sugars, while some studies have been made with reference to seed weight per fruit, fruit density, keeping quality index, dry matter, total phenols, orthodihydroxy phenols, total sugars and crude protein content in fruit along with fruit yield and yield attributes. A comprehensive effort has been made in the present study with genotypes representing available range of variation to understand the inheritance and heterosis of important yield attributes in this crop. The new information is also generated on the number of genes and their interaction involved in the inheritance of pigmentation and spininess on different parts of the plant and fruit, fruiting habit and fruit shape.

Further studies are needed to fully understand the genetic basis of different fruit quality parameters in brinjal because of many problems associated with quantification of fruit quality. But, breeding of cultivars and hybrids with high yield and improved fruit quality in a crop like brinjal should not be delayed on this account. The practical utility of the present investigation can be viewed in terms of identification of parental lines that could be profitably used in breeding programmes and potential cross combinations which may be used for exploitation of heterosis.

The following broad strategy for fruit yield as well as fruit quality improvement emerges from the results discussed above and material investigated in various experiments.

1. The study of variability in cultivar collections revealed substantial amount of genetic variation, high heritability and high genetic advance for traits like number of fruits per plant, fruit yield per plant, seed weight per fruit, fruit weight and fruit length which could be improved through simple selection.

2. The correlation analysis indicated the high positive association of fruit number, fruit weight and fruit length with yield. These characters need to be considered in selection programmes aimed at yield improvement.

3. The path coefficient analysis showed the maximum direct contribution of days to flower, primary branches and stalk length of fruit on yield indicating their role in yield improvement.

4. D^2 analysis revealed enormous amount of diversity present in the cultivars collected from various regions for different traits. Genetically diverse clusters that excelled for different traits were identified from the point of view of future breeding programmes.

5. The present study has clearly indicated Surya, Gokak local and Pusa Bhairav and Pusa Kranti as good general combiners for fruit quality parameters, yield and yield attributes, while Gare Local was the best general combiner for most fruit quality parameter, except

sugars. If efforts to enhance fruit yield along with improved fruit quality are to be successful, these five parents may be used in future breeding programme to develop high yielding and high fruit quality cultivars or hybrids.

7. The high *per se* performance crosses 5 x 7, 3 x 9, 5 x 6, 6 x 8, 1 x 10, 2 x 9 and 3 x 6 were found promising for yield and fruit quality variables as compared to best variety (Parent). Therefore, it is worthwhile to use these crosses in recombination breeding programme for simultaneous improvement of different quality parameters along with fruit yield and isolating the superior transgressants.

8. The top yielding 15 hybrids namely, 1 x 7, 1 x 8, 1 x 10, 2 x 3, 2 x 9, 3 x 6, 3 x 9, 3 x 10, 4 x 9, 4 x 10, 5 x 6, 5 x 7, 5 x 10, 6 x 8 and 6 x 10 could be tested in different locations and seasons to identify stable high yielding hybrids along with desirable quality attributes for different regions. Of these, the best namely, 6 x 10, 5 x 6 and 3 x 9 could be exploited commercially as they have high yield combined with maximum desirable quality attributes.

9. The presence of significant and predominant additive effects for important fruit quality parameters, yield and yield attributes indicated the possibility of their

improvement through conventional methods like pedigree and bulk method of breeding. However, the existence of significant and substantial non-additive effects for the fruit quality parameters, yield and yield attributes indicated that direct selection under selfing would mean the partial exploitation of the genetic variation that exist in the material. For the full harvesting of the existing variability in the material studied and to achieve simultaneous improvement in fruit yield and fruit quality, methods like biparental mating or recurrent selection may be followed. Alternatively, multiple crosses using promising crosses would also be helpful. The hybrids showing high *per se* performance over the best variety could be used depending upon their quality parameters. Double crosses between these hybrids would be profitable to isolate desirable types with many quality attributes along with yield.

5.5 Future line of work

Based on the present investigation, the following suggestions are made for the future.

1. The variability of different plant morphological and fruit related characters were studied in the collections. The variability as regards fruit quality related biochemical parameters may be determined to identify useful sources for these parameters in collections.

2. Promising parents, and crosses for fruit quality, yield and yield components have been identified. The experiments on stability of these genotypes over environment in respect of yield, yield components and quality related parameters can be taken up to identify stable lines.

3. Potential parents and crosses identified can be made use of for understanding of genetics of fruit quality parameters preferably through generation mean analysis. The number of crosses should be limited to two or three to generate large plant population in different generations.

4. Segregating populations of some of the promising crosses can be studied for further selection and evaluation based on different fruit quality parameters, fruit yield and yield components to formulate selection strategies for the simultaneous improvement in fruit yield and fruit quality.

5. The consumer's preference mainly depends upon fruit colour. The genetics of different fruit colouration patterns can be established on firm lines by studying inheritance in different contrasting parents.

CHAPTER - VI

SUMMARY

VI. SUMMARY

The investigation was undertaken at the Main Research Station, University of Agricultural Sciences, Dharwad for studying the genetic variation and diversity existing for different morphological and fruit characters, the pattern of association between yield and related characters, heterosis and genetics of yield and fruit quality parameters and inheritance of qualitative characters in brinjal (*Solanum melongena* L.). It was also intended to identify material that can be used in future breeding programme for developing varieties and hybrids with high fruit yield as well as fruit quality. For the purpose of obtaining information on above objectives, three different experiments were conducted. The results and the conclusions drawn for different experiments are summarised below, experimentwise.

5.1 Variability, correlation and diversity among collected genotypes (Experiment I)

Seventysix genotypes were evaluated in randomized block design with three replications during *kharif*, 1990 and the observations were made on individual plant basis for various morphological and fruit characters along with fruit quality parameters.

1. The genotypes differed significantly for fruit yield, yield attributes and fruit related characters. Moderate to high genetic coefficient of variation (GCV) & high heritability coupled with high genetic advance were

observed for fruit yield, number of fruits, seed weight per fruit, fruit weight and fruit length. It indicated that simple selection will be effective for improvement of these fruits. Low genetic coefficient of variation, high heritability and low genetic advance were observed for days to flower and fruit density.

2. Moderate GCV, moderate to high heritability and moderate genetic advance were recorded for plant height, plant spread, primary branches, secondary branches, fruit girth, stalk length of fruit, rind thickness and keeping quality index.

3. The correlation studies indicated that fruit yield was strongly correlated with number of fruits, fruit length and fruit weight, while negative significant association was observed between fruit yield and keeping quality index of fruit. The fruit yield was negatively associated with fruit density, and positively with stalk length of fruit appreciably. The remaining characters had weak association with yield.

4. Path analysis revealed that direct contribution of days to flower, primary branches and stalk length of fruit were of higher magnitude on fruit yield. However, indirect positive contribution of fruit weight, fruit length and fruit girth were appreciable to effect yield.

The direct and indirect contribution of days to flower were maximum on fruit yield.

5. D^2 analysis indicated enormous diversity among the collections. The 75 genotypes were assigned to seven clusters of which cluster VI (with Pusa Purple Long and Pusa Bhairav) was strikingly diverse from others. The maximum number of genotypes (59) were in cluster I with least intra cluster distance. The characters that contributed to diversity were mainly, fruit yield, number of days to flower and other fruit parameters. The pattern of genetic diversity was not related to their present geographic distribution.

6.2 Heterosis, combining ability and gene action of fruit quality parameters, yield and yield attributes (Experiment II)

Ten parents, White Madhapuri (1), Higna Dorla (2), Gare Local (3), SM 135 (4), Surya (5), Gokak Local (6), Malapur Local (7), Taiwan Naga (8), Pusa Kranti (9) and Pusa Bhairav (10), were crossed in all possible combinations (excluding reciprocals) to produce 45 F_1s and evaluated to obtain information on heterosis, combining ability and gene action for fruit quality parameters, yield and yield attributes. The experiment was conducted under irrigated conditions during *rabi*- summer 1991-92. Observations were recorded on 22 characters related to fruit yield and quality parameters.

The salient findings of this experiment are :

1. Substantial diversity exists among parents and F_1s for all 22 characters studied except primary branches and stem girth in parents. The interactions due to parents vs hybrids were significant for all characters except primary branches, stem girth, fruit length and stalk length of fruit indicating overall heterosis for 18 characters.

2. The frequency and magnitude of heterosis in desired direction were more for characters namely, days to flower, fruit yield, number of fruits per plant, plant height, plant spread, fruit weight, fruit length, fruit girth, rind thickness, dry matter, orthodihydroxy phenols and reducing sugar content in fruits, while heterosis for primary branches, secondary branches, stem girth and stalk length of fruit was low in magnitude. The heterosis for fruit density, seed weight per fruit, total phenols, total sugar and crude protein was more towards undesired direction.

3. Fifteen crosses exhibited significant positive heterosis over best parent for fruit yield. Among these, the top yielding Gokak Local x Pusa Bhairav (6 x 10), Surya x Gokak Local (5 x 6) and Gare Local x Pusa Kranti (3 x 9) exhibited maximum heterosis of 72, 65 and 58 per cent over best parent for fruit yield and also for

different fruit quality parameters and yield components. These hybrids can be used for exploitation of heterosis.

4. The significant heterosis in desired direction recorded for different yield related characters along with yield simultaneously in hybrids. Such potential crosses were 1 x 8, 1 x 10, 3 x 6, 5 x 7, 6 x 8 and 5 x 6 (Days to flower); 1 x 8, 3 x 6, 3 x 9, 4 x 9 and 6 x 8 (number of fruits per plant); 1 x 7, 1 x 8, 2 x 3, 3 x 10, 4 x 9, 4 x 10, 6 x 8 and 6 x 10 (plant height); 1 x 8, 1 x 10, 2 x 3, 4 x 10, 5 x 6 and 5 x 7 (plant spread); 1 x 7 and 5 x 7 (fruit length); 2 x 9, 3 x 6 and 3 x 9 (Fruit girth) and 1 x 7 (fruit weight). The increase in yield attributed to heterosis for different yield related parameters in above hybrids.

5. The potential crosses exhibiting significant heterosis over better parent for different fruit quality parameters were 3 x 9, 4 x 10, 5 x 6, 5 x 7 and 6 x 8 for keeping quality index of fruit, 1 x 7, 1 x 8, 3 x 6, 3 x 10, 5 x 6, 5 x 7, 5 x 10 and 6 x 8 for rind thickness; 5 x 7 for dry matter; 3 x 9 and 3 x 10 for total phenols, 1 x 10 , 2 x 9, 3 x 6 and 3 x 9 for ortho-dihydroxy phenols, 4 x 9, 5 x 6 and 5 x 7 for total sugar, 5 x 6, 5 x 7, 5 x 10, 6 x 8 and 6 x 10 for reducing sugars and 2 x 4 and 3 x 4 for crude protein in desired direction. It indicated possibility of simultaneous improvement of different fruit quality parameters along with yield in above hybrids.

6. Predominantly additive gene action was evident for primary and secondary branches, stem girth and stalk length of fruit, while additive and non-additive gene action was equally important for fruit yield per plant, fruit number per plant, fruit weight, fruit length, fruit girth and fruit density. The predominance of non-additive gene action over additive gene action was observed for days to flower, plant height, plant spread, keeping quality index, rind thickness, seed weight per fruit, dry matter, total phenol, orthodihydroxy phenol, total sugar, reducing sugar and crude protein.

7. Surya (5), Pusa Kranti (9), Gokak Local (6) and Pusa Bhairav (10) observed to be the high general combiner for different yield components and fruit quality parameters. The parents with significant gca effects for different characters in desired direction were 3, 5, 8 and 10 for earliness; 6 and 10 for fruit yield; 3, 5, 6 and 10 for number of fruits per plant; 1,5,6,7 and 8 for plant height; 5, 7, 8 and 9 for plant spread; White Madhapuri (1) for primary branches; Malapur Local (7) for primary and secondary branches; 7 and 9 for stem girth; 4, 7, 9 for fruit weight, 6, 7, 8, 9 and 10 for fruit length; 1, 2, 4 and 7 for fruit girth; 2, 3, 5 and 10 for stalk length of fruit; 1, 2, 3 for fruity density; 6, 9 and 10 for keeping

quality index; 4, 6, 9 for rind thickness; 3, 5, 6, 8, 9 and 10 for seed weight; 1, 4, 10 for dry matter; 1, 2, 3, 4 and 5 for total phenols; 2, 3, 4 and 5 for orthodihydroxy phenol; 5, 6, 7, 8, 9 and 10 for total sugars and reducing sugars and parents Higna Dorla(2); Gare Local (3) and SM 135 (4) for crude protein.

8. There was close relation between number of hybrids showing high overall sca and high overall heterosis which indicated that major sca effects could be accounted in terms of heterosis.

9. The frequency of crosses with high overall heterosis, high overall sca status and performance status was maximum in combination of parents with high x low gca status (H x L) compared to H x H and L x L.

10. The occurrence of differential frequencies of heterotic crosses in various divergence classes was related to parental divergence and/or specific combining ability of the cross. Moderate divergence class recorded maximum frequency of high heterotic hybrids.

11. Eleven hybrids exhibited high overall performance. Among these hybrids 1 x 10, 2 x 9, 3 x 6, 3 x 9, 5 x 6, 5 x 7 and 6 x 8 showed significantly superior yield over best parent. These hybrids could be exploited in recombination breeding programme by combining the features observed in respective populations to

build up new populations with maximum desired quality attributes along with yield.

6.3 Inheritance of qualitative characters (Experiment III)

Three contrasting varieties namely, Pusa Purple Cluster, Krishna Kati and White Madhapuri, their F_1s, F_2s, BC_1s and BC_2 generations were grown during *kharif* 1991. Following were the important findings of the study.

1. Inheritance studies indicated the involvement of three to four pairs of gene for different characters. The parents differed in single pair of gene for the character pubescence pigmentation in stalk and calyx of fruit.

2. All F_2 ratios were segregating in a manner that was expected in BC_2 generation

3. Common characters in the crosses involving a common parent had not shown similar gene interaction for pigmentation in main stem, basal leaf vein and terminal leaf vein.

4. Different gene interactions were observe. at different developmental stages indicating different sets of genes operated at these growth stages of same character namely, pigmentation in midrib, vein, pedicel, calyx and pubescence in pedicel and calyx and presence of pubescence in pedicel.

5. Trigenic F_2 ratio of 45 purple, 19 green were postulated for pigmentation in main stem, branches, basal leaf vein and terminal leaf vein in cross II and branches, basal leaf midrib, basal leaf petiole, terminal leaf petiole, and flower calyx in cross I indicating one basic gene and two complementary duplicate genes for control of pigmentation in above plant parts. The ratio of 54 purple: 10 green observed for pigmentation in pubescence of flower pedicel and calyx indicating the action of any two of the three complementary duplicate genes, while pubescence of stalk of fruit showed ratio of 27 present: 37 absent indicating three complementary genes. The fruit shape segregated into 39 elongated:25 round indicating one basic gene, one inhibitory gene and one anti-inhibitory gene for the control of this character.

6. The tetra hybrid F_2 ratios were observed for pigmentation in main stem and basal leaf vein (162 purple: 94 green) in cross I, terminal leaf lamina (crosses I and II), terminal leaf midrib, terminal leaf vein, pubescence in calyx of flower and pubescence in calyx of fruit (147:109) in cross I; pigmentation in pedicel, petal and petal line (189:67) cross I, thorn in pedicel, calyx of flower and fruit (195 present:61 absent) and fruit colour (195 purple:61 white) in cross II, pubescence on pedicel of flower (81 present:175 absent)

and fruiting habit (81 non-cluster: 175 cluster) in cross I, pigmentation in stalk, calyx and fruit(129:127) in cross I and thorn on leaf vein (117:139).

7. Purple pigmentation in different plant parts and presence of thorn were found to be dominant over green and absence of thorn, respectively. These characters in above mentioned plant parts can be used as suitable genetic markers to identify F_1 hybrid at seedling stage and confirm purity of seed lot during commercial exploitation of hybrids in brinjal.

Strategies for improvement in yield and fruit quality in brinjal and future line of work have been discussed.

CHAPTER - VII

REFERENCES

VII. REFERENCES

AL-JIBOURIE, H.A., MILLER, P.A. AND ROBINSON, H.F., 1958, Genotypic and environmental variances and covariances in an upland cotton cross of interspecific origin. Agron. J., 50: 633-636.

ANONYMOUS, 1991, FAO Production Year Book, 1989. Food and Agriculture Organization of United Stations, Rome, 43: 187.

A.O.A.C., 1965, Official methods of Analysis of Association of Official Agricultural Chemists, 10th Ed. Prentice Hall of India, Washington D.C., pp.744-745.

ARUNACHALAM, V. AND BANDYOPADHYAY, A., 1979, "Are multiple cross, multiple pollen hybrids", an answer for productive populations in Brassica campestris var. Brown Sarson? 1. Methods for studying 'Mucomorphs'. Theor. Appl. Genet., 54: 203-207.

ARUNACHALAM, V., BANDYOPADHYAY, A., NIGAM, S.N. AND GIBBONS, R.W., 1984, Heterosis in relation to genetic divergence and specific combining ability in groundnut (Arachis hypogea L.). Euphytica, 33: 33-39.

BAHA-ELDIN, S.A., BLACK HURST, H.T. AND PERRY, B.A., 1968, The inheritance of certain qualitative and quantitative characters in egg plant (Solanum melongena L.). Proc. Ame. Soc. Hort. Sci., 92: 480-497.

BAKER, R.J., 1978, Issues in diallele analysis. Crop Sci., 18: 533-536.

BALAMOHAN, T.N., SUBBIAH, R. AND SHANMUGVELU, K.G., 1983, Studies on heterosis in brinjal (Solanum melongena L.) (Abstract). Proceed. cong. Sci. Gen. Improv. Heter. Syst., Coimbatore (India), 23-24.

BHUTANI, R.D., KALLOO, G., SINGH, P. AND SIDHU, I.S., 1980, Heterosis and combining ability in brinjal (Solanum melongena L.). Haryana Agric. Univ. J. Res., 10:476-484.

BHUTANI, R.D., SINGH, G.P., KALLOO, G., 1977, A note on variability studies in brinjal (Solanum melongena L.). Haryana J. Hort. Sci., 6: 190-192.

BORIKAR, S.T., MAKNE, V.G. AND KULKARNI, U.G., 1981, Note on diallel analysis in brinjal. Indian J. agric. Sci., 51: 51-52.

BRIM, C.A., 1966, A modified pedigree method of selection in soybeans. Crop Sci., 6: 220.

BURTON, G.W. AND DEVANE, 1953, Estimating heritability in tall fiscue (Festula arundiracea L.) from replicated clonal material. Agron. J., 45: 478-481.

CAPININ, J.M. AND ALVIAR, M.A., 1949, Heterosis in egg plant. Philipp. Agric., 33: 126-141.

CHADHA, M.L. AND HEGDE, R.K., 1987, Graphic analysis of some agronomic characters in brinjal. _Ind. J. Hort._, _44_: 220-225.

CHADHA, M.L. AND HEGDE, R.K., 1989, Combining ability studies in brinjal. _Ind. J. Hort._, _46_: 44-52.

CHADHA, M.L., JOSHI, A.K. AND GHAI, T.R., 1990b, Heterosis breeding in brinjal (_Solanum melongena_ L.). _Ind. J. Hort._, _47_: 417-423.

CHADHA, M.L. AND PAUL, B., 1984, Genetic variability and correlation studies in egg plant (_Solanum melongena_ L.). _Ind. J. Hort._, _41_: 101-107.

CHADHA, M.L. AND SHARMA, C.M., 1989, Inheritance of yield in brinjal. _Ind. J. Hort._, _46_: 485-489.

CHADHA, M.L., SHARMA, C.M. AND BAJAJ, K.L., 1990a, Inheritance of bitterness in brinjal (_Solanum melongena_ L.). _Ind. J. Hort._, _47_: 244-249.

CHADHA, M.L. AND SIDHU, A.S., 1982, Studies on hybrid vigour in brinjal (_Solanum melongena_ L.). _Ind. J. Hort._, _39_: 233-238.

CHADHA, M.L. AND SIDHU, A.S., 1983, Variability and correlation studies in brinjal (_Solanum melongena_ L.). _Ind. J. Hort._, _40_: 60-64.

CHAUDHARY, L.B. AND PRASAD, B., 1968, Genetic variation and heritability of quantitative characters in Indian mustard (*Brassica juncea* L.) Czerh and Cross II. *Indian J. agric. Sci.*, **38**: 820-825.

*CHEAH, C.H., KWAN, K.H. AND NURMALA, M.D.N., 1981, Genetics of brinjal (*Solanum melongena* L.). In: *Fourth Int. SABRAO Congr.* Kaulalumpur (cf. *Pl. Breed. Abstr.*, **51**: 3500).

CHOUDHARY, B., 1966, Exploiting hybrid vigour in vegetables. *Indian Hort.*, **10**: 56-58.

CHOUDHARY, D.N. AND MISHRA, G.M., 1988, Heterosis for morphological characters in inter-varietal crosses of brinjal (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, **17**: 221-227.

CHOUDHARI, H.C., 1972, Genetical studies in some West African *Solanum melongena* L. *Canadian J. Genet. Cyto.*, **14**: 446-449.

CHOUDHARI, H.C., 1977, Genetical studies in West African egg-plant. *Indian J. Genet.*, **37**: 46-53.

COWEN, N.M. AND FREY, K.J., 1987, Relationship between three measures of genetic distance and breeding behaviour in oats (*Avena sativa* L.). *Genome*, **29**: 97-106.

COX, T.S., KIANG, Y.T., GORMAN, M.B. AND RODGERS, D.M., 1985, Relationship between coefficient of parentage and genetic similarity indices in the soybean. *Crop Sci.*, **25**: 529-532.

DAHIYA, M.S., DHANKHAR, B.S. AND KALLOO, 1984. Hybrid performance in eggplant (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, **13**: 147-149.

DAHIYA, M.S., DHANKHAR, B.S., KALLOO AND PANDITA, M.L., 1985. Line x Tester analysis for the study of combining ability in brinjal (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, **14**: 102-107.

*DASKALOFF, C.H., 1937. The study of heterosis in the eggplant and possibility of its practical utilisation in horticulture. *Rev. Inst. Rech. Agron. Bulg.*, **7**: 56-76 (Cf. *Pl. Breed. Abstr.*, **11**: 499).

*DASKALOFF, C.H., 1941. The study of heterosis in the egg plant (*Solanum melongena* L.) and the possibility of its practical utilisation. *Forschungsdienst*, **12**: 617-618 (Cf. *Pl. Breed. Abstr.*, **12**: 1224).

DEVI, Y.S. AND SANKAR, C.R., 1991. Path coefficient analysis of some biometric characters in brinjal. *J. Maharashtra agric. Univ.*, **16**: 104-105.

DEWEY, D.R. AND LU, K.H., 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.*, **51**: 515-518.

DHANKHAR, B.S., GUPTA, V.P. AND SINGH, K., 1977, Screening and variability studies for relative susceptibility to shoot and fruit borer in normal and ratoon crop of brinjal. Haryana J. Hort. Sci., 6: 50-58.

DHANKHAR, B.S., MEHROTRA, N., CHAUDHARY, B.D. AND PANDITA, M.L., 1979, Studies in genetic diversity for shoot and fruit borer (Leucinodes arbonalis Gn.) in normal and ratoon crop of brinjal (Solanum melongena L.). Haryana J. Hort. Sci., 8: 107-111.

DHANKHAR, B.S., MEHROTRA, N. AND SINGH, K., 1980, Heterosis in relation to yield components and shoot and fruit borer (Leucinodes orbonalis GN) in brinjal (Solanum melongena L.). Genet. Agrar., 34: 215-220.

DHANKHAR, B.S. AND SINGH, K., 1983, Genetic variability and correlation studies in brinjal (Solanum melongena L.). Ind. J. Hort., 40: 221-227.

DHANKHAR, B.S. AND SINGH, K., 1984, Path analysis for fruit yield and its components in brinjal. Haryana J. Hort. Sci., 13: 38-41.

DHARMEGOWDA, M.V., 1975, Genetic analysis of yield and yield components in brinjal (Solanum melongena L.). M.Sc. (Agri.) Thesis, UAS, Bangalore.

DHARMEGOWDA, M.V., 1977. Genic analysis of yield and yield components in brinjal (*Solanum melongena* L.). *Mysore J. agric. Sci.*, **11**: 426.

DHARMEGOWDA, M.V., HIREMATH, K.G. AND GOUD, J.V., 1979a. Genic analysis of yield and its components in brinjal (*Solanum melongena* L.). *Mysore J. agric. Sci.*, **13**: 151-155.

DHARMEGOWDA, M.V., HIREMATH, K.G. AND GOUD, J.V., 1979b. A study of heterosis in brinjal (*Solanum melongena* L.). *Mysore J. agric. Sci.*, **13**: 257-261.

DIXIT, J., BHUTANI, R.D. AND DUDI, B.S., 1982. Heterosis and combining ability in egg plant. *Indian J. agric. Sci.*, **52**: 444-447.

DIXIT, J., DUDI, B.S., PARTAP, P.S. AND BHUTANI, R.D., 1984. Gene action for yield characters in egg plant. *Indian J. agric. Sci.*, **54**: 557-559.

DIXIT, J. AND GAUTAM, N.C., 1987. Studies on hybrid vigour in egg plant (*Solanum melongena* L.). *Ind. J. Hort.*, **44**: 74-77.

*FUKUSAWA, C.A., 1964. Genetics of clustered and solitary fruit segregants from inter-specific cross between *Solanum melongena* x *S. cumingii* Dunal. *Arancta J. agric.* **11**: 55-75 (Cf. *Pl. Breed. Abstr.*, **36**: 1177).

*GENCHEV, S. AND POPOVA, D., 1973, A study on plastid pigments content in connection with the manifestation of heterosis effect in egg plant (*Solanum melongena* L.) *Comples Rendus dekcademis Agnicola Georgi Dimitriv*. *6*: 239-243. (Cf. *Hort. Abstr.*, *44*: 7719).

GILL, H.S., ARORA, R.S. AND PACHAURI, D.C., 1976, Inheritance of quantitative characters in egg plant. *Indian J. agric. Sci.*, *46*: 484-490.

GOPIMONY, R., NAYAR, N.K. AND GEORGE, M.K., 1986, Genetic variability in brinjal germplasm. *Agric. Res. J. Kerala*, *22*: 129-132.

GOPINATH, G. AND MADALAGERI, B.B., 1986, Genetics of yield and its components in brinjal (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, *15*: 103-109.

GOTOH, K., 1952, Studies on the heterosis in egg plant. Preliminary Report. *Jap. J. Breed.*, *1*: 196.

GOTOH, K., 1953, Genetic studies in egg plant (*Solanum melongena* L.). I. Regression analysis of quantitative gene action. *Genetica*, *26*: 445-457.

GOTOH, K., 1956, Variance and co-variance analysis applied to quantitative inheritance in egg plant. *Jap. J. Breed.*, *6*: 180-184.

GOULDEN, C.H., 1959, *Methods of Statistical Analysis*. 2nd Edn. Asia Pub. House, Calcutta.

GRIFFING, B., 1956a, Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 9: 463-493.

GRIFFING, B., 1956b, A generalized treatment of the use of diallel cross in quantitative inheritance. Heredity, 10: 31-50.

GRUBBEN, C.J.H., 1977, Tropical vegetables and their genetic resources. Eds. H.D. Tindall and J.T.Williams, pp.2-36.

*HANI, M., BADR KHALF-ALLAH, A.M., ELSHAL, M.A., ABDELKADER,M.M. AND DOOS, M.K., 1977, Estimation of heterosis in egg-plant.(Solanum melongena L.). Alex. J. Agric. Res., 25: 365-471. (Cf. Pl.Breed. Abstr., 48: 10254.)

HAYS, H.K., IMMER, F.R. AND SMITH, D.C., 1955, Methods of Plant breeding. McGraw Hill Book Co. Inc., New York. pp.551.

HERBERT, Y. AND GALLAIS, A., 1986, Heterosis and genetics for quantitative characters in 12 x 12 diallel mating design in maize. In: Proc. 6th Meet. EUCARPIA Sect. Biometrica in Pl.Breed., Urio, Birmingham, UK. pp.114-118.

HIREMATH, K.G. AND RAO, G., 1974, Genetic variability and correlation studies in Solanum melongena L. Mysore J. agric. Sci., 8: 197-202.

JADHAV, L.H., 1967, Studies on the heterosis in F_1 hybrids of intervarietal crosses in brinjal (Solanum melongena L.) and maintenance of purity of parental varieties and production of hybrid seed for exploitation of hybrid vigour. M.Sc.(Agri.) Thesis, Poona University, Poona (India).

JENSEN, N.F., 1970, A diallel selective mating system for cereal breeding. Crop Sci., 10: 629-635.

JINKS, J.L., 1983, Biometrical genetics of heterosis. In: Heterosis reappraisal of theory and practice. Monograph on theoretical and applied genetics. Ed. R.Frankel, Heidelberg, Berlin, New York, pp.1-46.

JINKS, J.L. AND HAYMAN, B.I., 1953, The analysis of diallel cross. Maize Genet. Newslett., 27: 48-54.

*JOARDER, O.I., ISLAM, G.N., SALEHUZZAMAN, M. AND ALAM, M.S., 1981, Inheritance of some quantitative characters in egg plant Solanum melongena L. Genetica Polonica 22: 91-102 (Cf. Pl.Breed. Abstr., 52: 894.

JOHNSON, H.W., ROBINSON, H.F. AND COMSTOCK, R.E., 1955, Estimates of genetic and environmental variability in soybean. Agron. J., 47: 314-318.

*KAKIZAKI, Y., 1928, Hybrid vigour in Solanum melongena L. Agric. and Hortic., 3: 371-380 (Cf. Biol.Abstr., 4:3534).

KAKIZAKI, Y., 1930, Breeding crossed egg plants in Japan. *J. Hered.*, *21*: 253-258.

KAKIZAKI, Y., 1931, Hybrid vigour in egg plant and its practical utilisation. *Genetics*, *16*: 1-25.

KALDA, T.S., SURAN, B.S. AND GUPTA, S.S., 1988, Phenotypic, genotypic variation and heritable components of some biometrical characters in egg plant. *South Ind. Hort.*, *36*: 110-113.

KALYANASUNDARAM, P., 1979, Correlation studies between various characters in brinjal (*Solanum melongena* L.). *Sci. Cult.*, *45*: 250-251.

KANDASWAMY, P., SINGH, N., KALDA, T.S., SIRCHI, P.S. AND CHOUDHARY, B., 1983, Heterosis and combining ability in egg plant. *Indian J. agric. Sci.*, *53*: 201-206.

KHAPRE, P.R., DEOKAR, A.B. AND WANJARI, K.B., 1987a, Inheritance of spininess in *Solanum melongena* x *Solanum indicum*. *J. Maharashtra agric. Univ.*, *12*: 107-108.

KHAPRE, P.R., WANJARI, K.B. AND DEOKAR, A.B., 1985, Genetic studies in *Solanum melongena* x *Solanum indicum* L. *P.K.V. Res. J.*, *9*: 13-18.

KHAPRE, P.R., WANJARI, K.B. AND DEOKAR, A.B., 1986, Inheritance of some colour characters in the interspecific cross *Solanum melongena* x *Solanum indicum*. *J. Maharashtra agric. Univ.* *1*: 296-298.

KHAPRE, P.R., WANJARI, K.B. AND DEOKAR, A.B., 1987b, Inheritance of fruiting pattern in egg plant. *J. Maharastra agric. Univ.*, *12*: 401.

KHAPRE, P.R., WANJARI, K.B. AND DEOKAR, A.B., 1987c, Addition of one more gene in the pst linkage group of *Solanum melongena* x *Solanum indicum* L. *P.K.V. Res. J.*, *11*: 127-132.

KHURANA, S.C., KALLOO, G., SINGH, C.B. AND THAKRAL, K.K., 1988, Correlation and path analysis in egg plant (*Solanum melongena* L.). *Indian J. agric. Sci.*, *58*: 799-800.

KOHINKAR, B.K., 1980, Heterosis and combining ability in brinjal (*Solanum melongena* L.). *M.Sc.(Agri.) Thesis*. M.P.A.U., Rahuri (India).

KOMOCHI, S., 1963, Fruit productivity in hybrid egg plants in relation to vegetative growth. *Jap. J. Breed.*, *13*: 269-276.

KOMOCHI, S., 1966, Gene controlling early maturation of F_1 hybrids of egg plants. *Jap. J. Breed.*, *16*: 31-38.

KUMAR, R.N., BISHT, J.K. AND JOSHI, M.C., 1990, Interrelationship of quantitative traits in egg plant. *Madras Agric. J.*, *77*: 86-69.

KUMAR, N. AND RAM, M.H., 1987, Combining ability and gene effect analysis of quantitative characters in egg plant. *Indian J. agric. Sci.*, *57*: 89-102.

KUMAR, N. AND RAM, M.H., 1989, 1989, Components of genetic variation in egg plant. *Crop Improv*., *16*: 92-94.

LAL, S. AND PATHAK, M.M., 1974, Combining ability in brinjal (*Solanum melongena* L.). *Indian J. Genet*., *34*:395-399.

LAL, S. AND SRIVASTAVA, B.P., 1978, Genetic divergence in brinjal (*Solanum melongena* L.). *Veg.Sci*., *5*: 89-92.

LAL, S., VERMA, G. AND PATHAK, M.M., 1974, Hybrid vigour for yield and yield components in brinjal (*Solanum melongena* L.). *Ind. J. Hort*., *31*: 52-54.

LANTICAN, R.M., RAJBHAIRI, G.R., CARANGAL, V.R. AND DEANON, J.R., 1936, Heterosis in *Solanum melongena* L. *Phillip. Agric*., *47*: 117-128.

LAWANDE, K.E., GADAKH, S.R., KALE, P.N. AND JOSHI, V.R., 1992, Generation mean analysis in brinjal. *J. Maharashtra agric. Univ*., *17*: 62-63.

LINGHAM, D.G., 1961, The high-low method of crop improvement. *Crop Sci*., *1*: 376-378.

LUSH, J.L., 1940, Heritability of qualitative characters in farm animals. *Proc. VIII Congr. Genet*., *Heriditas Suppl*., 375-376.

MAHALANOBIS, P.C., 1936, On the generalized distance in statistics. *Proc. Nat. Acad. Sci*., India, *2*:49-55.

MAK, C. AND VIJIARUNGAM, A.F., 1980, Variability in bacterial wilt resistance and interrelationships of some characteristics of brinjal (*Solanum melongena* L.). *SABRAO J.*, **12**: 65-75.

MATZINGER, D.F., 1963, Experimental estimates of genetic parameters and their application in self fertilizing plant. In: *Statistical genetics and plant breeding*. Eds. W.D. Hanson and H.F.Robinson, NAS-NRC,Washington.

MEHROTRA, H.N. AND DIXIT, P.K., 1973, Estimates of variability in egg plant (*Solanum melongena* L.). *Rajasthan J. Agric. Sci.*, **4**: 8-12.

MISHRA, G.M., 1961, Investigations on hybrid vigour in brinjal (*Solanum melongena* L.). *Ind. J. Hort.*, **18**: 305-317.

MISHRA, G.M., 1966, Preliminary chemical studies in four varieties of brinjal (*Solanum melongena* L.). and their F_1 hybrids. *Sci. Cult.*, **32**: 545-546.

MISHRA, G.M. AND ROY, S.N., 1976, Genotypic and phenotypic variability in brinjal (*Solanum melongena* L.). *Veg. Sci.*, **3**: 25-28.

MISHRA, S.N. AND MISHRA, R.S., 1990a, Correlation and path coefficient analysis in brinjal (*Solanum melongena* L.). *Environ. Ecol.*, **8**: 162-166.

MISHRA, S.N. AND MISHRA, R.S., 1990b, Variability, heritability and genetic advance in the F_1 generation of a diallel cross in brinjal. Ind. J. Hort., 47: 93-96.

MISHRA, S.N. AND MISHRA, R.S., 1990c, Diallel analysis for combining ability in brinjal. Ind. J. Hort., 47:239-243.

MITAL, R.K., SINGH, S.N. AND SINGH, H.N., 1976, Genetics of some characters in brinjal (Solanum melongena L.). Veg. Sci., 3: 79-86.

MORE, D.C., PATIL, S.B. AND NIMBALKAR, V.S., 1982, Inheritance of some characters in brinjal cross SM 2 x Nimbalkar Green Round. J. Maharashtra agric. Univ., 7: 243-244.

MUJUMDAR, D.N. AND RAO, C.R., 1958, Bengal anthropomorphic survey, 1945. A statistical study. Sankya, 19:201-408.

*NAGAI, K. AND KIDA, M., 1926, An experiment with some crosses of egg plant (In Japanese). Jap. J. Genet., 4: 10-30. (Cf. Biol. Abstr., 3: 4571, 1929).

NAINAR, P., SUBBIAH, R. AND IRULAPPAN, I., 1990, Path coefficient analysis in brinjal. South Ind. Hort., 38:18-19.

NAINAR, P., SUBBIAH, R. AND IRULAPPAN, I., 1991, Variability, heritability and genetic advance in brinjal (Solanum melongena L.). South Ind. Hort., 39: 32-36.

NAIR, P.M. AND VAIDYANATHAN, C.S., 1964, A colorimetric method for determination of pyrocatechol and related substances. Analytical Biochem., 7: 315-321.

NELSON, N., 1944, A photometric adoption of Somogyi method for determination of glucose. J. Biol. Chem., 153: 375-380.

NIMBALKAR, V.S. AND MORE, D.C., 1980, Genetic studies in a brinjal (Solanum melongena L.). cross Muktakeshi x White Green. J. Maharashtra agric. Univ., 5 :208-210.

NIMBALKAR, V.S. AND MORE, D.C., 1981a, Genetic studies in a brinjal (Solanum melongena L.) cross Nimbalkar Green Round x SM 213. J. Maharashtra agric. Univ., 6: 202-204.

NIMBALKAR, V.S. AND MORE, D.C., 1981b, Inheritance of fruit shape in a brinjal (Solanum melongena L.) Cross White Green x Manjari Gota. J. Maharashtra agric. Univ., 6: 253-254.

ODLAND, M.L. AND NOLL, C.J., 1948, Hybrid vigour and combining ability in egg plant. Proc. Amer. Soc. Hort. Sci., 51: 417-422.

*OGANESYAN, A.G., 1971, Heterosis for earliness in first generation egg plant hybrids. Referativnyi Zhurnal 2: 55-47. (Cf. Pl.Breed. Abstr., 42: 9327).

*OGANESYAN, A.G., 1976, Some problems of heterosis for yield in egg plant. Izv. S.Kh.nauk Arm. SSR Zhurnal, 5: 241. (Cf. Pl.Breed. Abstr., 48: 6052).

PAL, B.P. AND SINGH, H.B., 1946, Studies in hybrid vigour. II. Notes on the manifestation of hybrid vigour in the brinjal and bitter gourd. Indian J. Genet., 6: 19-33.

PAL, B.P. AND SINGH, H.B., 1949, Hybrid brinjals gave increased yields. Indian Fmg., 10: 378-380.

PANSE, V.G. AND SUKHATME, P.V., 1967, Statistical methods for Agricultural workers. ICAR, New Delhi.

PATIL, H.S. AND SHINDE, Y.M., 1985, Combining ability studies for different characters in egg plant. J.Maharashtra agric. Univ., 10: 179-181.

PATIL, R.B. AND SHINDE, S.R., 1984, Heterosis in egg plant. J. Maharashtra agric. Univ., 9: 289-292.

PATIL, S.R. AND MORE, D.C., 1983a, Inheritance studies in brinjal. J. Maharashtra agric. Univ., 8: 43-45.

PATIL, S.Y. AND MORE, D.C., 1983b, Inheritance studies of some characters in brinjal. J. Maharashtra agric. Univ., 8: 47-49.

PATIL, S.K. AND MORE, D.C., 1983c, Genetics of pigmentation in brinjal. J. Maharashtra agric. Univ., 8: 126-127.

PETER, K.V. AND SINGH, R.D., 1973, Diallel analysis of economic traits in brinjal. Indian J. agric. Sci., 43: 452-455.

PETER, K.V. AND SINGH, R.D., 1974, Combining ability, heterosis and analysis of phenotypic variation in brinjal. Indian J. agric. Sci., 44: 393-399.

*POPOVA, D., MURTAZOV, T., PETROV, K.H. AND DASKALOV, S., 1976, Some manifestations of heterosis in egg plant. Bio. Zhu. Arm. 29: 67-72 (Cf. Pl.Breed. Abstr., 46: 9699).

PRASAD, B. AND PRAKASH, R., 1974, Genotypic and phenotypic variability in egg plant (Solanum melongena L.). Curr. Res., 3: 29-30.

RAJASEKARAN, S., 1970, Sterility in an intervarietal hybrids, Solanum melongena x S.melongena var. bulsarensis Argikar. Madras Agric. J., 57: 194-195.

RAMAN, K.R., 1964, Further studies on hybrid vigour in brinjal (Solanum melongena L.). Madras Agric. J., 51: 79.

RANDHAWA, J.S., KUMAR, J.C. AND CHADHA, M.L., 1989, Correlation and path analysis in long fruited brinjal (*Solanum melongena* L.). *Veg. sci.*, *16*: 39-48.

RANDHAWA, K.S. AND SUKHIJA, B.S., 1973, A study of heterosis and its retention in F_2 generation in brinjal(*Solanum melongena* L.). *Haryana J. Hort. Sci.*, *2*: 76-82.

RANGASWAMY, P. AND KADAMBAVANASUNDARAM, M., 1973, A study on the inheritance of certain qualitative characters in the cross between *Solanum indicum* L. and *Solanum melongena* L. *South Ind. Hort.*, *21*: 1-6.

RAO, C.R., 1952, *Advanced Statistical Methods in Biometry*. John Wiley, New York.

RAO, N., PONNAIYA, B.W.X. AND MADAV MENON, P., 1969, Studies on the interspecific hybrids of non-tuberiferous species of *Solanum* L. *South Indian Hort.*, *17*: 71-78.

ROBINSON, H.F., COMSTOCK, R.E. AND HARVEY, P.H., 1949, Estimates of heritability and degree of dominance in corn. *Agron. J.*, *41*: 353-359.

SALEHUZZAMAN, M., 1981, Investigation on hybrid vigour in *Solanum melongena* L. *SABRAO J.*, *13*: 25-31.

SALEHUZZAMAN, M. AND ALAM, M.S., 1983, Genetic analysis of yield and its components in egg plant. *SABRAO J.*, *15*: 11-15.

SALEHUZZAMAN, M. AND JOARDER, O.I., 1980, Correlation and selection index in egg plant (*Solanum melongena* L.). *Genetica Agraria*, **34**: 193-205.

SALIMATH, S.B., 1979, Diallel analysis of yield and yield components in brinjal (*Solanum melongena* L.). *M.Sc. Thesis*, UAS, Bangalore.

SAMBANDAM, C.N., 1964, Inheritance of hypocotyl colour in brinjal. *Indian J. Genet.*, **24**: 175-176.

SAMBANDAM, C.N., 1969, Some genetics of the purple colour in egg plants. *Annamalai Univ. agri. Res. Ann.*, **1**: 1-7.

SAWANT, S.V., DESAI, U.T., KALE, P.N. AND JOI, M.B., 1991, Combining ability studies in egg plant for wilt resistance and yield characters. *J. Maharashtra agric. Univ.*, **16**: 343-346.

SOOSSIRCLI, R.E., SILVETTI, E. AND BRUNNELI, B., 1972, The genetics of some components of yield in the egg plant. *Genetica Agraria*, **26**: 321-339.

SHANKARAIAH, V. AND RAO, R.R., 1990, Studies on heterosis for growth characters and earliness in brinjal. *Veg. Sci.*, **17**: 56-62.

SHARIFF, R.A. AND HABIB, A.F., 1977, Inheritance studies in interspecific crosses of *Solanum xanthocarpum* and *S.melongena* L. *Veg. Sci.*, **4**: 22-24.

SHARMA, N.K., DHANKHAR, B.S. AND PANDITA, M.L., 1985, Inter-relationship and path analysis studies for yield and susceptibility to shoot and fruit borer components in brinjal. _Haryana J. Hort. Sci._, _14_: 114-117.

SIDHU, A.S., BHUTANI, R.D., KALLOO, AND SINGH, G.P., 1980, Genetics of yield components in brinjal (_Solanum melongena_ L.). _Haryana J. Hort. Sci._, _9_: 160-164.

SIDHU, A.S. AND CHADHA, M.L., 1985, Heterosis and _per se_ performance studies in brinjal. _Ind. J. Hort._, _42_: 107-111.

SIDHU, A.S. AND CHADHA, M.L., 1988, Metroglyph and index score analysis in brinjal. _Ind. J. Hort._, _45_: 85-88.

*SILVETTI, E. AND BRUNELI, B., 1970, Analysis of a diallel cross among some egg plant varieties and of their F_1 progeny. _Genet. agr. Pavia_, _24_: 258-268 (Cf. _Pl. Breed. Abstr._, _41_: 9210).

SINDE, S.R. AND PATIL, R.B., 1984, Line x tester analysis for the study of combining ability in brinjal. _J. Maharashtra agric. Univ._, _9_: 163-165.

SINGH, B., JOSHI, S. AND KUMAR, N., 1978, Hybrid vigour in brinjal (_Solanum melongena_ L.). _Haryana J. Hort. Sci._, _7_: 95-99.

SINGH, B. AND KHANNA, K.R., 1978, Correlation studies in egg plant. *Ind. J. Hort.*, *35*: 39-42.

SINGH, B. AND KHANNA, K.R., 1979, Inheritance of some quantitative characters in brinjal. *Ind. J. Hort.*, *36*:80-83.

SINGH, B. AND KUMAR, N., 1988, Studies on hybrid vigour and combining ability in brinla (*Solanum melongena* L.). *Veg. Sci.*, *15*: 72-78.

SINGH, D.K. AND GAUTAM, N.L., 1991, Genetics of quantitative traits in Brinjal. *Veg. Sci.*, *18*: 177-183.

SINGH, D.K., GAUTAM, N.C., AWASTHI, C.P. AND SINGH, R.D., 1988, Biochemical composition of fruits of promising brinjal varieties and hybrids (*Solanum melongena* L.). *Veg. Sci.*, *15*: 141-148.

SINGH, D.P. AND PRASAD, V.S.R.K., 1991, Genetic divergence of parents and hybrids in *Solanum melongena* L. *Ind. J. Hort.*, *48*: 139-144.

SINGH, H. AND KALDA, T.S., 1989, Heterosis and genetic architecture of leaf and yield characters in egg plant. *Ind. J. Hort.*, *46*: 53-58.

SINGH, H. AND NANDPURI, K.S., 1974, Genetic variability and correlation studies in egg plant (*Solanum melongena* L.) *Jour. of Res.*, *PAU*, *11*: 150-157.

SINGH, H.N., SINGH, S.N., VERMA, H.P.S., MITAL, R.K. AND SINGH, R.R., 1974, Combining ability in brinjal (*Solanum melongena* L.). *Indian J. agric. Sci.*, **44**: 151-155.

SINGH, N.N. AND MITAL, R.K., 1988, Genetics of yield and its components in egg plant (*Solanum melongena* L.). *Ind. J. agric. Sci.*, **58**: 402-403.

SINGH, O. AND PARODA, R.S., 1984, A comparison of different diallel analysis. *Theor. Appl. Genet.*, **67**: 541-545.

SINGH, R.D. AND RAI, B., 1990, Studies on heterosis and gene action in brinjal (*Solanum melongena* L.). *Veg. Sci.* **17**: 180-185.

SINGH, S.N., 1984, The magnitude of GCA in relation to heterosis and inbreeding depression in egg plant. *Haryana J. Hort. Sci.*, **13**: 175-181.

SINGH, S.N., CHAUHAN, Y.S. AND SINGH, N.D., 1981, Combining ability analysis for some quantitative characters in egg plant (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, **10**: 95-101.

SINGH, S.N. AND SINGH, H.N., 1980a, Association in segregating populations of brinjal. *Indian J. Genet.*, **40**: 322-326.

SINGH, S.N. AND SINGH, H.N., 1980b, Genetic variability and heritability in brinjal (*Solanum melongena* L.). *Progr. Hort.*, **12**: 13-17.

SINGH, S.N., SINGH, H.N. AND HAZARIKA, M.H., 1979, Fractional diallel analysis of some quantitative characters in brinjal. *Acta Hort.*, **93**: 307-316.

SINGH, S.N., SINGH, H.N., SINGH, N.D. AND JAIN, B., 1978, Hybrid performance in hybrid. *Haryana J. Hort. Sci.*, **7**: 74-77.

SINGH, S.N. AND SINGH, N.D., 1981, Correlation and path analysis in brinjal. *Progr. Hort.*, **13**: 13-16.

SINGH, S.N., SINGH, N.D. AND HAZARIKA, G.N., 1982, A note on degree of dominance and parental mean performance in brinjal (*Solanum melongena* L.). *Haryana J. Hort. Sci.*, **11**: 146-148.

SINGH, S.N., SINGH, N.D., CHAUHAN, S. AND KATIYAR, R.P., 1974, Genetic variability, heritability and genetic advance in brinjal (*Solanum melongena* L.). *Progr. Hort.*, **6**: 16-18.

SINHA, B.K., PRAKASH, R. AND HAGUE, M.F., 1966, Linkage studies in brinjal. *Indian J. Genet.*, **26**: 223-226.

SINHA, S.K., 1983, Path coefficient analysis for some quantitative characters in brinjal (*Solanum melongena* L.). *Madras Agric. J.*, *70*: 351-354.

SNEDECOR, G.W. AND COCHRAN, W.G., 1967, *Statistical methods*. Oxford and IBH Publ. Co., Bombay. pp.560.564.

SRIVASTAVA, L.S. AND SAGHAN, S.C.P., 1973a, Correlation coefficient and path analysis in brinjal. *Indian J. agric. Sci.*, *43*: 673-675.

SRIVASTAVA, L.S. AND SACHAN, S.C.P., 1973b, Variability study in brinjal (*Solanum melongena* L.). *Punjab Hort. J.*, *13*: 46-49.

SRIVASTAVA, O.P. AND BAJPAI, P.N., 1977, combining ability in egg plant. *Indian J. agric. Sci.*, *47*: 181-184.

SWAIN, T. AND HILLIS, W., 1959, The phenolic constituents of prunus domestica. The quantitative analysis of phenolic constituents. *J. Sci. Fd. Agric.*, *10*:63-68.

SWAMY RAO, T., 1970, A preliminary note on the inheritance of qualitative characters in brinjal. *Madras Agric. J.* *57*: 508-509.

TAMBE, T.B., 1984, Genetic diversity and correlation studies in brinjal (*Solanum melongena* L.). *M.Sc.(Agri.) Thesis*. M.P.A.U., Rahuri, India.

THAKUR, M.R., SINGH, K. AND SINGH, J., 1968, Hybrid vigour studies in brinjal (*Solanum melongena* L.). *J. Res. PAU*, 5: 490-495.

THAKUR, M.R., SINGH, K. AND SINGH, J., 1969, Inheritance of some qualitative characters in brinjal (*Solanum melongena* L.). *J. Res. PAU*, 6: 769-775.

THOMPSON, C.M. AND KELLY, C.W., 1957, *Vegetable crops*. Public. McGraw-Hill Book Co. Inc., New York, pp.501.

*TIGCHELAAR, E.G., 1967, Genetic and photo control of anthocyanin colouration in egg plant (*Solanum melongena* L.) *Diss. Abstr.*, 27: 66 (Cf. *Pl.Breed. Abst.*, 37:7175).

TIWARI, R.D., 1966, Studies on hybrid vigour in *Solanum melongena* L. *J. Indian Bot. Soc.*, 45: 138-149.

TODKAR, J.S., 1975, Heterosis studies in some F_1 hybrids of intervarietal crosses in brinjal. *M.Sc.(Agri.)Thesis*. M.P.A.U., Rahuri (India).

TURNER, J.H., 1953, A study of heterosis in upland cotton II. Combining ability and inbreeding effects. *Agron. J.* 45: 487-490.

VADIVEL, E. AND BAPU, J.R.K., 1988, Genotypic correlation and path coefficient analysis in egg plant (*Solanum melongena* L.). *South Ind. Hort.*, 36: 304-307.

VADIVEL, E. AND BAPU, J.R.K., 1989a, Studies on coheritability for yield components in egg plant. Capsicum Newslett., 8-9: 66-67.

VADIVEL, E. AND BAPU, J.R.K., 1989b, Path analysis of yield components in egg plant. Capsicum Newslett., 8-9: 68-69.

VADIVEL, E., BAPU, J.R.K., 1989c, Studies on genetic variability and heritability estimates in F_2 and F_3 generation in egg plant (Solanum melongena L.). South Ind. Hort., 37: 75-76.

VADIVEL, E. AND BAPU, J.R.K., 1990a, Estimation of heritability through parent offspring analysis in egg plant (Solanum melongena L.). Indian J. agric. Sci., 60: 139-140.

VADIVEL, E. AND BAPU, J.R.K., 1990b, Variability and correlation coefficients in F_2 generation of egg plant. South Ind. Hort., 38: 153-155.

VADIVEL, E., BAPU, J.R.K. AND BALASUBRAMANIAN, S., 1988, Biometrical studies in F_2 generation of intervarietal crosses in egg plant (Solanum melongena L.). South Ind. Hort., 36: 242-244.

VENKATARAMANI, H.S., 1946, Breeding brinjals (Solanum melongena L.) in Madras, I. Hybrid vigour in brinjals. Proc. Ind. Acad. Sci. Section B. 23: 266-273.

VERMA, S., 1991, Combining ability analysis for dry matter and protein content in brinjal (*Solanum melongena* L.) *Ann. agric. Res.*, **12**: 186-188.

VIJAY, O.P. AND NATH, P., 1978, Studies on heterosis and development of hybrid variety in brinjal (*Solanum melongena* L.). *Ind. J. Hort.*, **35**: 229-234.

VIJAY, O.P., NATH, P. AND JALIKOP, S.M., 1978a, Combining ability in a diallel crosses of brinjal. *Ind. J. Hort.*, **35**: 35-38.

VIJAY, O.P., NATH, P. AND JALIKOP, S.M., 1978b, Correlation and path coefficient analysis of some biometric characters in brinjal. *Ind. J. Hort.*, **35**:370-372.

VISHWANATHAN, T.V., 1973, Hybrid vigour in brinjal. *Proc. Ind. Acad. Sci.*, **77**: 176-180.

WANJARI, K.B. AND KHAPRE, P.R., 1977, Inheritance of pigmentation in *Solanum melongena* x *S. indicum*. *Genetica agraria*: **31**: 327-332.

WRIGHT, S., 1921, Correlation and causation. *J. Agric. Res.*, **20**: 557-585.

---

*Original not seen

APPENDICES

APPENDIX I: The Meteorological data for the cropping seasons

Year/month	Rainfall (mm)	Average temperature °C		Average relative humidity(%)
		Maximum	Minimum	
1990				
January	25.1	30.7	13.0	74
February	0.0	34.1	15.3	69
March	0.0	34.9	17.4	67
April	36.3	37.6	19.1	62
May	115.7	33.4	20.5	68
June	73.6	27.6	20.4	81
July	123.6	26.1	19.7	88
August	121.6	25.9	19.9	92
September	29.0	28.1	19.6	86
October	148.6	29.8	18.8	81
November	56.8	29.4	16.9	81
December	0.0	29.4	14.2	82
1991				
January	0.0	31.0	14.5	78.0
February	0.0	33.5	15.4	75.0
March	0.0	36.5	19.4	68.0
April	87.0	35.9	21.2	64.0
May	159.1	36.3	20.9	65.0
June	344.5	29.3	21.1	82.0
July	160.5	25.4	20.6	92.0
August	122.2	25.8	20.3	91.0
September	89.8	29.1	19.8	82.0
October	125.6	29.7	19.4	81.0
November	3.4	29.0	16.1	82.0
December	0.0	28.5	13.8	82.0
1992				
January	0.0	29.4	12.7	81
February	0.0	32.0	15.9	75
March	0.0	36.1	19.3	67
April	18.0	37.0	20.8	65
May	81.4	35.3	20.8	67
June	181.6	30.0	20.7	81
July	88.7	27.4	20.3	87
August	107.2	26.4	19.9	87
September	121.3	28.8	19.3	84
October	94.6	29.1	19.5	84
November	136.4	28.7	16.9	83
December	0.0	27.2	11.4	87