"STUDIES ON GENETIC DIVERSITY FOR FRUIT CHARACTERISTICS IN BRINJAL (*Solanum melongena* L.)"

M. Sc. (Ag.) THESIS

by

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DEPARTMENT OF HORTICULTURE
COLLEGE OF AGRICULTURE
INDIRA GANDHI KRISHI VISHWAVIDYALAYA
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"STUDIES ON GENETIC DIVERSITY FOR FRUIT CHARACTERISTICS IN BRINJAL (*Solanum melongena* L.)"

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CERTIFICATE - I

This is to certify that the thesis entitled **"Studies on Genetic Diversity for Fruit Characteristics in Brinjal (*Solanum melongena* L.)"** submitted in partial fulfilment of the requirement for the degree of **"Master of Science in Agriculture"** of the Indira Gandhi Krishi Vishwavidyalaya, Raipur, is a record of the bonafide research work carried out by **Ku. Deepti Patel** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by her.

Date: 12.09.2007

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CERTIFICATE – II

This is to certify that the thesis entitled **"Studies on Genetic Diversity for Fruit Characteristics in Brinjal (*Solanum melongena* L.)"** submitted by **Ku. DEEPTI PATEL** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur in partial fulfilment of the requirements for the degree of **M. Sc. (Ag.)** in the **Department of Horticulture** has been approved by the external examiner and Student's Advisory Committee after oral examination.

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Introduction

CHAPTER- I

INTRODUCTION

Brinjal (*Solanum melongena* Linn.; 2n = 24) also known as egg plant or aubergine, is one of the most popular and important vegetables grown extensively in almost all parts of India except at higher altitude. It is adapted to a wide range of climatic conditions from north to south and east to west, whereas, in hilly regions it is grown only in summer. Brinjal plant is polymorphous, erect, aculeate or unarmed herb, woody at the base and 0.5- 1.5 m in height, flowers are rather large, stalked lateral or leaf-opposed, the female ones solitary, the male in many flowered inflorescence. Calyx is tubular- campanulate, 5-lobed far less than half way down, on the outside grayish-green, often strongly tinged with purple, on both sides densely stellate- tomentose and 1.5-2.0 cm long. Corolla is gamopetalous, deeply 5-lobed, stellately spreading, on outside light violet, densely white stellate tomentose, within dark violet, glabrous, rugose and 2.5-4.0 cm in diameter. Though brinjal is self-pollinated crop, but there is high degree of cross-pollination due to heteromorphic flower structure (called as heterostyly). Extent of cross pollination has been reported as high as 29% (Ram, 1999). The flower types of brinjal are: (a) long-styled, big ovaries (b) medium-styled, oval (c) short styled and (d) pseudoshort styled. Only long-styled and medium-styled flowers are set fruit.

Brinjal is said to be the native plant of India (Thompson and Kelly, 1957) and China as secondary center of origin. It belongs to economically important family 'Solanaceae' and occupies third position among vegetables. In our country, it is

cultivated in an area of 530.3 thousand hectare with a production of 8703.8 million tonnes and productivity of 16.41 tonnes per hectare (Anon, 2005). However, in Chhattisgarh brinjal is cultivated in an area of 19445.7 hectare amongst all the vegetables with a production of 266411 million tonnes and productivity of 13.7 tonnes per hectare (Anon, 2006).

The fruit of brinjal is preferred by both vegetarians and non- vegetarians. The edible fresh and mature fruits contain 92.7% moisture and a large number of chemical components including vitamin A, vitamin C and thiamine (124 I.U., 12.0 mg and 0.04 mg, respectively) besides organic acids and minerals like magnesium (16 mg), phosphorus (47 mg), iron (0.9 mg), sodium (3.0 mg), potassium (200.0 mg) and copper (0.17 mg). It has many medicinal properties. In *Ayurveda,* it is used as appetiser, aphrodisiac, cardiotonic and beneficial in "*vata*" and "*kaph*" etc (Chadha and Kaloo, 1993). In *unani* system of medicine, roots of brinjal are used to alleviate pain, fruit is used as cardiotonic, laxative, muturant and reliever of inflammation (Chadha, 1993). Its leaves are used as narcotics and seeds as stimulant but they are apt to lead to dyspepsia and constipation (Nadkarni, 1927). White brinjal is also said to be good for diabetic patients (Choudhary, 1967).

In brinjal, a great genetic variation is available throughout the country with regard to fruit size, shape, colour, growth habit, canopy bearing habit, yield, diseases & insect-pests resistance, as well as quality and adaptability for different localities and for different growing seasons. Attentions have already been paid by several scientists to evolve the varieties with high yield potential as well as to improve the quality of fruits. Even then the productivity of brinjal in state is lower than national

average. Possible reasons are the large area of brinjal in Chhattisgarh is under locally available open-pollinated genotypes and area under F_1 hybrids is quite low. Hence, there is an urgent need of systematic breeding approach to develop suitable heterotic hybrids for cultivation in Chhattisgarh plains.

In this context, existing genetic stock provides an opportunity for selecting the suitable parents for the hybridization programme and D^2 analysis has been very effective for studying genetic diversity among the available brinjal genotypes. In this regard, knowledge of genetic diversity, its nature and degree are pre-requisite for selecting suitable parents from a germplasm pool for successful vegetable improvement especially hybridization programme as well as for heterotic hybrid development. In respect to Chhattisgarh, the information regarding the genetic divergence is lacking in general and brinjal in particular.

Thus, keeping in view the above facts, the present study entitled **"Studies on Genetic Diversity for Fruit Characteristics in Brinjal (*Solanum melongena* Linn.)."** was carried out with following objectives:

1. To determine the genetic diversity among the fruit characteristics of brinjal germplasm.
2. To study genetic variation, heritability and genetic gain for fruit yield and its components under Chhattisgarh plains.
3. To establish the inter-relationship among fruit traits and it's contributing traits as well as partitioning them into direct and indirect effects.
4. To isolate genotypes suitable for Chhattisgarh plains.

Review of Literature

CHAPTER- II

REVIEW OF LITERATURE

The updated literature pertaining to different aspects of the present study has been reviewed under the following sub-heads:

2.1 Genetic divergence

2.2 Genetic variability, heritability and genetic advance

2.3 Association analysis

2.4 Path coefficient analysis

2.1 Genetic Divergence

Genetic diversity refers to the total amount of genetic variation present in a germplasm or population or species or variety of genes and genotypes found in a particular crop species. Normally, parents are selected on the basis of phenotypic morphology. Study of genetic divergence in existing germplasm in selecting the parents for hybridization is more realistic. The genetic diversity is represented in terms of statistical distance is called D^2 statistic. It measures the distance for a number of traits between two populations. Among several statistical methods developed for measuring diversity, D^2 statistics or multivariate analysis has been extensively used for estimation of genetic diversity. The concept of D^2 statistics was given by Mahalanobis (1936) and Rao (1952) suggested its application for the assessment of genetic diversity in plant breeding. The advantage with D^2 statistics is that it enables us to obtain an indication of the distances in the p-dimensional shape

in which samples are most distinct as also to obtain an estimate of the extent to which the sets in multiple measurements differ.

Tambe *et al.* (1993) at Rahuri, Maharashtra studied diversity in twenty-five varieties of brinjal and are grouped into five clusters with substantial genetic divergence between them. The cluster mean for fruit yield was highest in cluster D (37.1 kg) and the lowest in cluster E (28.4 kg), which contained two and ten varieties, respectively.

Genetic diversity was studied for ten quantitative characters of forty diverse types of brinjal at Imphal by Yadav *et al.* (1996). They observed maximum genetic distance between clusters VI and IX during1987-88 and II and IX during 1988-99. There was no close correspondence between geographical distribution and genetic divergence. The study also revealed that clustering behaviour of entries and mean yield performance of genotypes of individual clusters were not consistent over environments.

Forty- one genotypes of aubergine were studied at Anand by Doshi *et al.* (1998) for genetic diversity in nine fruit yield and agronomic characters. They were grouped in six clusters irrespective of geographic divergence, indicating no parallelism between geographic distribution and genetic diversity. Characters like reducing sugar content, polyphenol oxidase activity, glycoalkloid content and total soluble sugars played an important role in genetic divergence between the populations.

Kumar *et al.* (1998) at Ranchi studied genetic divergence in forty accessions of *Solanum melongena* for seventeen yield-related traits. Multivariate analysis of the

results grouped the accessions into six distinct clusters and found no relationship between genetic divergence and geographical distribution. Fruit width (58.72%), fruit length (18.08%) and fruit yield per plot (12.12%) contributed most towards total divergence.

Mishra *et al.* (1998) conducted an experiment at Bhubaneshwar to study genetic divergence in twenty cultivars of brinjal. These cultivars were grouped into seven clusters. Maximum genetic distance was found between clusters IV and VI followed by clusters I and IV. Considering clusters mean and the genetic distances, the crosses of the cultivar of cluster VI (AB-2) with the cultivars of clusters I and IV were likely to recombine the genes for high yield.

Thirty-five genotypes of brinjal were studied at Raipur by Sarnaik *et al.* (1998) for genetic diversity. These genotypes were grouped in five clusters. The maximum inter-cluster distance was observed between cluster III and IV (20.38), while minimum was recorded between clusters I and II (11.80). The cluster mean for fruit yield was the highest in cluster IV (2.74 kg/plant) and the lowest in cluster V (1.36 kg/plant).

Mohanty and Prusti (2000) studied fifteen genotypes at Bhawanipatna for five economic characters of brinjal revealed sufficient diversity among the accessions for all the traits. The genotypes were grouped into six clusters. The highest inter-cluster distance was recorded between cluster V (Pusa Purple Round) and VI (Bhawani Patna Local). The characters like plant height, number of fruits per plant and average fruit weight contributed maximum to divergence. They also

observed that there was no relationship between geographical distribution and genetic divergence.

Thirty-four genotypes of brinjal of diverse origin were evaluated by Sharma *et al.* (2000) at Jorhat. The genotypes were grouped into ten clusters. Fruit circumference and average fruit weight were the main characters affecting grouping of genotypes. They also observed that geographical diversity of the genotypes was not related to genetic diversity.

Mohanty and Prusti (2001) studied fifteen genotypes for five economic characters of brinjal. The accessions were grouped into six clusters which included two solitary groups. Maximum intercluster distance (D^2 = 971.15) was observed between the clusters VI and I. No relationship was noticed between geographic distribution and genetic divergence. Average fruit weight and number of fruits per plant contributed predominantly to total divergence. Multiple crossing among cluster II (BB-26 and Black Beauty), IV (Pusa Kranti and Bhawanipatna Local) and VI (H-8) was suggested for developing high-yielding cultivars of brinjal with other desirable traits.

Prasad (2003) at Raipur studied genetic divergence in fifty-two genotypes of brinjal. The results revealed that cluster I and IV had high number of genotypes (11 each). Cluster III showed highest intra-cluster distance while, higher inter-cluster distance was observed between cluster VII and VIII. Cluster III showed high mean values for average fruit weight, days to first flowering, days to first fruit set and fruit yield per plant.

Prasad and Singh (2003) at Bangalore studied genetic distance of six parents and their possible 30 F_1s which were grouped in ten clusters. The intra-cluster distance was higher in cluster IX whereas, the inter-cluster distance was higher in cluster V and X.

Sharma and Maurya (2004) assessed forty genotypes of aubergine for genetic divergence. The genotypes were grouped into seven clusters. The characters like number of fruits per plant, 1000 seed weight and average width of fruit had the maximum contribution toward genetic divergence. Inter-cluster distance was maximum between cluster V and VII. They also found that there was no relationship between genetic divergence and geographic distribution.

Singh *et al.* (2005) studied thirty-five genotypes of brinjal for genetic diversity at Ludhiana and are grouped into eleven clusters. The clustering was irrespective of geographic divergence. Three genotypes viz., Punjab Sadabahar, Punjab Jamunigola and HP-14 exhibited maximum diversity from other genotypes and thus can effectively be used as one of the parents in hybrid breeding programme to exploit heterotic expressions for fruit yield and other economic characters.

Genetic divergence was studied using twenty-nine brinjal genotypes by Singh *et al.* (2006) at Srinagar. The genotypes were grouped into six clusters irrespective of geographical diversity. Cluster II topped in having maximum 14 genotypes, while cluster V and VI were solitary clusters. The maximum inter-cluster distance was noticed between cluster I and VI. The characters like number of fruits per plant, plant height, average fruit yield per plant, number of branches per plant contributed

maximum towards divergence and have major role in improvement of fruit yield in brinjal.

Thirty-five genotypes of brinjal were studied for genetic diversity at Ludhiana by Singh *et al.* (2006). The genotypes were grouped into eight clusters irrespective of geographic divergence. The genotype Punjab Sadabahar was highly divergent from all other genotypes and can effectively be used as one of the parent to exploit heterotic expressions for yield and other economic characters.

At Karnataka, Naik (2006) studied sixty-one genotypes of brinjal and is grouped into eight clusters. The cluster III showed maximum intra cluster distance and maximum inter-cluster distance observed between clusters III and VIII. Among sixteen characters, fruit length contributed maximum to genetic diversity followed by number of primary branches, plant height and number of fruits per cluster.

2.2 Genetic variability, heritability and genetic advance

Planning and execution of any breeding programme for improvement of quantitative traits depends to a great extent upon the magnitude of genetic variability and diversity existing in the germplasm. Hence, genetic variability is the pre-requisite for any crop improvement programme. Fisher (1918) interprets quantitative characters in terms of mendelian genetics and subsequently the estimates of genotypic and phenotypic variations were used to predict the expected genetic response. The coefficient of variability is used to assess the extent of variability between two diverse characteristics. The phenotypic and genotypic coefficients of variations were calculated according to the formula of Burton (1952).

Heritability is the transmissibility of characteristics from parents to offspring (Falconer, 1960). Heritability in a broad sense is the ration of genotypic variance to total or phenotypic variance in percentage. Lush (1940) estimates of heritability help vegetable breeder in selection of superior/desirable/elite genotypes from diverse genetic populations. Heritability and genetic advance are important selection parameters. Heritability estimates along with genetic advance are normally more useful in predicting the gain under selection than heritability estimates alone. Genetic advance denotes the improvement in the genotype value of the new population when compared to the original (parental) population and measures genetic gain under selection. So, knowledge of genetic advance to be expected by applying selection pressure to a segregating and variable population is useful in designing an effective breeding programme.

Dash and Mishra (1995) conducted an experiment in Bhubaneshwar to study genetic variability in nine genotypes of brinjal. The results revealed that yield, bacterial wilt and plant height showed high estimates of genotypic variance, genotypic coefficient of variation (GCV), heritability and genetic advance as percentage of mean.

Saraswati *et al.* (1997) studied genetic variability and heritability of twelve yield components in the parents and F_2 hybrids from six crosses at Bangalore. F_2 population of WCGR X T. Naga expressed high GCV and PCV along with high heritability and genetic advance for most of the yield components.

Rai *et al.* (1998) at Raipur estimated genetic variability and heritability in long shape brinjal hybrids on nine characters. High co-efficient of variation was

observed for average fruit weight, total number of fruits per plot, equatorial fruit length and yield. High value of heritability coupled with genetic advance was observed in fruit weight, yield, equatorial fruit length and total number of fruit indicated preponderance of additive gene action.

Rai *et al.* (1998) studied genetic variability and heritability of nine yield-contributing characters, thirteen hybrids of round-shaped brinjal at Raipur. The estimate of phenotypic, genotypic and environmental variances showed a considerable range of variation for most of the characters. Fruit weight exhibited high estimates of heritability along with high genetic advance indicating the presence of additive gene action, which proves that pure line selection, may be of use for mobilization of this character.

Doshi *et al.* (1999) at Anand conducted experiments with forty-one genotypes of brinjal. The result showed that highest GCV was observed for anthocyanin content followed by glycoalkaloid content. High heritability was observed for all the characters studied. Further, anthocyanin content, total phenols, polyphenol oxidase activity, total soluble sugars and reducing sugars had high genetic advance coupled with high heritability, which suggested that these traits are under the control of additive gene action and can be improved through simple selection.

Patel *et al.* (1999) at Anand observed the highest GCV for fruit volume followed by seed to pulp ratio. High heritability coupled with high genetic advance as per cent of mean were observed in characters like, fruit weight, fruit volume, plant height and seed to pulp ratio.

Singh and Gopalakrishnan (1999) at Vellanikkara (Kerala) conducted experiments with seventy-eight brinjal accessions for seventeen traits. The genotypic and phenotypic coefficient of variation was highest in number of fruits per plant and fruit yield per plant. The highest heritability estimate was observed in plant spread, average fruit weight, and days to 50% harvest, while number of fruits per plant and fruit yield per plant gave the highest genetic advance.

At Hisar, fourteen genotypes of aubergine were assessed for ten yield components by Kumar *et al.* (2000). Higher values of phenotypic than genotypic coefficient of variation in all the three environments indicated the role of environmental influence in the expression of various characters. High heritability coupled with high genetic advance was recorded for number of fruits per plant and fruit weight.

Genetic variability was studied in forty genotypes of brinjal for twenty-one characters by Negi *et al.* (2000) at Hisar. Significant differences were found among the genotypes for all the traits, indicating wide range of variation. High GCV were found for number of fruits per plant, fruit yield per plant and fruit set on normal and total flower basis. Most of the traits showed high estimates of heritability (>70%). High genetic advance coupled with high heritability was exhibited by number of fruits per plant, fruit yield per plant and weight per fruit suggesting predominance of additive gene action.

Damnjanovic *et al.* (2000) studied genetic variance for fruit weight and fruit number per plant in five divergent eggplant genotypes. The high values of narrow sense heritability indicated a more important role of additive genes. It can be

concluded that selection of genotypes with high values for fruit weight and fruit number per plant could be a way for the improvement of eggplant breeding.

Mohanty (2001) at Bhawanipatna studied genetic variability in fifteen accessions of brinjal. The result revealed that phenotypic coefficient of variance (PCV) was greater than genotypic coefficient of variance (GCV) for all the traits. High heritability accompanied by moderate to high genetic gain were observed for average fruit weight, number of fruits and number of branches per plant which could be improved by simple selection methods. Plant height, days to first harvest and fruit yield exhibited high heritability coupled with low GCV and genetic gain, which require heterosis breeding for their amelioration.

Chung *et al.* (2003) estimated heritability in 11 F_1 generations. The heritability showed a high value in the range 82.25-99.85% for plant height, stem diameter, fruit weight, fruit length, fruit diameter, leaf length, leaf width and crop yield. Fruit diameter showed the highest value with 99.85%.

Prasad (2003) at Raipur studied genetic variability in fifty-two genotypes of brinjal and found high PCV along with GCV for average fruit weight, number of fruits per plant, fruit yield per plant, fruit girth and fruit length. High heritability coupled with high genetic advance as per cent of mean were observed in average fruit weight, fruit yield per plant, number of fruits per plant and fruit girth.

Naik (2006) at Karnataka conducted experiment to study genetic variability of sixty-two genotypes of brinjal. The results revealed that GCV and PCV were high for fruit length, number of fruits per cluster, number of fruits per plant, total yield per plant, and fruit length to diameter ratio. High heritability coupled with high genetic

advance over mean was observed for fruit length, number of fruits per cluster, number of fruits per plant, total yield per plant, and fruit length to diameter ratio, indicating predominance of additive gene action for these traits.

Kamani and Monpara (2006) conducted experiment with three brinjal varieties (H-7, PLR-1 and GBL-1), their F_1 and F_2 generations at Junagarh. Heritability and associations for ten characters were determined. All the characters in both the crosses were largely under genetic control, except days to first picking in both the crosses and plant height in one cross, for which environmental variance accounted for appreciable portion of the total variability. The heritability for days to first picking and plant height was erratic due to the large environmental variance. The high heritability estimates for other characters warrant good progress from selection.

Ram *et al.* (2007) conducted experiment to study genetic variability on fifteen lines and four testers at Kalyanpur. They observed high genotypic and phenotypic coefficient of variation for yield per plant, number of fruits per plant and plant spread in parents. High heritability coupled with high genetic advance indicating additive gene action was exhibited by characters, plant height, days to marketable maturity, plant spread, days to flowering, fruit yield per plant, fruit weight and number of branches per plant in F_1s, F_2s and parent populations.

2.3 Association analysis

Association of characteristics among yield and its components is important for making selection in the breeding programme. It is used to find out the degree and direction of relationship between two or more characters. Information on genetic

associations among various characters under a particular environmental condition may also help to formulate the most effective method of breeding in any particular case and also to simplify the approach to selection. It is an established fact that the structure of yield must be probed through its components rather than yield *per se*.

Sarnaik *et al.* (1999) studied phenotypic and genotypic correlation coefficient of twelve yield and its contributing characters in thirty-five genotypes of aubergine at Raipur. The fruit yield per plant was positively correlated with number of fruits per plant, fruit length, plant height, plant spread and number of primary branches, while it was negatively correlated with stalk length and days to first picking.

The correlation studies carried out by Asati (2001) on twelve varieties of brinjal at Raipur, concluded that the number of primary branches per plant, percentage of long-styled flowers, number of fruits per plant, number of secondary branches per plant, percentage of medium-styled flowers and plant spread were found most important characters which may be given due consideration while making selection for high-yielding varieties in brinjal for Chhattisgarh plains.

The experiments conducted at Bhawanipatna by Mohanty (2001) on fifteen genotypes of brinjal revealed that the genotypic correlation coefficients were higher than corresponding phenotypic ones for most character combinations. Fruit yield per plant displayed positive and significant phenotypic association with plant height and number of fruits per plant.

Patel (2001) conducted correlation studies on thirteen long-fruited genotypes of brinjal at Raipur and concluded that the number of fruits per plant, number of branches per plant, number of leaves per plant and plant spread were found most

important characters which may be given due consideration while making selection for high-yielding genotypes in brinjal.

Singh and Singh (2001) investigated some quantitative traits of twenty-four cultivars of brinjal for correlation and path coefficient analysis at Dhaulakuan. Fruit yield was positively correlated with number of fruits per plant at both genotypic and phenotypic levels.

Kumar *et al.* (2002) conducted experiment at Hisar on fourteen aubergine cultivars, which revealed that the magnitude of genotypic correlation was higher than that of the phenotypic correlation. High correlation values were recorded for fruit setting and number of fruits per plant; fruit width and fruit weight; number of fruits per plant and fruit setting percentage. The number of fruits per plant recorded significant positive association with fruit yield regardless of transplanting date.

Chung *et al.* (2003) estimated correlation coefficient in eleven F_1 generations of brinjal and found that correlation coefficients related to fruit number per plant (yield per plant) were positively significant correlation with plant height, stem diameter, fruit weight and fruit diameter.

An investigation was carried out at Ranchi by Singh *et al.* (2003) on fifty-three genotypes of brinjal and they found that fruit yield showed significant and positive correlation with days to first flowering, plant spread and fruit weight. Significant and positive correlation were also observed for days to first flowering with plant height, plant spread, number of branches per plant and fruit length.

Study carried out at Raipur by Prasad (2003) on fifty-two genotypes of brinjal and found that at phenotypic level, number of fruits per plant and fruit length

exhibited high positive association with fruit yield whereas, days to first fruit set and days to first flowering showed high negative association with fruit yield per plant. Characters like number of fruits per plant, fruit length and average fruit weight showed high positive correlation with fruit yield per plant at genotypic level.

Patel and Sarnaik (2004) at Raipur observed correlation coefficient on twenty-four genotypes of brinjal and found that fruit yield per plant had positive correlation with number of branches, fruit size index and fruit width but significant positive association was observed with number of fruits per plant, fruit length and weight per fruit at genotypic level.

Katoch *et al.* (2005) conducted correlation studies on nineteen genotypes of brinjal at Palampur. The results showed that marketable yield per plant was positively and significantly associated with number of marketable fruits, gross yield and total number of fruits per plant. Days to flowering were significantly associated with days to first picking.

Kushwah and Bandhyopadhya (2005) at Tehri Garhwal, conducted correlation analysis for thirteen traits of aubergine. Results showed that at the genetic level, the number of fruits per plant, fruit diameter and number of pickings showed a significant positive correlation with fruit yield per plant. At the phenotypic level, fruit yield was positively correlated with the number of pickings, fruit diameter and number of fruits per plant, but was negatively correlated with the number of days to first picking. Fruit weight and diameter were negatively correlated with the number of fruits per plant, fruit length, number of fruits per cluster and number of flowers per cluster.

Sixty-one brinjal genotypes were evaluated at Karnataka by Naik (2006). The correlation studies revealed significant and positive association of total yield per plant with number of fruits per plant and average fruit weight.

2.4 Path coefficient

Path analysis is an important tool for partitioning the correlation coefficients into direct and indirect effects of an independent variable on a dependent variable or it simply measures direct and indirect contribution of various independent characters on a dependent character. The degree of influence of one variable on the other can be expressed in quantitative terms with the help of path analysis. The concept of path analysis was originally developed by Wright (1921) but the technique was first used for plant selection by Dewey and Lu (1959).

In brinjal, path coefficient analysis was carried out by Mishra and Mishra (1990) at Bhubaneshwar on thirty genotypes of brinjal and found that fruits per plant, fruit weight and number branches per plant were the most important characters contributing towards fruit yield per plant.

Nainar *et al.* (1990) at Madurai found that fruit yield per plant was selected as the dependent variable and other characters as independent variables for path coefficient analysis of earliness, plant height plant spread, number of branches and number of fruits per plant, fruit weight, fruit length, fruit girth and fruit yield per plant. A positive association with yield in all crosses was found, in descending order, for fruits per plant, fruit weight and fruit length.

Ushakumari and Subramanian (1993) studied path coefficient analysis on fifty-four genotypes of brinjal at Madurai and observed that number of fruits and

fruit breadth had the highest direct effect on fruit yield per plant followed by fruit length.

Lakshmi *et al.* (2000) at Bapatla reported that the percentage of long-styled (LS) flowers per cluster and fruit set percentage showed high negative direct effect on fruit yield per plant, but showed positive indirect effect through fruit number. Fruit volume had a negative indirect effect on fruit yield per plant through number of fruits per plant.

Sharma and Swaroop (2000) revealed that number of fruits per plant, mean weight of fruits and diameter of fruits had maximum direct effect at genotypic level and hence, direct selection could be made effective for these characters for improving the fruit yield per plant, while maximum direct effect at phenotypic level showed by number of fruits per cluster, plant height, number of fruits per plant, mean weight of fruits and diameter of fruit. The number of fruits per cluster showed maximum indirect positive effect on fruit yield per plant. Number of flowers per cluster, number of branches per plant, plant height and length of fruit had positive indirect effect towards fruit yield per plant via number of fruits per plant and hence simultaneous selection for these characters can be made for the improvement of fruit yield per plant.

Singh and Singh (2001) at Dhaulakuan showed that the highest consideration should be given to the traits number of fruit per plant, average fruit weight, number of clusters per plant and number of tertiary branches per plant for the improvement of fruit yield in brinjal.

The phenotypic and genotypic path coefficient studies investigated by Mohanty (2001) at Bhawanipatna showed that average fruit weight had the highest positive direct effect on fruit yield per plant followed by the number of fruits per plant.

Singh *et al.* (2003) carried out path analysis studies at Ranchi and found that plant spread followed by fruit breadth, fruit length and number of branches per plant had highest direct positive effect on fruit yield per plant whereas, plant height showed positive contribution towards fruit yield via plant spread followed by fruit weight via fruit breadth.

Katoch *et al.* (2005) conducted experiment on nineteen genotypes of brinjal (aubergine) at Palampur. Path analysis revealed that purposeful and balanced selection on the basis of horticultural traits viz., fruit diameter, number of fruits (total and marketable), fruit length and days to first picking would be more rewarding for improvement of brinjal.

The result of the path analysis study carried out by Praneetha (2006) at Yercaud, Tamil Nadu showed that the characters like number of fruits per plant, number of branches per plant, single fruit weight, fruit length, ascorbic acid content were the most important fruit yield determinants because of their high direct effects also showed that most of the characters influenced the fruit yield through number of fruits per plant and single fruit weight.

Path analysis study carried out by Naik (2006) at Karnataka showed high direct effects of average fruit weight and number of fruits per plant on total fruit yield per plant.

Materials and Methods

CHAPTER- III

MATERIALS AND METHODS

This chapter deals with a concise description of materials used and methods adopted during the course of investigation. The present investigation entitled "Studies on Genetic Diversity for Fruit Characteristics in Brinjal (*Solanum melongena* Linn.)" was carried out at the Horticultural Research Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C. G.).

3.1 Geographical situation

Raipur, the place of investigation, is situated in the central part of Chhattisgarh at 21°16' N latitude, 81°36' E longitude and at an altitude of 289.56 m from mean sea level. The climate of Raipur is characterized as dry sub-humid with normal rainfall of 1200 mm per annum, mostly concentrated during the monsoon months i.e., June to September. The meteorological data recorded at Agrometeorological observatory, IGKV, Raipur during the period of study are given in Table 3.1 and illustrated through figure 3.1.

3.2 Soil

The soil of experimental field was clay-loam in texture with average fertility. Before the commencement of experiment soil sample collected randomly from five places were mixed thoroughly and a composite sample was subjected to chemical analysis. The results of the analysis have been given in Table 3.2.

Table 3.1: Weekly Meteorological Parameters during crop growth period.

Std. Met. Week	Dates	Maxi. Temp. (°C)	Mini. Temp. (°C)	Rain-fall (mm)	Relative Humidity (%)		Wind Speed (kmph)	Sun-shine (hrs)	Evapo-ration (mm)
					I	II			
23	June 04-10	36.1	25.3	48.6	78	46	10.1	3.2	7.2
24	11-17	40.4	28.3	0.0	53	24	7.1	4.2	10.2
25	18-24	38.2	26.6	24.8	72	41	6.5	5.0	7.7
26	25-01	35.3	26.9	22.5	80	54	8.6	4.7	6.9
27	July 02-08	30.6	25.5	55.4	85	69	12.8	2.3	4.4
28	09-15	32.5	26.0	18.1	82	62	13.3	2.3	5.8
29	16-22	28.0	23.8	159.2	93	84	11.9	0.3	2.4
30	23-29	29.7	24.1	129.1	94	77	10.5	3.1	2.8
31	30-05	28.9	24.2	45.3	92	79	10.7	1.3	3.3
32	Aug.06-12	29.5	24.2	7.0	89	75	11.7	6.3	4.9
33	13-19	29.1	24.2	266.8	93	80	11.2	2.3	3.5
34	20-26	29.2	24.6	30.8	93	81	9.0	1.9	2.6
35	27-02	28.4	23.7	60.1	92	75	8.4	1.8	2.4
36	Sept.03-09	31.3	25.1	114.4	94	71	5.5	7.0	3.9
37	10-16	32.0	24.6	72.2	94	77	3.3	4.9	3.0
38	17-23	30.9	24.4	11.6	90	70	6.6	6.7	3.8
39	24-30	31.5	23.1	34.0	90	64	4.2	7.7	4.1
40	Oct. 01-07	31.8	23.7	5.9	94	63	4.4	7.7	3.5
41	08-14	33.7	23.0	0.0	91	43	2.0	8.6	3.9
42	15-21	33.3	20.8	0.0	93	46	2.4	9.0	4.1
43	22-28	31.3	18.8	0.0	90	47	2.5	9.3	4.0
44	29-04	27.8	20.8	1.6	93	65	3.6	2.8	2.3
45	Nov.05-11	29.6	18.3	0.0	92	43	2.7	5.6	3.1
46	12-18	29.4	14.6	0.0	91	35	2.6	9.0	3.4
47	19-25	31.0	15.2	0.0	89	31	2.1	8.4	3.3
48	26-02	30.7	18.0	0.0	87	41	2.3	7.2	3.5
49	Dec.03-09	30.8	15.0	0.0	88	32	1.9	8.3	3.4
50	10-16	29.4	12.2	0.0	88	29	2.2	8.5	3.3
51	17-23	26.9	10.6	0.0	90	35	2.4	8.1	3.1
52	24-31	28.1	11.9	0.0	88	36	2.2	8.1	2.7
1	Jan. 01-07	26.7	9.6	0.0	88	30	2.6	8.5	3.1
2	08-14	28.8	10.6	0.0	89	32	2.0	8.3	3.0
3	15-21	28.4	11.5	0.0	83	30	2.5	7.5	3.4
4	22-28	29.8	10.4	0.0	83	22	2.2	9.0	3.8
5	29-04	31.6	15.6	0.0	80	32	2.2	7.1	3.9
6	Feb. 05-11	31.3	16.4	0.0	85	37	4.5	7.6	4.6
7	12-18	27.6	15.0	22.4	87	43	4.2	8.2	4.0
8	19-25	30.4	13.0	0.0	81	21	2.9	10.2	4.9

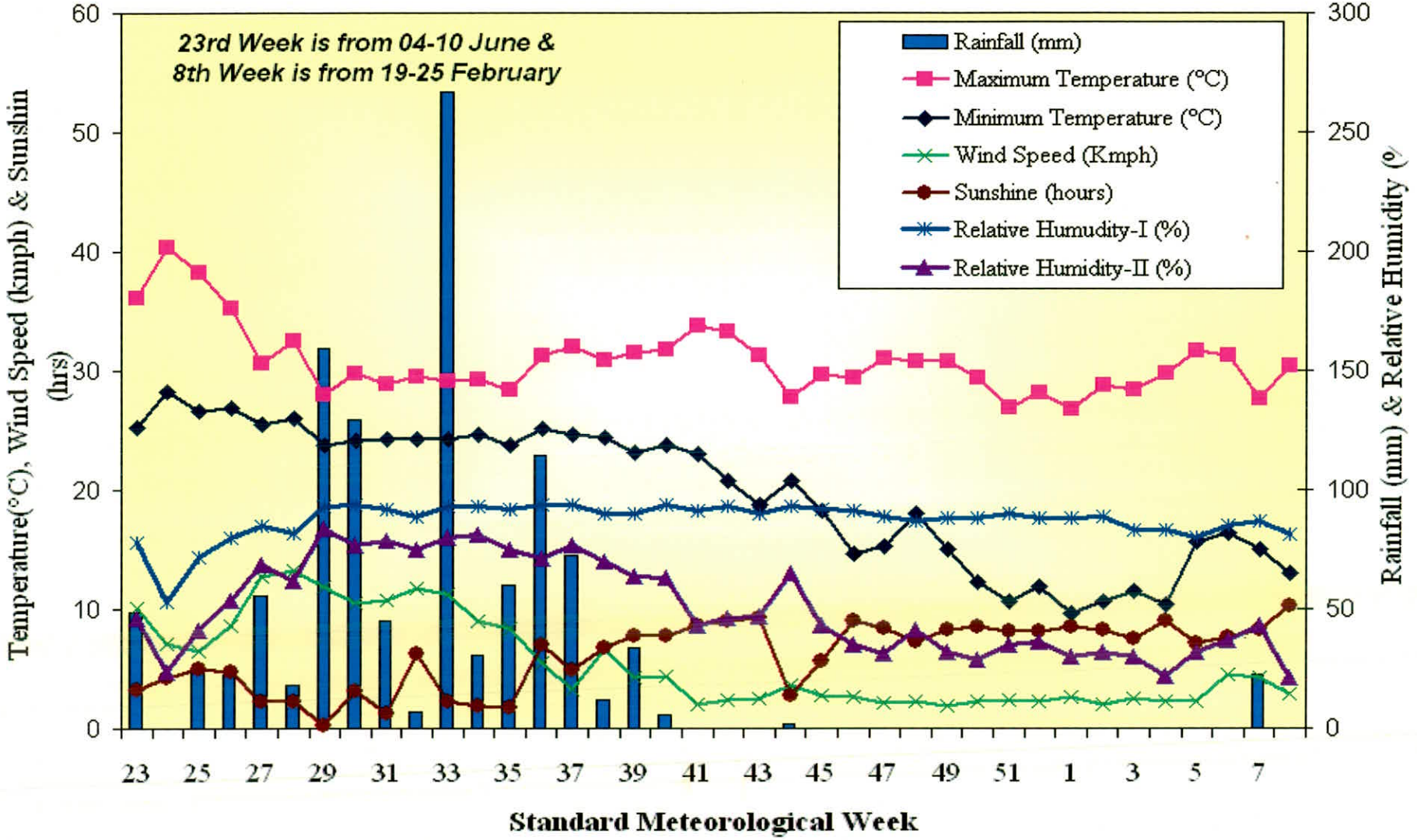


Fig. 3.1: Weekly Meteorological observation of June 2006 to February 2007at IGKV, Raipur

Table 3.2: Chemical analysis of soil of the experimental field

Particulars	Value	Status/range
pH	7.96	Slightly alkaline
Electrical Conductivity (ds m^{-1})	0.12	No deleterious effect on crop
Organic Carbon (%)	0.64	Medium
Available N (kg/ha)	247	Low
Available P (kg/ha)	14.4	Medium
Available K (kg/ha)	285	High

3.3 Cropping history

The experimental field was cropped with crop like brinjal, chilli etc during last five years.

3.4. A. Experimental details

1. Experimental design — Randomized Block Design
2. Number of replication — Three
3. Number of treatments — 63 genotypes of brinjal
4. Total number of plots — 189
5. Plot size — 3.0 X 1.8 m = 5.4 m^2
6. Distance between two replication — 1 m
7. Distance between two plots — 0.5 m
8. Number of rows in each plot — 5
9. Spacing — 60 cm X 45 cm

3.4. B. Treatment details

S. No.	Accession number	Source
1.	IC 74224	IIVR, Varanasi (U.P.)
2.	IC 74243	IIVR, Varanasi (U.P.)
3.	IC 89815	IIVR, Varanasi (U.P.)
4.	IC 89945	IIVR, Varanasi (U.P.)
5.	IC 89847	IIVR, Varanasi (U.P.)
6.	IC 89883	IIVR, Varanasi (U.P.)
7.	IC 90113	IIVR, Varanasi (U.P.)
8.	IC 90117	IIVR, Varanasi (U.P.)
9.	IC 90126	IIVR, Varanasi (U.P.)
10.	IC 90130	IIVR, Varanasi (U.P.)
11.	IC 90140	IIVR, Varanasi (U.P.)
12.	IC 90141	IIVR, Varanasi (U.P.)
13.	IC 90146	IIVR, Varanasi (U.P.)
14.	IC 99643	IIVR, Varanasi (U.P.)
15.	IC 99656	IIVR, Varanasi (U.P.)
16.	IC 99658	IIVR, Varanasi (U.P.)
17.	IC 99660	IIVR, Varanasi (U.P.)
18.	IC 99688	IIVR, Varanasi (U.P.)
19.	IC 99696	IIVR, Varanasi (U.P.)
20.	IC 99703	IIVR, Varanasi (U.P.)
21.	IC 99708	IIVR, Varanasi (U.P.)
22.	IC 99731	IIVR, Varanasi (U.P.)
23.	IC 99735	IIVR, Varanasi (U.P.)
24.	IC 99736	IIVR, Varanasi (U.P.)
25.	IC 99737	IIVR, Varanasi (U.P.)
26.	IC 99744	IIVR, Varanasi (U.P.)
27.	IC 90975	IIVR, Varanasi (U.P.)
28.	IC 90793	IIVR, Varanasi (U.P.)
29.	IC 90842	IIVR, Varanasi (U.P.)
30.	IC 90860	IIVR, Varanasi (U.P.)
31.	IC 90882	IIVR, Varanasi (U.P.)
32.	IC 90890	IIVR, Varanasi (U.P.)
33.	IC 90899	IIVR, Varanasi (U.P.)
34.	IC 90913	IIVR, Varanasi (U.P.)
35.	IC 90923	IIVR, Varanasi (U.P.)
36.	IC 90938	IIVR, Varanasi (U.P.)
37.	IC 90958	IIVR, Varanasi (U.P.)
38.	IC 90965	IIVR, Varanasi (U.P.)
39.	IC 90982	IIVR, Varanasi (U.P.)
40.	IC 104101	IIVR, Varanasi (U.P.)
41.	IC 104086	IIVR, Varanasi (U.P.)
42.	IC 111005	IIVR, Varanasi (U.P.)
43.	IC 111081	IIVR, Varanasi (U.P.)
44.	IC 203585	IIVR, Varanasi (U.P.)

45.	IC 249293	IIVR, Varanasi (U.P.)
46.	IC 249297	IIVR, Varanasi (U.P.)
47.	IC 249300	IIVR, Varanasi (U.P.)
48.	IC 249331	IIVR, Varanasi (U.P.)
49.	IC 249349	IIVR, Varanasi (U.P.)
50.	IC 249358	IIVR, Varanasi (U.P.)
51.	IC 249367	IIVR, Varanasi (U.P.)
52.	IC 249375	IIVR, Varanasi (U.P.)
53.	IC 310886	IIVR, Varanasi (U.P.)
54.	IC 332439	IIVR, Varanasi (U.P.)
55.	IC 336793	IIVR, Varanasi (U.P.)
56.	IC 343008	IIVR, Varanasi (U.P.)
57.	IC 345740	IIVR, Varanasi (U.P.)
58.	IC 342832	IIVR, Varanasi (U.P.)
59.	IC 398153	IIVR, Varanasi (U.P.)
60.	KS 224 (c)	Kalyanpur, Kanpur
61.	DBR 8 (c)	IARI, New Delhi
62.	PPL (c)	IARI, New Delhi
63.	Local (c)	IGKV, Raipur (C.G.)

3.5 Nursery raising

Well-pulverized raised nursery beds of 1 m x 1 m were prepared. These beds were provided with 30 cm wide channels all around to facilitate irrigation, drainage of excess water, interculture operations and uprooting of seedlings. Each bed was added with FYM. Seeds were sown in rows at the distance of 8 cm at about 2 cm depth after treating them with Bavistin @ 3 g/kg on June 23, 2006. The seeds were thoroughly covered with fine mixture of soil and FYM. The beds were irrigated with the help of rose cane just after sowing and covered with dried grass, which was removed after germination. Hoeing was done at 10 days after germination to allow proper aeration followed by weeding to avoid crop-weed competition for obtaining vigorous seedlings. To protect from pest and diseases, the nursery was sprayed with Endosulfan/Dimethoate @ 1 ml/liter of water after 10 and 15 days of germination.

The nursery beds were supplied with light but frequent irrigation unless the seedlings were uprooted for transplanting.

3.6 Transplanting

Before uprooting the seedlings, nursery beds were irrigated to minimize damage to the roots. Thirty days old seedlings were transplanted at the distance of 60 cm row to row and 45 cm plant to plant in the after noon hours to avoid mortality on August 02, 2006. Light irrigation was given just after transplanting.

3.7 Gap filling

In order to maintain the desired plant population, the dried seedlings were replaced by new and healthy ones whenever mortality was observed within a week.

3.8 Fertilizer application

Well-rotten FYM @ 2.0 t/ha along with 100: 80: 60 kg N: P_2O_5: K_2O/ha were given to the crop. Entire quantity of FYM, P_2O_5 and K_2O and half of N was applied and mixed thoroughly in the soil before transplanting. Rest half of N was applied in two equal splits at 30 and 70 days after transplanting through urea.

3.9 Irrigation

The crop was irrigated as and when required. Total seven irrigations were given to the crop during the entire crop season by ridge and furrow method of irrigation.

3.10 Weeding and plant protection

Interculture followed by weeding and earthing was done at 30 days after transplanting in order to avoid crop weed competition. Two subsequent weeding was also preformed at 60 and 90 days after transplanting. Spraying of endosulphon and

rogor was done as and when required to protect the crop from shoot and fruit borer (Leucinodes *orbonalis* Guen), aphids and jassids.

3.11 Harvesting

Picking of fruits was done when they developed in suitable marketable size at an interval of 10 days. Proper care was taken during harvesting of fruits. The fruits were picked at least after a week of insecticide spraying.

3.12 Observations

The observations were recorded on the basis of five randomly selected plants or fruits in each genotype under replication for various characters, which are given below:

3.12.1 Morphological observations

3.12.1.1 Fruit shape

The standard shape of fruits such as round, oval, oblong and long shape was recorded in varieties.

3.12.1.2 Fruit colour

The colour of the fruits was recorded as light purple, purple, black, greenish purple, green and variegated.

3.12.1.3 Flower colour

Flower colour was noted as light purple, purple and violet.

3.12.1.4 Spines

Spines on the plant was noted on the basis of following categories

i Present ii Absent

3.12.1.5 Plant spread

Plant spread was noted as narrow, very narrow and broad.

3.12.2 Plant height (cm)

The length of main stem from the ground level to the apical bud of five randomly selected plants in each plot was recorded in centimetre using metre scale. The observation was taken at the time of maximum fruiting. Average height of plants was calculated.

3.12.3 Number of primary branches per plant

Number of primary branches was counted from the sample plants at last harvest and treatment wise mean number of primary branches per plant was calculated.

3.12.4 Days to 50% flowering

The plots were observed daily and exact date was noted, when 50% plants of the plot bloomed and number of days counted from the date of transplanting

3.12.5 Number of flowers/cluster

Number of flowers from ten randomly selected clusters (one cluster from each selected plant) was counted at three stages i.e. after first, second and third picking. Average number of flowers per cluster was calculated at each stage and finally mean value was worked out by dividing summation of averages with three.

3.12.6 Average fruit weight

Weight of five randomly selected immature fruits at marketable stage from each genotype was recorded in grams and averaged.

3.12.7 Fruit length (cm)

The length of five randomly selected fruits were measured at each picking from fruit base to the apex in centimeter and averaged to get fruit length.

3.12.8 Fruit girth (cm)

The girth of five randomly selected fruits was measured at each picking through measuring tape from the middle and averaged to get the fruit girth.

3.12.9 Fruit stalk length (cm)

The stalk length of five randomly selected fruits from each plot was measured by running a thread along the stalk length and measuring it on a metre scale at each picking. Then average values were worked out.

3.12.10 Yield per plant (g)

The weight of fruits of five selected plants was recorded at each picking and the total weight of fruits per plant was calculated.

3.12.11 Yield per plot (kg)

The fruits harvested from each plot were weighed at each picking. The cumulative yield was carried out as total yield (kg/plot).

3.12.12 Yield per hectare (q)

Total yield of fruits in kilograms per plot was converted into quintals per hectare.

3.13 Statistical and genetical analysis

3.13.1 Analysis of variance

The data collected from different characters were processed and analyzed by the method of analysis of variance as derived by Panse and Sukhatme (1967).

Source of variation	Degree of freedom	Sum of squares	MSS	F ratio	
				Calculated	Table at 5%
Replications	r-1	SS_r	$Mr = SS_r / r-1$	Mr/ Me	
Treatments	t-1	SS_t	$Mt = SS_t / t-1$	Mt/ Me	
Error	(r-1)(t-1)	SS_e	$Me = SS_e/(r-1)(t-1)$	-	
Total	rt-1				

Where,

r = Number of replication

t = Number of treatment

SS_r = Replication sum of squares

SS_t = Treatment sum of squares

SS_e = Error sum of squares

Mr = Replication mean sum of squares

Mt = Treatment mean sum of squares

Me = Error mean sum of squares

The significance of difference among treatment means were tested by F test at 5% level of significance. If significant F value was found, critical difference was calculated to test the significance of difference between any two-treatment mean as follows:

a. Critical difference

CD = S Ed x t value at 5 % at error degree of freedom

$$SEd = \sqrt{\frac{2\,EMS}{r}}$$

Where,

SEd = standard error of difference between two treatment means

EMS = Error mean of square

r = Number of replications

b. Standard error of mean

$$SEm = \sqrt{\frac{EMS}{r}}$$

c. Coefficient of variation (%)

It is defined as the ratio of standard deviation to the mean of a given series expressed into percentage.

$$\text{Coefficient of variation (CV)} = \frac{SD}{\overline{X}} \times 100$$

Where,

SD = standard deviation

$\overline{X}$ = Mean of character

3.13.2 Studies on Variability, heritability and genetic advance

A. Range

The range of distribution is the difference between the largest and the smallest of observations and gives some idea of the amount of variability present.

B. Mean

This mean is the arithmetic average and is obtained when the sum of the values of individuals in the data is divided by the number of individuals in the data.

C. Variability

The phenotypic and genotypic components of variance were computed according to formulae given by Lush (1940). However, Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) in percentage were calculated according to Burton and De Vane (1953)

$$\sigma^2_g = \frac{Mg - Me}{r}$$

Where, σ^2_g = Genotype variance,

Mg = Treatment mean square,

Me = Error mean square (σ^2_e)

a. Phenotypic coefficient of variation (PCV)

$$\sigma^2_p = \sigma^2_g + \sigma^2_e$$

$$PCV = \frac{\sigma_p}{\bar{X}} \times 100 \qquad \{\sigma_p = \sqrt{\sigma^2_p}\}$$

Where, σ^2_p & σ_p = Phenotypic variance and its standard deviation,

σ^2_g & σ_g = Genotypic variance and its standard deviation,

σ^2_e = Environmental variance,

$\bar{X}$ = General mean.

b. Genotypic coefficient of variation (GCV)

$$GCV = \frac{\sigma_g}{\bar{X}} \times 100 \qquad \{\sigma_g = \sqrt{\sigma^2_g}\}$$

The estimates of PCV and GCV were classified as low, moderate and high according to Sivasubramanian and Madhavamenon (1973).

< 10 % = Low

10-20% = Moderate, and

> 20% = High

B. Heritability

Heritability (h^2) estimates (Broad sense) for fruit yield and its components was calculated based on the ratio of genotypic variance to the phenotypic variance and was expressed in percentage. This was estimated by using the following formula given by Burton and De Vane (1953).

$$h^2 (bs) = \frac{\sigma^2_g}{\sigma^2_p} \times 100$$

The broad sense heritability estimates were classified as low, moderate and high as follows:

0 - 30 % = Low

31 - 60% = Moderate, and

> 60% = High

C. Genetic advance

Genetic advance was estimated by using the method suggested by Johnson *et al.* (1955) and the formula is:

$$GA = i.\ h^2.\sigma_p$$

Where,

GA = Genetic advance,

i = Selection intensity (at 5%, i = 2.06),

h^2 = Heritability estimate,

σ_p = Phenotypic standard deviation.

GA was reported as percentage of mean and it was calculated as follows:

$$\text{Genetic advance as percentage of mean (GA as \% of } \overline{X}) = \frac{G.\ A}{\overline{X}} \times 100$$

The GA was categorized as,

>20% = High,

10 - 20% = Moderate, and

< 10% = Low.

3.13.3 Association analysis

3.13.3.1 Coefficient of correlation

Correlation coefficients (r) were calculated for all possible combinations among the characters at genotypic, phenotypic and environmental levels were estimated as given by Searle (1961).

$$r(x, y) = \frac{Cov(x, y)}{\sqrt{Var(x) \cdot Var(y)}}$$

Where,

r (x, y) = Correlation coefficient between character x and y

Var (x) = Variance of x character

Var (y) = Variance of y character

3.13.4 Test of significance

Correlation coefficients were tested for their significance by't' test

$$tc = r\sqrt{\frac{n-2}{1-r^2}}$$ at (n-2) degree of freedom

If 't' calculated (t_c) is greater than 't' tabulated (t_t) at (n-2) degree of freedom at given probability level the phenotypic correlation is taken as significant.

The calculated (r) is then compared with table value of 'r' at 5% and 1% level of significance (Snedecor and Cochran, 1956).

3.13.5 Path-coefficient analysis

The genotypic correlation coefficients were further partitioned into direct and indirect effects with the help of path coefficient analysis as suggested by Wright

(1921) and elaborated by Dewey and Lu (1959). Path coefficient was calculated separately for all-important characters considering fruit yield as dependable variable.

Path-coefficient was estimated using simultaneous equations and the equations showed a basic relationship between correlation coefficient and path coefficient. These equations were solved by presenting them in matrix notations.

$$A = B \times C$$

The solution for the vector 'C' may be obtained by multiplying both sides by inverse of 'B' matrix i.e. $B^{-1} A = C$

After calculation of values of path-coefficient i.e. 'C' vector, it is possible to obtain path values for residual (R). Residual effect was calculated using formula referred from Singh and Chaudhary (1985).

$$R = \sqrt{1 - \Sigma d_i \times r_{ij}}$$

Where,

d_i = direct effect of i^{th} character

r_{ij} = correlation coefficient of i^{th} character with j^{th} character

Direct and indirect effects of different characters on fruit yield were calculated at genotypic level.

3.13.6 Genetic divergence analysis

The Mahalanobis (1936) D^2 statistic was used to measure the genetic divergence between the populations. The D^2 values were estimated on the basis of P character by the formula:

$$D^2 P = \sum_{i=1}^{p} = \sum_{j=1}^{p} = (\lambda ij)\, \lambda i \lambda j$$

Where,

(λ i, j) is the reciprocal or (λ i, j), the pooled common dispersion matrix (i.e. error matrix)

i = the difference in the mean value for the i^{th} character

j = the difference in the mean value for the j^{th} character

For calculating the D^2 values, the variance and covariance were calculated. The genotypes were grouped into different clusters by Tocher's method. The population was arranged in order of their relative distances from each other. For including a particular population in the clusters, a level of D^2 was fixed by taking the maximum D^2 values between any two populations in the first row of the table where D^2 values were arranged in increasing order of magnitude. The two populations having the smallest distance from each other was considered first to which a third populations was added. Then nearest fourth population and soon till the stage the average D^2 of a group did not exclude the value already fixed. Similarly all the other clusters were formed till all the populations were included into one or the other cluster.

Results and Discussion

CHAPTER- IV

RESULTS AND DISCUSSION

The present chapter deals with the experimental results obtained during the course of investigation and are presented under the following heads:

4.1 Morphological character

4.2 Analysis of variance

4.3 Range and Mean performance

4.4 Heritability and genetic advance as per cent of mean

4.5 Coefficient of variation

4.6 Association analysis

4.7 Path- coefficient analysis

4.8 Genetic divergence analysis

4.1 Morphological character

Morphological characters of sixty-three brinjal genotypes are presented in Table 4.1.

4.2 Analysis of variance

The analysis of variance (Table 4.2) of brinjal genotypes for eleven quantitative characters indicated that the mean sum of squares due to genotypes were highly significant for all the traits viz., plant height, number of branches per plant, fruit length, fruit girth, fruit stalk length, number of flowers per plant, days to 50% flowering, fruit weight, fruit yield per plant, fruit yield per plot and fruit yield per hectare.

Table 4.1: Morphological characters of brinjal genotypes

S. No.	Accession No.	Fruit Shape	Fruit Colour	Flower Colour	Spines	Plant Spread
1.	IC 74224	Oblong	Green with white lining	Violet	Absent	Broad
2.	IC 74243	Round	Purple	Violet	Absent	Broad
3.	IC 89815	Long thick	Greenish purple	Violet	Absent	Narrow
4.	IC 89945	Small Round	Purple	Violet	Present	Narrow
5.	IC 89847	Long	Light Purple	Violet	Absent	Broad
6.	IC 89883	Oblong	Bottle Green	Violet	Absent	Broad
7.	IC 90113	Oblong	Green with white marking	Violet	Present	Narrow
8.	IC 90117	Green white variegated	Round	Violet	Absent	Narrow
9.	IC 90126	Small Long	Purple	Violet	Absent	Broad
10.	IC 90130	Oblong	Green with white lining	Violet	Absent	Broad
11.	IC 90140	Long slender	Green	Violet	Absent	Narrow
12.	IC 90141	Medium Long	Greenish Purple	Violet	Absent	Broad
13.	IC 90146	Medium Long	Green	Violet	Absent	Broad
14.	IC 99643	Medium Long	Green white variegated	Violet	Present	Very Narrow
15.	IC 99656	Oblong	Green with white lining	Violet	Present	Broad
16.	IC 99658	Medium Long	Greenish Purple	Violet	Absent	Broad
17.	IC 99660	Medium Long	Bottle green	Violet	Absent	Broad
18.	IC 99688	Oblong	Green lining	Violet	Present	Broad
19.	IC 99696	Oblong	Purplish white	Violet	Present	Broad
20.	IC 99703	Oblong	Light purple	Violet	Absent	Broad
21.	IC 99708	Oblong	Green purple spotted	Violet	Present	Broad
22.	IC 99731	Small Round	Purple	Violet	Present	Broad
23.	IC 99735	Oblong	Bottle Green	Violet	Present	Broad
24.	IC 99736	Oblong	Green white lining	Violet	Present	Broad
25.	IC 99737	Oblong	Green white lining	Violet	Present	Narrow
26.	IC 99744	Medium Round	Purple	Violet	Present	Narrow
27.	IC 90975	Oblong	Greenish purple	Violet	Present	Broad
28.	IC 90793	Small Long	Green Purple lining	Violet	Present	Narrow
29.	IC 90842	Small Long	Green white lining	Violet	Absent	Narrow
30.	IC 90860	Small Long	Black	Violet	Present	Narrow
31.	IC 90882	Medium Round	Green with purple lining	Light Purple	Present	Broad
32.	IC 90890	Oblong	Green with white lining	Violet	Absent	Broad

Table 4.1 Contd....

S. No.	Accession No.	Fruit Shape	Fruit Colour	Flower Colour	Spines	Plant Spread
33.	IC 90899	Small Long	Black	Violet	Absent	Broad
34.	IC 90913	Oblong	Green purple spotted	Violet	Present	Broad
35.	IC 90923	Medium Long	Greenish purple	Light Purple	Absent	Broad
36.	IC 90938	Oblong	Green white variegated	Violet	Present	Narrow
37.	IC 90958	Medium Long	Greenish purple	Violet	Absent	Narrow
38.	IC 90965	Medium Long	Purple greenish	Violet	Present	Narrow
39.	IC 90982	Medium Long	Bottle green	Violet	Absent	Broad
40.	IC 104101	Medium Long	Green purple variegated	Violet	Absent	Narrow
41.	IC 104086	Medium Long	Black	Violet	Absent	Narrow
42.	IC 111005	Oblong	Bottle green	Violet	Absent	Narrow
43.	IC 111081	Small Long	Black	Violet	Absent	Narrow
44.	IC 203585	Round	Green purple lining	Violet	Present	Narrow
45.	IC 249293	Small Long thick	Purple	Violet	Absent	Narrow
46.	IC 249297	Oblong	Greenish purple	Violet	Absent	Broad
47.	IC 249300	Round	Purplish green	Violet	Absent	Narrow
48.	IC 249331	Round	Green white lining	Violet	Absent	Broad
49.	IC 249349	Small Long	Purple greenish	Violet	Present	Narrow
50.	IC 249358	Large Round	Purplish green	Violet	Absent	Narrow
51.	IC 249367	Round	Green purple lining	Violet	Absent	Narrow
52.	IC 249375	Oblong	Purplish white	Violet	Absent	Broad
53.	IC 310886	Oblong	Green white lining	Violet	Present	Narrow
54.	IC 332439	Round	Black	Violet	Absent	Broad
55.	IC 336793	Small Long	Black	Violet	Absent	Narrow
56.	IC 343008	Small Long thick	Purplish green	Violet	Present	Broad
57.	IC 345740	Small Long	Purple	Violet	Absent	Narrow
58.	IC 342832	Round	Purple	Violet	Absent	Broad
59.	IC 398153	Round	Green with white lining	Violet	Present	Narrow
60.	KS 224	Round	Light purple	Violet	Absent	Broad
61.	DBR 8	Round	Purple	Violet	Absent	Broad
62.	PPL	Long	Purple	Violet	Absent	Narrow
63.	Local	Round		Violet	Absent	Narrow

Table 4.2: Analysis of variance for different characteristics of brinjal genotypes

Source of variation	d.f	Plant height (cm)	No. of branche/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)	Fruit yield/ plant (g)	Fruit yield/ plot (kg)	Fruit yield (q/ha)
Genotypes	62	747.0**	8.0**	24.6**	29.9**	4.0**	3.5**	183.7**	1809.7**	156001.9**	62.21**	21358.6**

**Significant at 1% level

Plate 1 – Different genotypes of brinjal

Plate 2 – Different genotypes of brinjal

Plate 3 – Different genotypes of brinjal

Isolation of superior genotypes depends mainly on the exploration of genetic variability to a greater extent. This emphasizes the importance of variability for crop improvement. Analysis of variance indicated that the mean sum of squares due to genotypes were highly significant for all the traits viz., plant height, number of branches per plant, fruit length, fruit girth, fruit stalk length, number of flowers per plant, days to 50% flowering, fruit weight, fruit yield per plant, fruit yield per plot and fruit yield per hectare. This indicated the presence of significant variation for most of the characters which are useful for brinjal improvement Patel *et. al.* (1999) and Prasad (2003) also got the similar results in brinjal.

4.3 Range and Mean performance

The mean performance of sixty-three genotypes for fruit yield and its components in brinjal are presented in Table 4.3.

4.3.1 Plant height (cm)

Plant height ranged from minimum of 65.1 cm (Local) to maximum of 130.9 cm (IC-345740) followed by IC 99731 (126.6 cm), IC 90113 (125.6 cm), IC 203585 (114.9 cm) and IC 342832 (113.0 cm).

4.3.2 Number of branches per plant

The grand mean of number of branches per plant was 9.72. Number of branches per plant ranged from minimum of 6.3 (PPL) to maximum of 14.9 (IC 99731) followed by IC 203585 (14.6), IC 104101 (12.7), IC 249297 (12.3) and IC 99703 (12.1).

Table 4.3: Mean performance of 63 genotypes of brinjal for fruit yield and its components

Accession No.	Plant height (cm)	No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)	Fruit yield/ plant (g)	Fruit yield/ plot (kg)	Fruit yield/ha (q)
IC 74224	87.85	8.17	9.13	15.13	5.80	3.73	60.67	87.62	720.00	14.08	260.80
IC 74243	70.60	8.33	9.83	18.40	4.07	4.60	58.00	81.39	503.33	10.68	197.84
IC 89815	72.02	8.43	8.77	16.93	4.93	4.67	60.33	42.22	451.67	9.03	167.28
IC 89945	69.47	9.77	8.67	18.93	4.23	4.33	50.33	69.83	688.33	13.77	254.94
IC 89847	97.23	10.13	13.83	9.33	6.33	4.00	52.00	53.81	718.57	14.37	266.13
IC 89883	99.60	9.10	12.07	14.40	5.40	2.93	53.33	50.28	741.25	14.83	274.54
IC 90113	125.60	10.07	9.00	13.13	4.53	2.33	47.67	49.33	310.10	6.20	114.85
IC 90117	83.20	8.56	8.67	17.53	4.80	4.53	51.33	74.55	396.67	7.93	146.91
IC 90126	86.17	7.72	13.07	16.73	5.30	5.07	45.00	75.56	516.67	10.33	191.36
IC 90130	96.70	8.14	11.00	17.40	4.10	1.80	60.33	80.32	250.00	5.00	92.59
IC 90140	95.01	8.89	24.10	8.00	6.00	4.07	47.00	43.81	280.00	5.60	103.70
IC 90141	91.00	11.47	13.47	11.07	6.23	5.60	55.67	66.20	473.33	9.47	175.31
IC 90146	100.35	8.78	13.93	18.40	8.60	4.53	58.67	66.50	400.00	8.00	148.15
IC 99643	95.44	11.03	12.87	13.77	7.13	4.20	56.00	95.00	246.67	4.93	91.36
IC 99656	93.01	9.71	9.33	10.87	5.57	5.67	60.00	38.33	564.17	11.28	208.95
IC 99658	70.84	10.17	10.07	13.40	7.50	4.53	51.67	42.22	420.00	8.40	155.56
IC 99660	88.49	8.48	13.27	12.20	5.33	2.93	52.67	75.56	815.67	16.31	302.10
IC 99688	96.77	11.54	8.87	17.77	4.33	2.47	53.33	77.50	566.67	11.33	209.88
IC 99696	87.58	10.53	10.27	14.87	5.07	2.00	51.33	50.48	1153.33	23.07	427.16
IC 99703	88.80	12.05	8.93	16.40	3.50	3.93	53.00	37.50	882.50	17.65	326.85
IC 99708	100.97	10.41	11.33	17.07	5.70	3.20	49.67	81.07	838.58	16.77	310.59
IC 99731	126.60	14.88	9.40	10.55	4.20	2.60	51.67	48.18	539.17	10.78	199.69
IC 99735	88.74	10.08	10.47	17.40	6.20	5.27	47.67	108.33	701.67	14.03	259.88
IC 99736	85.18	10.88	8.67	14.47	4.03	3.87	56.33	94.58	500.00	10.00	185.19
IC 99737	111.30	10.01	9.57	16.13	7.23	4.33	53.67	79.17	1245.00	24.90	461.11
IC 99744	71.64	8.72	10.93	20.13	4.80	4.73	52.33	89.17	1126.67	22.53	417.28
IC 90975	72.44	8.75	11.33	17.20	5.20	3.53	52.00	66.25	545.00	10.90	201.85
IC 90793	68.47	10.73	10.07	17.20	5.40	5.80	51.67	51.67	762.00	15.24	282.19
IC 90842	94.39	8.00	11.27	12.60	7.83	2.93	52.00	25.42	481.67	9.63	178.40
IC 90860	75.05	9.97	7.20	11.70	5.27	4.73	58.67	26.11	693.33	13.87	256.79
IC 90882	79.32	8.33	10.03	17.60	4.30	3.40	58.67	55.48	780.00	15.60	288.89
IC 90890	109.54	9.00	7.67	14.73	4.80	4.60	57.33	48.61	408.33	8.17	151.23

Table 4.3: Contd....

Accession No.	Plant height (cm)	No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)	Fruit yield/ plant (g)	Fruit yield/ plot (kg)	Fruit yield/ha (q)
IC 90899	86.68	8.73	10.17	14.80	4.63	2.87	50.33	61.11	525.00	10.50	194.44
IC 90913	87.45	11.67	8.50	15.73	5.17	4.73	58.33	59.62	732.25	14.80	273.98
IC 90923	86.68	11.71	10.77	14.70	5.40	3.80	51.00	45.67	741.67	14.83	274.69
IC 90938	102.67	9.10	7.27	14.87	4.00	4.27	51.67	92.36	795.42	15.91	294.60
IC 90958	93.72	7.71	10.13	10.80	5.07	5.60	53.67	81.94	735.00	14.70	272.22
IC 90965	112.77	10.27	10.90	10.43	4.50	5.37	53.33	68.33	687.25	13.75	254.54
IC 90982	72.73	9.33	13.77	12.97	5.07	3.00	58.67	49.00	818.33	16.37	303.09
IC 104101	76.45	12.67	10.93	11.67	4.33	4.73	59.33	27.50	680.00	13.60	251.85
IC 104086	104.90	10.21	14.60	11.80	5.40	5.20	47.00	57.50	920.00	18.40	340.74
IC 111005	109.43	10.01	12.67	12.80	7.33	2.87	52.67	50.42	782.08	15.64	289.66
IC 111081	85.63	11.67	11.47	15.27	7.13	4.87	49.00	62.46	588.33	11.77	217.90
IC 203585	114.88	14.64	8.67	14.87	3.97	4.93	48.33	37.12	686.67	13.73	254.32
IC 249293	95.33	9.33	9.33	14.20	5.67	3.20	56.33	81.94	516.50	10.33	191.30
IC 249297	106.55	12.33	9.47	14.13	4.67	4.47	56.33	52.22	694.17	13.88	257.10
IC 249300	103.20	7.40	10.13	21.60	6.67	4.47	64.33	65.28	440.83	8.82	163.27
IC 249331	80.08	7.65	7.87	18.00	2.93	4.20	51.33	91.73	888.33	17.77	329.01
IC 249349	73.25	9.33	11.00	17.83	4.87	3.40	52.33	84.17	788.33	15.77	291.98
IC 249358	111.67	10.50	10.63	20.80	6.07	2.93	56.00	91.39	940.17	18.80	348.21
IC 249367	82.42	9.60	11.17	17.50	5.07	2.80	53.00	64.17	1243.33	24.87	460.49
IC 249375	97.33	9.45	8.50	13.97	4.57	4.53	55.33	73.15	500.00	10.00	185.19
IC 310886	92.67	9.20	9.40	18.70	3.73	5.07	52.00	100.00	1243.33	24.87	460.49
IC 332439	109.22	9.93	8.93	20.67	4.83	4.87	66.00	103.33	778.33	15.57	288.27
IC 336793	106.30	11.27	11.93	14.57	5.73	3.40	51.67	106.39	600.00	12.00	222.22
IC 343008	109.73	8.40	10.73	16.47	7.50	1.73	53.33	51.67	677.87	13.56	251.06
IC 345740	130.92	7.80	13.53	17.07	6.57	1.93	64.00	70.00	479.58	9.59	177.62
IC 342832	113.03	8.84	9.00	16.47	5.80	1.93	54.67	99.44	715.75	14.32	265.09
IC 398153	67.42	8.63	10.77	21.80	4.27	5.20	49.00	94.44	567.50	11.35	210.19
KS 224	71.59	7.97	8.92	20.29	4.93	3.57	87.60	105.47	723.67	14.47	281.75
DBR 8	80.70	11.47	9.95	20.17	5.67	3.18	93.47	145.33	825.67	16.51	305.35
PPL	96.47	6.30	22.35	13.20	6.99	4.03	52.67	127.42	733.00	14.66	268.67
Local	65.13	8.70	9.75	19.09	4.49	2.70	50.33	91.67	735.80	14.72	272.39
Grand mean	92.16	9.72	10.80	15.53	5.35	3.92	55.13	69.75	674.67	13.50	250.17
S Em ±	5.78	1.49	1.33	1.71	0.57	0.38	1.68	7.54	57.20	0.82	15.26
CD (5%)	16.02	4.13	3.69	4.74	1.58	1.05	4.68	20.90	158.53	2.30	42.73
CV (%)	7.68	18.79	15.08	13.49	12.99	11.79	3.75	13.24	10.39	10.54	10.57

4.3.3 Fruit length (cm)

The general mean for fruit length was 10.80 cm, while it ranges from 7.2 cm in genotype IC 90860 to 24.1 cm in genotype IC 90140 followed by PPL (22.4 cm), IC 104086 (14.6 cm), IC 90146 (13.9 cm), IC 89847 (13.8 cm), IC 90982 (13.8 cm), IC 345740 (13.5 cm) and IC 99660 (13.3 cm).

4.3.4 Fruit girth (cm)

The general mean for fruit girth was 15.5 cm. The character, fruit girth ranged from 8.0 cm (IC 90140) to 21.8 cm (IC 398153) followed by IC 249300 (21.6 cm), IC 249358 (20.8 cm), IC 332439 (20.7 cm), KS 224 (20.3 cm) and DBR 8 (20.2 cm). The lowest fruit girth was found in IC 90140 (8.0 cm), which is followed by IC 89847 (9.3 cm), IC 90965 (10.4 cm), IC 99731 (10.6 cm), IC 90958 (10.8 cm), IC 99656 (10.9 cm), IC 90141 (11.1 cm) and IC 104101 (11.7 cm).

4.3.5 Fruit stalk length (cm)

The character, fruit stalk length ranged from 2.9 cm in genotype IC 249331 to 8.6 cm in genotype IC 90146 followed by IC 90842 (7.8 cm), IC 99658 (7.5 cm), IC 343008 (7.5 cm), IC 111005 (7.3 cm) and IC 99737 (7.2 cm) whereas, the lowest fruit stalk length was recorded in IC 249331 (2.9 cm), IC 99703 (3.5 cm), IC 310886 (3.7 cm), IC 203585 (3.97 cm) and IC 90938 (4.0 cm).

4.3.6 Number of flowers per cluster

The highest number of flowers per cluster was recorded in IC 90793 (5.8) followed by IC 99656 (5.7), IC 90141 (5.6), IC 90958(5.6), IC 90965 (5.4), IC 90965 (5.4) and IC 99735 (5.3) whereas, lowest number of flowers per cluster was recorded

Plate 4 – Different genotypes of brinjal

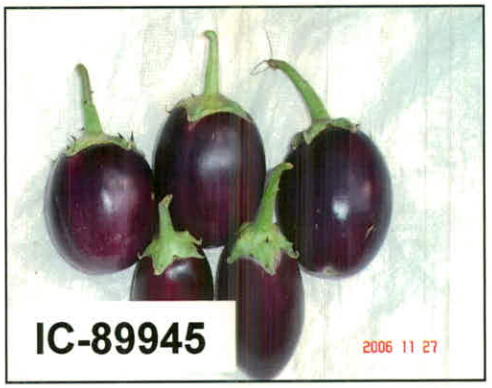
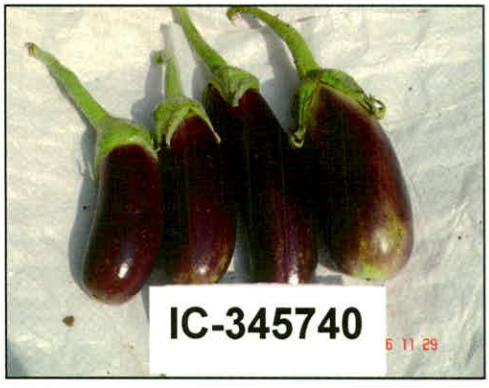


Plate 5 – Different genotypes of brinjal



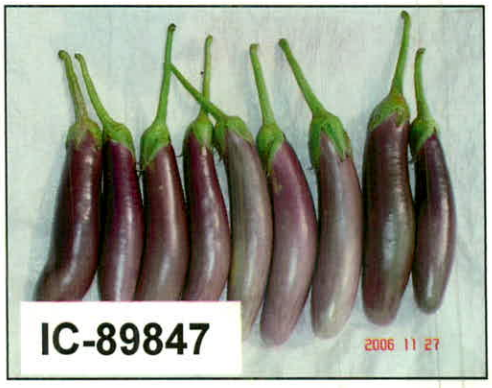
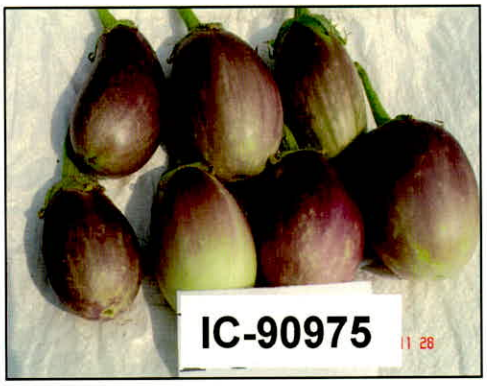
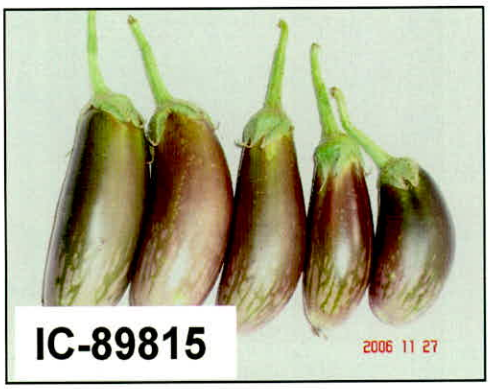


Plate 6 – Different genotypes of brinjal





in IC 343008 (1.7) followed by IC 90130 (1.8), IC 345740 (1.9), IC 342832 (1.9), IC 99696 (2.0) IC 90113 (2.3) and IC 99688 (2.5).

4.3.7 Days to 50% flowering

Days to 50% flowering were recorded from the date of transplanting and it ranges from 45.0–93.5. The earliest 50% flowering was observed at 45.0 days in IC 90126, which is followed by IC 104086 (47.0), IC 90140 (47.0), IC 90113 (47.7), IC 99735 (47.7), IC 203585 (48.3), IC 111081 (49.0) and IC 398153 (49.0). The delayed 50% flowering was observed in DBR 8 (93.5), followed by KS 224 (87.6), IC 332439 (66.0), IC 249300 (64.3), IC 345740 (64.0), IC 74224 (60.7), IC 89815 (60.3), IC 90130 (60.3), IC 104101 (59.3) and IC 90146 (58.7).

4.3.8 Fruit weight (g)

The highest average fruit weight was recorded in DBR 8 (145.3 g), which is followed by PPL (127.4 g), IC 99735 (108.3 g), IC 336793 (106.4 g), KS 224 (105.5 g), IC 332439 (103.3 g) and IC 310886 (100.0 g). The lowest average fruit weight was observed in IC 90742 (24.4 g) followed by IC 90860 (26.1 g), IC 104101 (27.5 g), IC 203585 (37.1 g), IC 99703 (37.5 g), IC 99656 (38.3 g), IC 89815 (42.2 g) and IC 99658 (42.2 g).

4.3.9 Yield

The data on fruit yield per plant (g), fruit yield per plot (kg) and fruit yield per hectare (q) were statistically analyzed and presented in Table 4.3.

Fruit yield per plant was ranged from 246.67 g (4.93 kg/plot, 91.36 q/ha) to 1245.00 g (24.90 kg/plot, 461.11 q/ha). It is clear from the table that maximum fruit yield was recorded in IC 99737 (1245.00g, 24.90 kg, 461.11 q) followed by

IC 249367 (1243.33g, 24.87kg, 460.49q), IC 310886 (1243.33g, 24.87kg, 460.49q), IC 99696 (1153.33 g, 23.07 kg, 427.16 q), IC 99744 (1126.67 g, 22.53 kg, 471.28 q), IC 249358 (940.17 g, 18.80 kg, 348.21 q), IC 104086 (920.00 g, 18.40 kg, 340.74 q), IC 249331 (888.33 g, 17.77 kg, 329.01 q), IC 99703 (882.50 g, 17.65 kg, 326.85 q) and IC 99708 (838.58 g, 16.77 kg, 310.59 q). The lowest fruit yield was observed in IC 99643 (246.67g, 4.93 kg, 91.36 q) followed by IC 90130 (250.00 g, 5.00 kg, 92.59 q), IC 90140 (280.00 g, 5.60 kg, 103.70 q), IC 90113 (310.10 g, 6.20 kg, 114.85 q), IC 90117 (396.67 g, 7.93 kg, 146.91 q), IC 90146 (400.00 g, 8.00 kg, 148.15 q), IC 90890 (408.33 g, 8.17 kg, 151.23 q), IC 99658 (420.00 g, 8.40 kg, 155.56 q) and IC 249300 (440.83 g, 8.82 kg, 163.27 q).

The twelve promising brinjal genotypes namely, IC 99696, IC 99703, IC 99708, IC 99737, IC 99744, IC 90982, IC 104086, IC 249331, IC 249358, IC 249367, IC 310886 and DBR 8 showed highest fruit yield and maximum range for their component characters (Table 4.4).

The highest plant height was recorded in IC 345740 followed by IC 99731 and IC 90113 while, it was lowest in Local. Maximum number of branches was observed in IC 99731 followed by IC 203585 whereas, it is minimum in Pusa Purple Long (PPL). The genotypes IC 90140 and PPL showed maximum fruit length whereas, IC 90860 showed minimum fruit length. Maximum fruit girth was observed in IC 398153 followed by IC 249300 and IC 249358 while, it is minimum in IC 90140. The highest fruit stalk length was recorded in IC 90140 followed by IC 90842 and IC 99658 whereas, it was lowest in IC 249331. The genotype IC 90793 contains

Table 4.4: Promising genotypes of brinjal showing mean performance for high fruit yield and its components

S. No.	Promising genotypes → / Characters ↓	IC 99696	IC 99703	IC 99708	IC 99737	IC 99744	IC 90982	IC 104086	IC 249331	IC 249358	IC 249367	IC 310886	DBR 8
1.	Plant height (cm)	-	-	H	H	L	L	H	-	H	-	-	-
2.	No. of branches per plant	H	H	H	-	-	-	H	-	H	-	-	H
3.	Fruit length (cm)	-	-	-	-	-	H	H	L	-	-	-	-
4.	Fruit girth (cm)	-	-	-	-	H	-	-	-	H	-	-	H
5.	Fruit stalk length (cm)	-	-	-	H	-	-	-	L	-	-	-	-
6.	No. of flowers per cluster	L	-	-	-	-	-	H	-	-	L	H	-
7.	Days to 50% flowering	-	-	-	-	-	-	L	-	-	-	-	H
8.	Fruit weight (g)	-	L	-	-	-	-	-	-	-	-	H	H
9.	Fruit yield per plant (g)	H	H	H	H	H	H	H	H	H	H	H	H

H- high: L- Low

maximum number of flowers per cluster followed by IC 99656 and IC 90141 whereas, IC 343008 recorded lowest number of flowers per cluster.

The earliest 50% flowering was observed in IC 90126 followed by IC 104086 and IC 90140 while, delayed 50% flowering was observed in DBR 8 (c) and KS 224 (c). The genotype DBR 8 recorded highest fruit weight followed by PPL whereas, IC 90842 and IC 90860 had lowest fruit weight.

4.4 Heritability and genetic advance as per cent of mean

The estimates of broad sense heritability [h^2 (bs)] and genetic advance as per cent of mean (GA) for fruit yield and its components are given in Table 4.5. The highest estimates of heritability in broad sense was obtained for days to 50% flowering (93.3%) followed by fruit yield per plant (91.1%), fruit weight (87.1%), number of flowers per cluster (83.5%), plant height (82.2%), fruit length (73.4%), fruit stalk length (71.1%) and fruit girth (65.9%), whereas number of branches per plant (31.9%) exhibited moderate estimates of heritability in broad sense.

The highest (> 20%) values of genetic advance as per cent of mean was shown by fruit weight (70.38%) followed by fruit yield per plant (65.41%), number of flowers per cluster (50.00%), fruit length (44.17%), fruit stalk length (35.33%), fruit girth (31.36%), plant height (30.82%) and days to 50% flowering (27.92%), whereas number of branches per plant (14.92%) showed moderate (10-20%) estimate of genetic advance.

Heritability provides the information about the amount of transmissible genetic variation to the total variation happen to be the most important factors, which determine genetic improvement or response to selection. The estimate of genetic

Table 4.5: Genetic components of variability for fruit yield and its components in brinjal

S. No.	Parameters → / Characters ↓	Range		Range difference as % of mean	Mean	Coefficient of variation (%)		h^2 (bs) (%)	GA	GA as % of Mean
		Minimum	Maximum			Phenotypic	Genotypic			
1	Plant height (cm)	65.13	130.92	71.39	92.16	18.23	16.54	82.20	28.40	30.82
2	No. of branches/plant	6.30	14.88	88.27	9.72	22.78	12.86	31.90	1.45	14.92
3	Fruit length (cm)	7.20	24.10	156.48	10.80	29.24	25.05	73.40	4.77	44.17
4	Fruit girth (cm)	8.00	21.80	88.86	15.53	23.11	18.76	65.90	4.87	31.36
5	Fruit stalk length (cm)	2.93	8.60	105.98	5.35	24.15	20.36	71.10	1.89	35.33
6	No. of flowers/cluster	1.73	5.80	103.83	3.92	29.04	26.54	83.50	1.96	50.00
7	Days to 50% flowering	45.00	93.47	87.92	55.13	14.52	14.03	93.30	15.39	27.92
8	Fruit weight (g)	25.42	145.33	171.91	69.75	36.83	34.34	87.10	46.09	70.38
9	Yield/plant (g)	246.67	1245.00	147.97	674.67	34.85	33.26	91.10	441.29	65.41

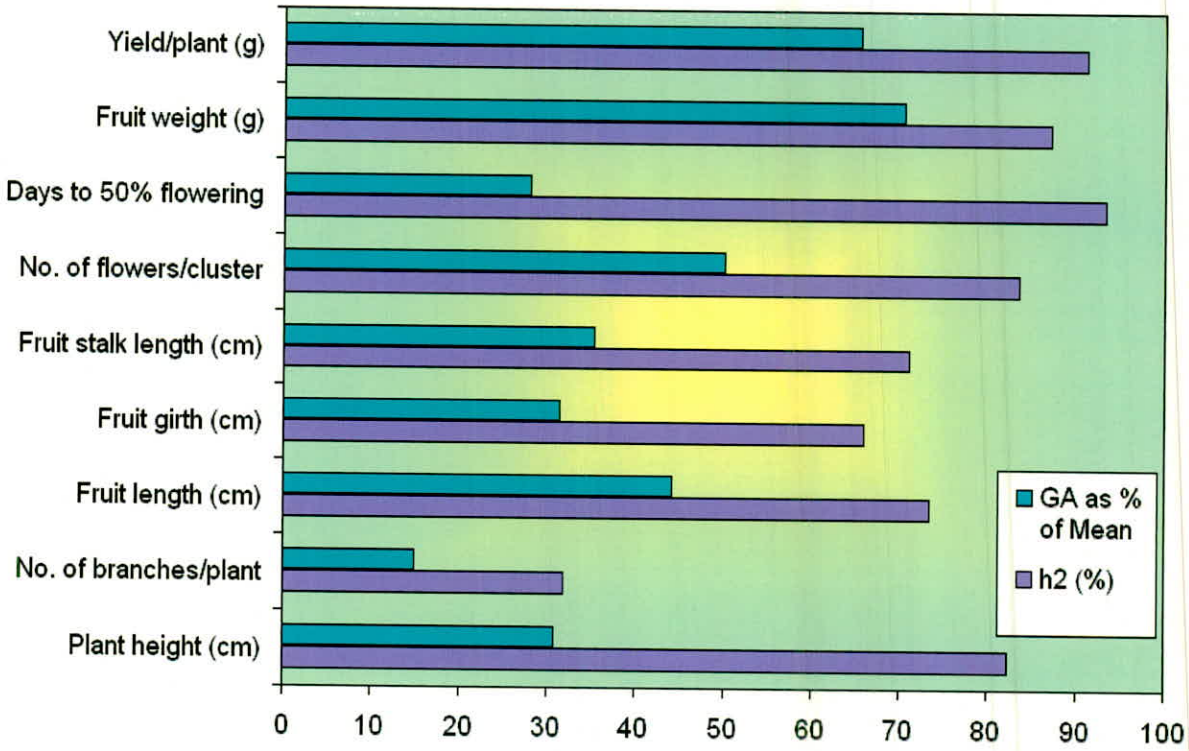


Fig 4.1: Heritability (h2) and Genetic advance (GA) as percent of mean of brinjal genotypes

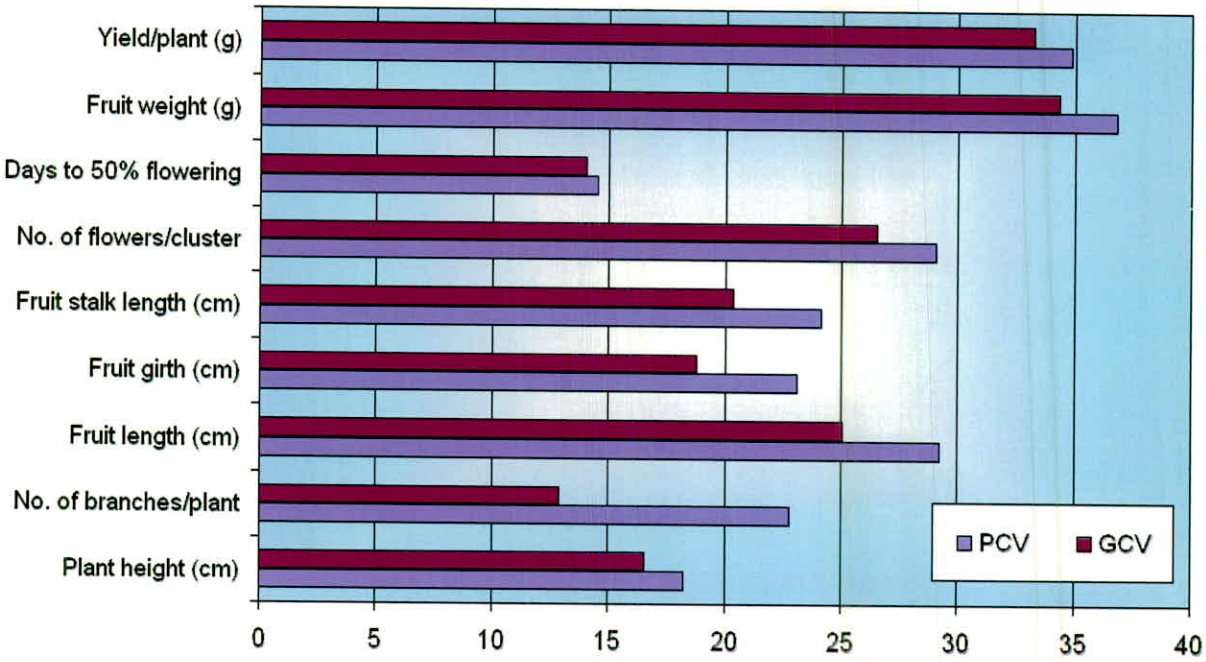


Fig. 4.2: Phenotypic and Genotypic coefficient of variation of brinjal genotypes

advance as per cent of mean provides more reliable information regarding the effectiveness of selection in improving a trait.

High estimates of heritability coupled with high genetic advance was observed in characters like, plant height, fruit length, fruit girth, fruit stalk length, number of flowers per cluster, days to 50% flowering, fruit weight and fruit yield per plant. The results of the present investigation were in consonance with the findings of Rai *et al.* (1998), Patel *et al.* (1999), Singh and Gopalakrishnan (1999), Kumar *et al.* (2000), Negi *et al.* (2000), Damnjanovic *et al.* (2000), Mohanty (2001), Chung *et al.* (2003), Prasad (2003), Prasad *et al.* (2004) and Ram *et al.* (2007) for fruit weight; Dash and Mishra (1995), Patel *et al.* (1999), Mohanty (2001), Chung *et al.* (2003) and Ram *et al.* (2007) for plant height; Dash and Mishra (1995), Rai *et al* (1998), Singh and Gopalakrishnan (1999), Negi *et al.* (2000), Chung *et al.* (2003), Prasad (2003), Prasad *et al.* (2004), Naik (2006) and Ram *et al.* (2007) for fruit yield; Chung *et al.* (2003) and Naik (2006) for fruit length; Mohanty (2001) and Ram *et al.* (2007) for number of branches per plant; Prasad (2003) and Prasad *et al.* (2004) for fruit girth.

However, heritability gives only a rough estimate and alone it is not sufficient to determine the amount of variation which is heritable. Hence, heritable variation can be realized with greater accuracy when heritability alongwith genetic advance is studied. In the present study, high heritability alongwith high genetic advance was found for the characters, plant height, fruit length, fruit girth, fruit stalk length, number of flowers per cluster, days to 50% flowering, fruit weight and fruit yield per plant. Hence, simple selection procedure like mass selection and pedigree selection

would be effective for the improvement of these characters. Thus, these characters may be used as selection criteria in breeding programme.

4.5 Coefficient of variation

The estimates of phenotypic and genotypic coefficient of variation for fruit yield and its components in brinjal are presented in Table 4.5.

In general, phenotypic coefficient of variation (PCV) is higher than genotypic coefficient of variation (GCV). The highest estimates (20%) of PCV and GCV were observed in case of fruit weight 36.83 and 34.37 per cent respectively, followed by fruit yield per plant (34.85% and 33.26%), fruit length (29.24% and 25.05%), number of flowers per cluster (29.04% and 26.54%) and fruit stalk length (24.15% and 20.36%). The high estimates of PCV coupled with moderate estimates of GCV were observed in case of fruit girth (23.11% and 18.76%) and number of branches per plant (22.78% and 12.86%) whereas, plant height (18.23% and 16.54%) and days to 50% flowering (14.52% and 14.03%) showed moderate estimates of PCV and GCV.

The high estimates of phenotypic (PCV) and genotypic (GCV) coefficient of variation were observed for fruit weight, fruit yield per plant, fruit length, number of flowers per cluster and fruit stalk length. Similar findings were also observed by Dash and Mishra (1995), Rai *et al.* (1998), Singh and Gopalakrishnan (1999), Negi *et al.* (2000), Prasad (2003), Naik (2006) and Ram *et al.* (2007) for fruit yield per plant; Rai *et al.* (1998) and Prasad (2003) for fruit weight; Prasad (2003) and Naik (2006) for fruit length.

The coefficient of variation analysis indicated that phenotypic coefficient of variation (PCV) was higher than that to genotypic coefficient of variation (GCV), which indicated the role of environmental influence in the expression of the characters. Similar results were also reported by Ushakumari *et al.* (1991), Saraswati *et al.* (1997) and Kumar *et al.* (2000).

In the present investigation, high estimates of PCV and GCV were observed for fruit weight, fruit yield per plant, fruit length, number of flowers per cluster and fruit stalk length, which indicated the presence of large variation for these characters in the available germplasm. Thus, desirable variability of these characters could be exploited for improvement in brinjal fruit yield and its components for Chhattisgarh plains.

4.6 Association analysis

The phenotypic and genotypic correlation coefficient computed among fruit yield and its component under study are presented in Table 4.6

Fruit yield per plant was significantly and positively correlated with fruit girth. It showed positive correlation with number of branches per plant and fruit weight. As regard to other characters, it showed a negative correlation. Fruit weight was highly correlated with fruit girth and days to 50% flowering. It showed significant but negative correlation with number of branches per plant. In contrast, fruit length showed positive but non-significant correlation with fruit weight.

Fruit length was significant but negatively correlated with number of branches per plant and fruit girth and positively correlated with fruit stalk length. Whereas, plant height showed a positive correlation with number of branches per

Table 4.6: Genotypic and phenotypic correlation coefficient of fruit yield and its components in brinjal

Characters		No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)	Fruit yield/ plant (g)
Plant height (cm)	G	0.219	0.081	-0.304*	0.240	-0.282*	-0.105	-0.050	-0.110
	P	0.223	0.091	-0.222	0.196	-0.240	-0.089	-0.034	-0.094
No. of branches/ plant	G		-0.335**	-0.340*	-0.263*	0.121	-0.102	-0.422**	0.111
	P		-0.125	-0.173	-0.064	0.074	-0.048	-0.170	0.043
Fruit length (cm)	G			-0.460**	0.476**	-0.030	-0.200	0.059	-0.131
	P			-0.125	0.390**	-0.059	-0.160	0.051	-0.129
Fruit girth (cm)	G				-0.176	-0.095	0.342**	0.561**	0.245*
	P				-0.119	-0.077	0.268*	0.451**	0.169
Fruit stalk length (cm)	G					-0.085	0.038	-0.040	-0.180
	P					-0.054	0.033	-0.010	-0.146
No. of flowers/cluster	G						-0.099	-0.029	-0.011
	P						-0.091	-0.050	-0.009
Days to 50% flowering	G							0.341**	-0.013
	P							0.314**	-0.013
Fruit weight (g)	G								0.202
	P								0.175

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

plant, fruit length and fruit stalk length but negatively correlated with fruit girth, number of flower per cluster, days to 50% flowering, fruit weight and fruit yield per plant.

Association analysis gives an idea about relationship between various characters and determines the component characters, on which selection can be imposed for genetic improvement in the yield. Since, 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 prerequisite to isolate desirable genotypes. The major causes underline genetic associations are either the pleiotropic gene action or linkage or both (Adams, 1967). The phenotypic correlations were normally of genetic and environmental effects and provides information about the association between two characters. Genotypic correlation normally provides a measure of genetic association between the characters. The silent features of phenotypic and genotypic correlation for different fruit yield and its components in brinjal are as follows:

1. Number of branches per plant, fruit girth and fruit weight showed positive association with fruit yield per plant whereas, plant height, fruit length, fruit stalk length, number of flower per cluster and days to 50% flowering showed negative correlation.
2. Fruit weight showed significant and positive correlation with fruit girth and days to 50% flowering whereas, number of branches per plant was negatively correlated.

3. Fruit stalk length shows significant and negative correlation with number of branches per plant but recorded significant and positive correlation with fruit length at both genotypic and phenotypic level.
4. Fruit girth and number of flowers per cluster recorded significant and negative association with plant height.
5. Fruit length, fruit girth, fruit stalk length and fruit weight recorded significant and negative association with number of branches per plant at genotypic level.
6. Days to 50% flowering showed significant and positive correlation with fruit girth and fruit weight at both phenotypic and genotypic level.

Positive correlation between number of branches per plant and fruit yield per plant observed in this investigation is also supported by the findings of Mishra and Mishra (1990), Yadav *et al.* (1996), Sharma and Swaroop (2000), Patel and Sarnaik (2004), and Kamani and Monpara (2006). Similarly positive association of fruit girth and fruit weight with fruit yield per plant, fruit weight with fruit girth observed in present investigation are in consonance with those of Singh *et al.* (2003), Chung *et al.* (2003), Patel and Sarnaik (2004), Kushwah and Bandhyopadhya (2005) and Naik (2006).

A significant negative association was observed in the present study between fruit length and fruit girth. It is in conformity with the findings of Sharma and Swaroop (2000), who also reported a negative association between length of fruit and girth of fruit. It is also supported with the findings of Yadav *et al* (1996), Singh *et al.* (2003) and Patel and Sarnaik (2004).

Therefore, it can be concluded from the correlation study that the fruit yield per plant is the cumulative effect of number of branches per plant, fruit girth and fruit weight. It can be suggested that the selection based on these characters can give better results for fruit yield improvement in brinjal for Chhattisgarh plains.

4.7 Path coefficient analysis

The genotypic and phenotypic correlation coefficient of fruit yield and its components were broken down into direct and indirect effect and taking total fruit yield per plant as dependent variable and rest of the characters were taken as independent variables. Direct and indirect effects of fruit yield contributing characters in brinjal are presented in Table 4.7 and 4.8.

In path-coefficient analysis, at genotypic level, number of branches per plant (0.340), fruit girth (0.284) and fruit weight (0.219) exhibited high positive direct effect on fruit yield per plant, whereas, fruit length showed moderate positive indirect effect on fruit yield per plant. Negative direct effect on fruit yield per plant was observed for days to 50% flowering (-0.147), plant height (-0.117), number of flowers per cluster (-0.068) and fruit stalk length (-0.054). Plant height observed positive indirect effect on fruit yield per plant through number of branches per plant (0.075), number of flowers per cluster (0.019) and days to 50% flowering (0.015). Number of branches per plant had positive indirect effect on fruit yield per plant via days to 50% flowering (0.015) and fruit stalk length (0.014). Fruit length recorded positive indirect effect through days to 50% flowering (0.029) and fruit weight (0.013). Fruit girth showed positive indirect effect on fruit yield per plant through fruit weight (0.123) and plant height (0.036) whereas, it showed negative indirect

Table 4.7: Genotypic path coefficients for fruit yield contributing characters of brinjal

Characters	Plant height (cm)	No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)
Plant height (cm)	**-0.117**	0.075	0.008	-0.087	-0.013	0.019	0.015	-0.011
No. of branches/ plant	-0.026	**0.340**	-0.035	-0.097	0.014	-0.008	0.015	-0.092
Fruit length (cm)	-0.010	-0.114	**0.104**	-0.131	-0.026	0.002	0.029	0.013
Fruit girth (cm)	0.036	-0.116	-0.048	**0.284**	0.010	0.006	-0.050	0.123
Fruit stalk length (cm)	-0.028	-0.089	0.050	-0.050	**-0.054**	0.006	-0.006	-0.009
No. of flowers/ cluster	0.033	0.041	-0.003	-0.027	0.005	**-0.068**	0.015	-0.006
Days to 50% flowering	0.012	-0.034	-0.021	0.097	-0.002	0.007	**-0.147**	0.075
Fruit weight (g)	0.006	-0.143	0.006	0.160	0.002	0.002	-0.050	**0.219**

Residual = 0.8366 Diagonal and bold figures shows direct effect on fruit yield.

Table 4.8: Phenotypic path coefficients for fruit yield contributing characters of brinjal

Characters	Plant height (cm)	No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)
Plant height (cm)	**-0.085**	0.020	-0.008	-0.019	-0.014	0.010	0.010	-0.007
No. of branches/ plant	-0.019	**0.091**	0.012	-0.015	0.005	-0.003	0.005	-0.032
Fruit length (cm)	-0.008	-0.011	**-0.093**	-0.019	-0.029	0.002	0.018	0.010
Fruit girth (cm)	0.019	-0.016	0.020	**0.086**	0.009	0.003	-0.031	0.079
Fruit stalk length (cm)	-0.017	-0.006	-0.036	-0.010	**-0.073**	0.002	-0.004	-0.002
No. of flowers/ cluster	0.021	0.007	0.005	-0.007	0.004	**-0.040**	0.010	-0.009
Days to 50% flowering	0.008	-0.004	0.015	0.023	-0.002	0.004	**-0.115**	0.060
Fruit weight (g)	0.003	-0.015	-0.005	0.036	0.001	0.002	-0.036	**0.190**

Residual = 0.9159 Diagonal and bold figures shows direct effect on fruit yield.

effect on fruit yield via number of branches per plant (-0.116). Apart from this, fruit stalk length showed negative indirect effect on fruit yield via plant height (-0.028) and number of branches per plant (-0.089) but had positive indirect effect through fruit length (0.050). Number of flowers per cluster recorded positive indirect effect on fruit yield per plant via plant height (0.033), number of branches per plant (0.041) and days to 50% flowering (0.015) while, days to 50% flowering showed positive indirect effect on fruit yield through fruit girth (0.097), fruit weight (0.075) and plant height (0.012) whereas, fruit weight showed negative indirect effect on fruit yield through number of branches per plant.

At phenotypic level, fruit weight (0.190) showed high positive direct effect on fruit yield per plant followed by number of branches per plant (0.091), whereas, days to 50% flowering (-0.115) showed high negative direct effect on fruit yield per plant. Number of branches per plant (-0.032) showed negative indirect effect whereas, fruit girth (0.079) and days to 50% flowering (0.060) showed high positive indirect effect on fruit yield per plant through fruit weight. Plant height (0.020) showed high positive indirect effect on fruit yield per plant via number of branches per plant while, number of flowers per cluster (0.021) recorded high positive indirect effect on fruit yield through plant height. Fruit stalk length (-0.036) showed negative indirect effect on fruit yield via fruit length. Apart from this, fruit weight (0.036) showed positive indirect effect on fruit yield per plant via fruit girth.

At genotypic level, number of branches per plant, fruit length, fruit girth and fruit weight showed positive direct effect on fruit yield per plant. Similar findings were observed by Mishra and Mishra (1990), Nainar *et al.* (1990) Sharma and

Swaroop (2000), Singh and Singh (2001), Singh *et al.* (2001), Mohanty (2001) Patel and Sarnaik (2004), Praneetha (2006) and Naik (2006) for fruit weight; Mishra and Mishra (1990), Singh *et al.* (2003), Patel and Sarnaik (2004) and Praneetha (2006) for number of branches per plant; Nainar *et al.* (1990), Ushakumari and Subramanian (1993), Singh *et al.* (2003), Patel and Sarnaik (2004), Katoch *et al.* (2005) and Praneetha (2006) for fruit length; and Ushakumari and Subramanian (1993), Sharma and Swaroop (2000) and Katoch *et al.* (2005) for fruit diameter.

Plant height, days to 50% flowering, fruit stalk length and number of flowers per cluster showed negative direct effect on fruit yield which is in confirmation to the findings of Singh *et al.* (2003) and Patel and Sarnaik (2004); Praneetha (2006) for plant height.

Therefore, it can be concluded from the present investigation that the character viz., number of branches per plant, fruit length, fruit girth and fruit weight showed direct and positive effect on fruit yield. Thus, selection of these characters proved efficient for the improvement of fruit yield. But the residual estimates at phenotypic and genotypic path-coefficient analysis was high, which makes it clear that other characters should be taken into consideration alongwith above mentioned characters.

4.8 Genetic divergence analysis

The presence of genetic diversity among sixty-three genotypes was analyzed using Mahalanobis D^2 statistics and clustering pattern on the basis of D^2 analysis has been presented in Table 4.9. The genotypes were grouped into five non-overlapping clusters. The highest twenty number of genotypes appeared in cluster V, namely, IC 74224, IC 74243, IC 89815, IC 89945, IC 90117, IC 90126, IC 90130, IC 99735,

Table 4.9: Clustering pattern of brinjal genotypes on the basis of Mahalanobis D^2 statistics

Cluster No.	No. of genotypes	Accession numbers
I	11	IC-99688, IC-99696, IC-99708, IC-99737, IC-90938, IC-249358, IC-249367, IC-310886, IC-332439, IC-336793, IC-342832
II	17	IC-90113, IC-90141, IC-99656, IC-99703, IC-90731, IC-99736, IC-90860, IC-90890, IC-90913, IC-90923, IC-90965, IC-104101, IC-104086, IC-111081, IC-203585, IC-249297, IC-249375
III	2	KS-224, DBR-8
IV	13	IC-89847, IC-89883, IC-90140, IC-90146, IC-99643, IC-99658, IC-99660, IC-90842, IC-90982, IC-111005, IC-343008, IC-345740, PPL
V	20	IC-74224, IC-74243, IC-89815, IC-89945, IC-90117, IC-90126, IC-90130, IC-99735, IC-99744, IC-90975, IC-90793, IC-90882, IC-90899, IC-90958, IC-249293, IC-249300, IC-249331, IC-249349, IC-398153, Local.

Table 4.10: Average inter and intra-cluster distance in brinjal genotypes

Cluster	I	II	III	IV	V
I	**2.152**	2.648	5.331	3.019	2.198
II		**2.218**	6.356	2.866	2.615
III			**1.470**	6.316	5.322
IV				**2.708**	2.885
V					**2.038**

Note: Bold figures shows intra-cluster distance.

IC 99744, IC 90975, IC 90793, 90882, IC 90899, IC 90958, IC 249293, IC 249300, IC 249331, IC 249349, IC 398153 and Local. The lowest two numbers of genotypes namely KS 224 and DBR 8 constituted cluster III.

Cluster I, contains eleven genotypes namely, IC 99688, IC 99696, IC 99708, IC 99737, IC 90938, IC 249358, IC 249367, IC 310886, IC 332439, IC 336793 and IC 342832. Cluster II, which have seventeen number of genotypes are, IC 90113, IC 90141, IC 99656, IC 99703, IC 90731, IC 99736, IC 90860, IC 90890, IC 90913, IC 90923, IC 90965, IC 104101, IC 104086, IC 111081, IC 203585, IC 249297 and IC 249375 and constituted the next highest cluster. The thirteen genotypes viz., IC 89847, IC 89883, IC 90140, IC 90146, IC 99643, IC 99658, IC 99660, IC 90842, IC 90982, IC 111005, IC 343008, IC 345740 and PPL made cluster IV.

The average inter and intra-cluster distance in brinjal germplasm was presented in Table 4.10. The highest intra cluster distance was recorded in cluster IV (2.708) followed by cluster II (2.218) and cluster I (2.152), whereas, cluster III (1.470) showed lowest intra cluster distance which is followed by cluster V (2.038) whereas, in case of inter-cluster distance, highest inter cluster distance were observed between cluster III and II (6.356), which is followed by cluster III and IV (6.316), cluster I and III (5.331) and cluster III and V (5.322). The higher inter cluster distance were observed between cluster I and IV (3.019) whereas, lowest inter cluster in brinjal genotypes was recorded in between cluster I and V (2.198)

The mean cluster value for different traits in brinjal was presented in Table 4.11. High cluster mean values for fruit yield per plant (919.98 g) and plant height (101.33 cm) was recorded in cluster I whereas, Cluster II showed highest cluster

Table 4.11: Mean cluster values for different traits in brinjal

Characters / Cluster	Plant height (cm)	No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)	Fruit yield/ plant (g)
I	101.33	10.09	9.85	17.22	5.23	3.39	53.91	85.94	919.98
II	98.08	11.33	9.85	13.26	4.90	4.47	54.02	50.73	623.60
III	76.14	9.72	9.43	20.23	5.30	3.38	90.53	125.40	774.68
IV	96.97	8.96	14.19	13.43	6.74	3.36	54.21	61.62	584.19
V	80.57	8.66	10.06	17.44	4.89	4.15	53.80	76.73	631.97

Table 4.12: Percentage contribution of different traits towards genetic divergence

Characters	Plant height (cm)	No. of branches/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit stalk length (cm)	No. of flowers/ cluster	Days to 50% flowering	Fruit weight (g)	Fruit yield/ plant (g)	Total
No. of times appearing first in ranking	215	3	77	74	87	267	313	342	539	1917
Percent contribution	11.21	0.15	4.01	3.86	4.53	13.92	16.32	17.84	28.11	100.00

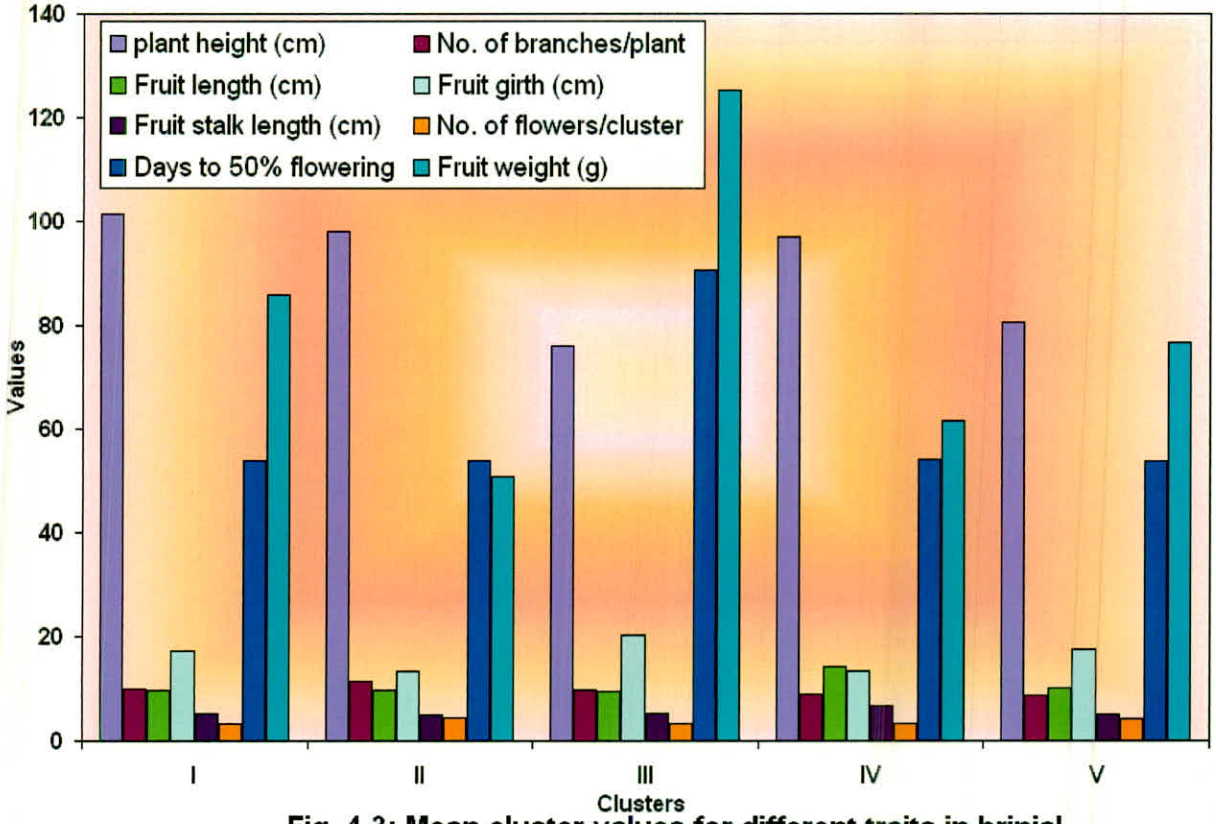


Fig. 4.3: Mean cluster values for different traits in brinjal

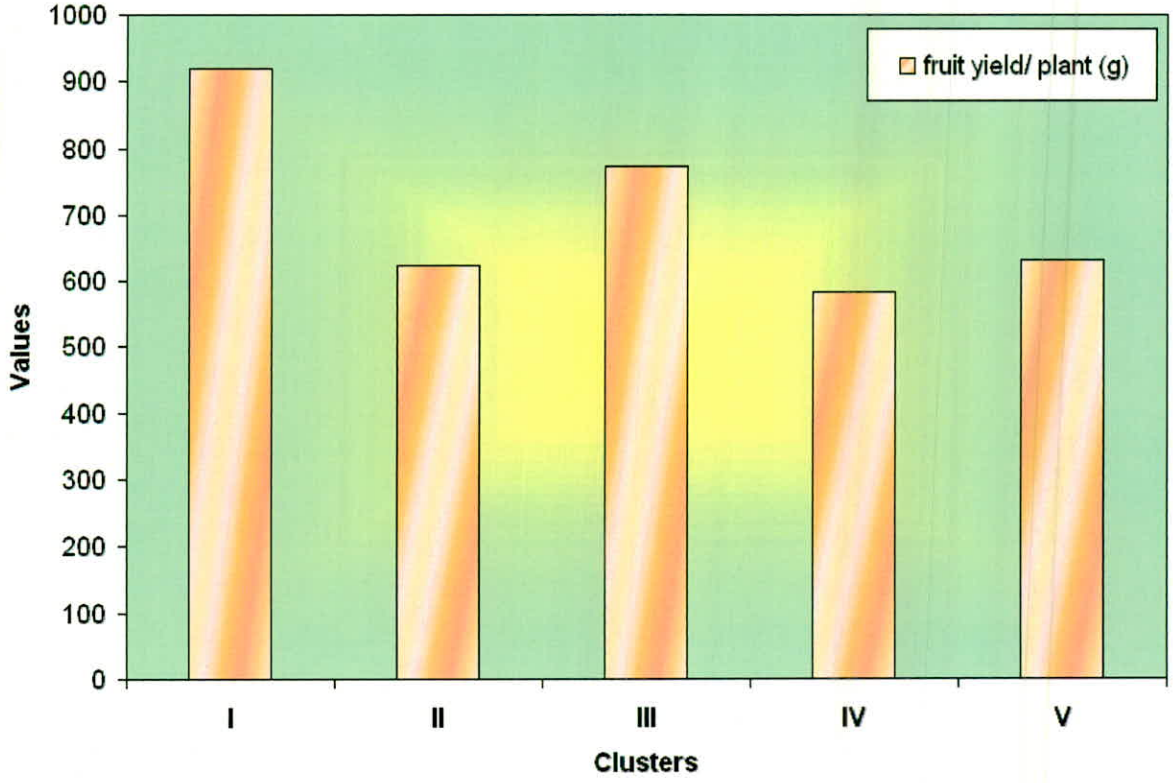


Fig. 4.4: Mean cluster values for fruit yield per plant in brinjal

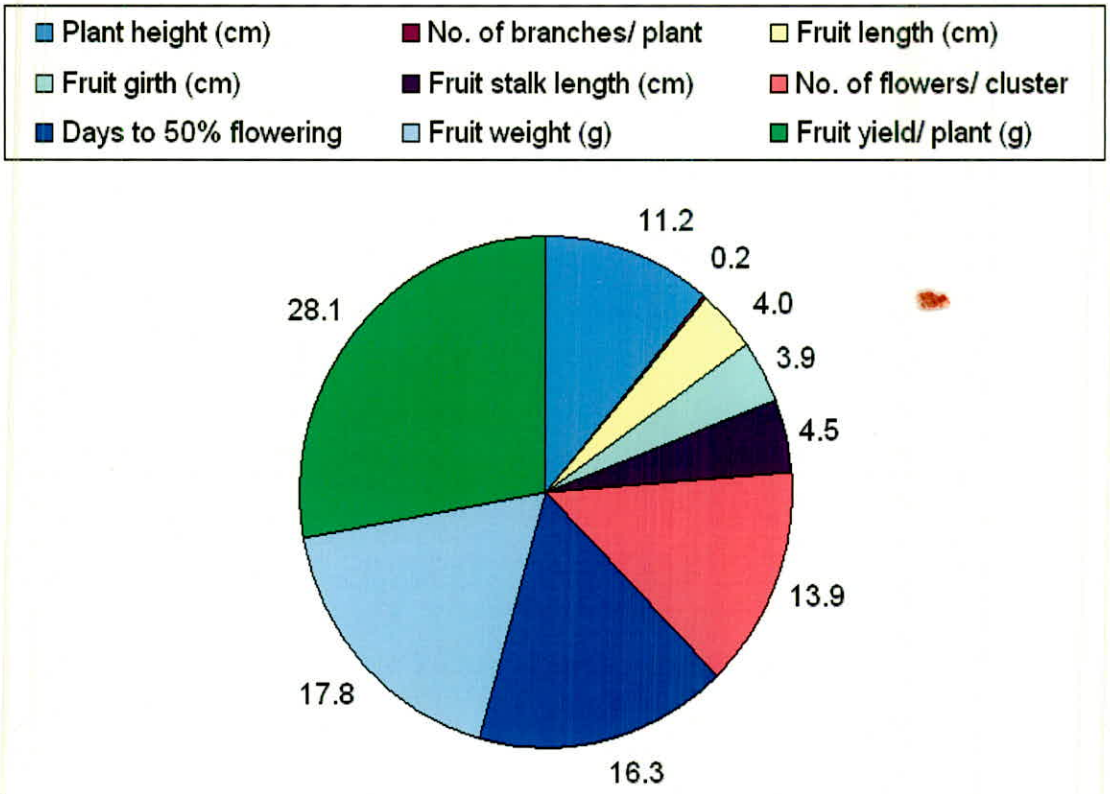


Fig. 4.5: Percent Contribution of different traits towards genetic divergence

mean values for number of branches per plant (11.33) and number of flowers per cluster (4.47). For fruit girth (20.23), days to 50% flowering (90.53) and fruit weight (125.40) cluster III carried high cluster mean values. While, cluster IV noted high mean value for fruit length (14.19) and fruit stalk length (6.74).

Percentage contribution of different traits towards genetic divergence was presented in Table 4.12. The highest per cent contribution towards genetic divergence in brinjal was recorded in fruit yield per plant (28.117%) followed by fruit weight (17.840%) and days to 50% flowering (16.328%) whereas, number of branches per plant (0.156%) showed lowest percentage contribution towards genetic divergence which is followed by fruit girth (3.860%).

The highest number of genotypes (20) appeared in cluster V, the clustering pattern of different genotypes did not necessarily follow their geographical distribution and was fairly at random. This suggested that, causes other than geographical suppression were also responsible for divergence. These results are in accordance with the findings of Yadav *et al.* (1996), Doshi *et al* (1998), Kumar *et al.* (1998), Mohanty and prusti (2000), Sharma *et al.* (2000), Sharma and Maurya (2004), and Naik (2006).

The inter and intra-cluster distances in brinjal represented that cluster IV recorded highest intra-cluster distance while cluster III recorded lowest intra-cluster distance Apart from this, the highest inter-cluster distance among brinjal genotypes was observed between cluster II and III. The mean cluster values for different traits in brinjal revealed that high cluster means for average fruit weight, days to 50% flowering and fruit girth were recorded under cluster III.

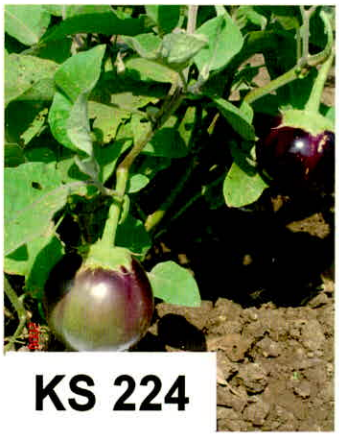
Some important quantitative fruit yield-related genotypes were observed as follows:

1. The highest mean cluster value for fruit yield per plant was recorded in cluster I with the genotype IC 99737.
2. Cluster III showed highest mean cluster value for average fruit weight with genotypes DBR-8 and for fruit girth and days to 50% flowering with genotypes KS-224.
3. The highest mean cluster value for fruit length and fruit stalk length was recorded in cluster IV with genotypes IC 90140 and IC 90146 respectively.
4. Number of flower per cluster was observed in cluster II in the genotype IC 99656.

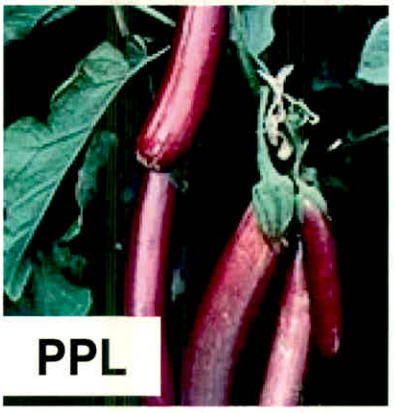
The characters contributing maximum to the divergence are given greater emphasis for deciding on the clusters for the purpose of further selection and choice of parents for hybridization. The highest contributors in this regard were fruit yield per plant, fruit weight, days to 50% flowering and number of flowers per cluster, which were in confirmation to the findings of Mishra *et al.* (1998), Pramanik *et al.* (1992), and Singh *et al.* (2006), for fruit yield per plant and Mishra *et al* (1998) for days to 50% flowering.

Considerable diversity both within and between the clusters was observed and it was revealed that fruit yield per plant, fruit weight, days to 50% flowering, number of flowers per cluster and plant height were the most important characters, hence, selection for divergent parents based on these traits will be used for heterosis breeding or combination breeding for brinjal improvement for Chhattisgarh plains.

Check varieties of brinjal



KS 224



PPL

View of experimental field

Summary, Conclusions and Suggestions for Future Research Work

CHAPTER V

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH WORK

The present investigation entitled "Studies on genetic diversity for fruit characteristics in brinjal (*Solanum melongena* L.)" was carried out at Horticultural Research Farm, College of Agriculture, IGKV, Raipur (C. G.) during *Kharif* 2006-2007. The experimental material comprised of 59 genotypes of brinjal along with 4 check varieties viz., KS 224, DBR 8, PPL and Local and was replicated three times in Randomized Completely Block Design.

In this study, the analysis of variance indicated that the mean sum of squares due to genotypes were highly significant for all the traits. The highest estimates of phenotypic and genotypic coefficient of variation were observed in case of fruit weight followed by fruit yield per plant, fruit length, number of flowers per cluster and fruit stalk length.

The highest heritability alongwith high genetic advance were observed for days to 50% flowering, fruit yield per plant, fruit weight, number of flowers per cluster, plant height, fruit length, fruit stalk length and fruit girth. In association analysis, the character, fruit yield per plant showed significant and positive association with fruit girth at genotypic level whereas, at phenotypic level, fruit yield per plant was positively correlated with number of branches per plant, fruit girth and fruit weight.

Path- coefficient analysis revealed that number of branches per plant and fruit girth at genotypic level and fruit weight at phenotypic level showed highly positive direct effect on fruit yield per plant.

Genetic divergence analysis indicated that cluster V contains highest number of genotypes (20 genotypes). Highest intra-cluster was observed in cluster IV followed by cluster II while, highest inter-cluster distance was recorded between cluster II and cluster III followed by cluster III and IV.

The highest mean cluster value for fruit yield per plant was recorded in cluster I. In this cluster I, genotype IC 99737 performed best for fruit yield followed by IC 249367. Cluster III showed earliest 50% flowering and fruit girth with genotype KS 224, while, for average fruit weight, DBR 8 of cluster III recorded highest mean value whereas, IC 90140 and IC 90146 belonging to cluster IV showed highest mean cluster value for fruit length and fruit stalk length, respectively. Fruit yield per plant, fruit weight, days to 50% flowering, number of flowers per cluster and plant height contributed maximum towards genetic divergence.

Conclusions

1. Improvement in any crop depends on the magnitude of its genetic variability and vegetable breeders are continuously looking for this which enables them to identify specific parental material for desirable characters and also to impose further selection. In this gene pool, high coefficients of variation at both phenotypic and genotypic level were observed for most of the traits indicating the continuance of sufficient variability.

2. High heritability coupled with high genetic advance were observed for most of the characters, indicating the role of additive gene effects in the expression of those characters. Thus, these traits are highly responsive to suitable selections.
3. On the basis of association analysis, it can be concluded that the selection based on these characters can improve fruit yield per plant in Chhattisgarh conditions,
4. Path-coefficient analysis indicated that the direct selection for the characters like, number of branches per plant, fruit girth, fruit weight and fruit length will be very competent for increasing fruit yield per plant.
5. The D^2 analysis indicated the presence of appreciable genetic diversity in the studied material. Based on the mean performance, genetic distance, clustering pattern and per cent contribution, inter-varietal crosses can be made, which may be advantageous in creating wider variability for better transgressive segregants as well as heterotic hybrids in brinjal for Chhattisgarh plains.
6. Genotype KS 224 performed best for fruit girth and earliest 50% flowering. Highest yield per plant was recorded in genotype IC 99737 whereas, fruit weight was high in case of DBR 8. High fruit length and fruit stalk length was recorded in the genotypes IC 90140 and IC 90146, respectively. Maximum number of branches per plant was recorded in the genotype IC 90731. Hence, these genotypes could be utilized as parents for brinjal improvement for Chhattisgarh plains.

Suggestions for future research work

On the basis of experience gained and results obtained after completion of the present investigation, following suggestions may be given to conduct further research:

1. The genotypes included under this investigation may be evaluated under different climatic conditions of Chhattisgarh to know the stability of these genotypes and to select promising genotypes for wider adaptability.
2. Agro morphological characterization in brinjal is of utmost important. Therefore, morphological characterization criteria may also be formulated by using the marker aided selection technology.
3. For hybridization programme, better genotypes of brinjal should be selected from different clusters on the basis of fruit yield and study the combining ability effects.
4. Quality analysis particularly for total phenol content, chlorophyll content, total soluble solids etc will be very useful for vegetable quality improvement work.

ABSTRACT

"Studies on Genetic Diversity for Fruit Characteristics in Brinjal (*Solanum melongena* L.)"

By

DEEPTI PATEL

ABSTRACT

The present investigation entitled "Studies on genetic diversity for fruit characteristics in brinjal (*Solanum melongena* L.)" was carried out at Horticultural Research Farm, College of Agriculture, IGKV, Raipur (C. G.) during *kharif* 2006-2007 with 63 genotypes of brinjal in Randomized Completely Block Design with three replications.

The analysis of variance indicated that the mean sum of squares for all the characters are highly significant. High estimates of PCV coupled with GCV were recorded in fruit weight, fruit yield per plant, fruit length, number of flowers per cluster and fruit stalk length. High heritability coupled with high genetic advance as per cent of mean were observed for days to 50% flowering, fruit yield per plant, fruit weight, number of flowers per cluster, plant height, fruit length, fruit girth and fruit stalk length.

At phenotypic level, number of branches per plant, fruit girth and fruit weight were positively associated with fruit yield per plant. Whereas, character fruit girth showed significant positive association with fruit yield per plant at genotypic level. Number of branches per plant, fruit length, fruit girth and fruit weight exhibited positive direct effect on fruit yield at genotypic level whereas, at phenotypic level, number of branches per plant, fruit girth and fruit weight showed positive direct effect on fruit yield. In addition to this, days to 50% flowering showed high negative direct effect on fruit yield at genotypic level.

Genetic divergence analysis concluded that cluster V and II had highest number of genotypes (20 and 17). The maximum intra-cluster distance was obtained in cluster IV while, inter-cluster distance was highest between cluster II and III. Cluster I exhibited high cluster mean value for plant height and fruit yield per plant whereas, cluster III showed high cluster mean value for fruit girth, days to 50% flowering and fruit weight. The maximum contributions towards total genetic divergence were obtained from fruit yield per plant, fruit weight, days to 50% flowering, number of flowers per cluster and plant height.

Among the genotypes evaluated, KS 224 was found best for fruit girth and earliness (50% flowering) whereas, DBR 8 for highest fruit weight. Fruit yield per plant was recorded maximum in the genotype IC 99737. Maximum fruit length, fruit stalk length and number of branches per plant were recorded in the genotypes IC 90140, IC 90146 and IC 90731, respectively. Hence, these genotypes could be utilized as parents for brinjal improvement programme under Agro-climatic conditions of Chhattisgarh.

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