

**Genetic Divergence Studies in Brinjal  
(*Solanum melongena* L.)**

**Saima Tabasum**  
(MSH-2020-329)



**Division of Vegetable Science  
Faculty of Horticulture  
Sher-e-Kashmir University of Agricultural Sciences &  
Technology of Kashmir**

**2022**

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**Thesis**

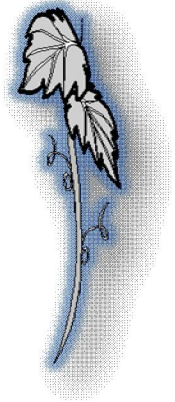
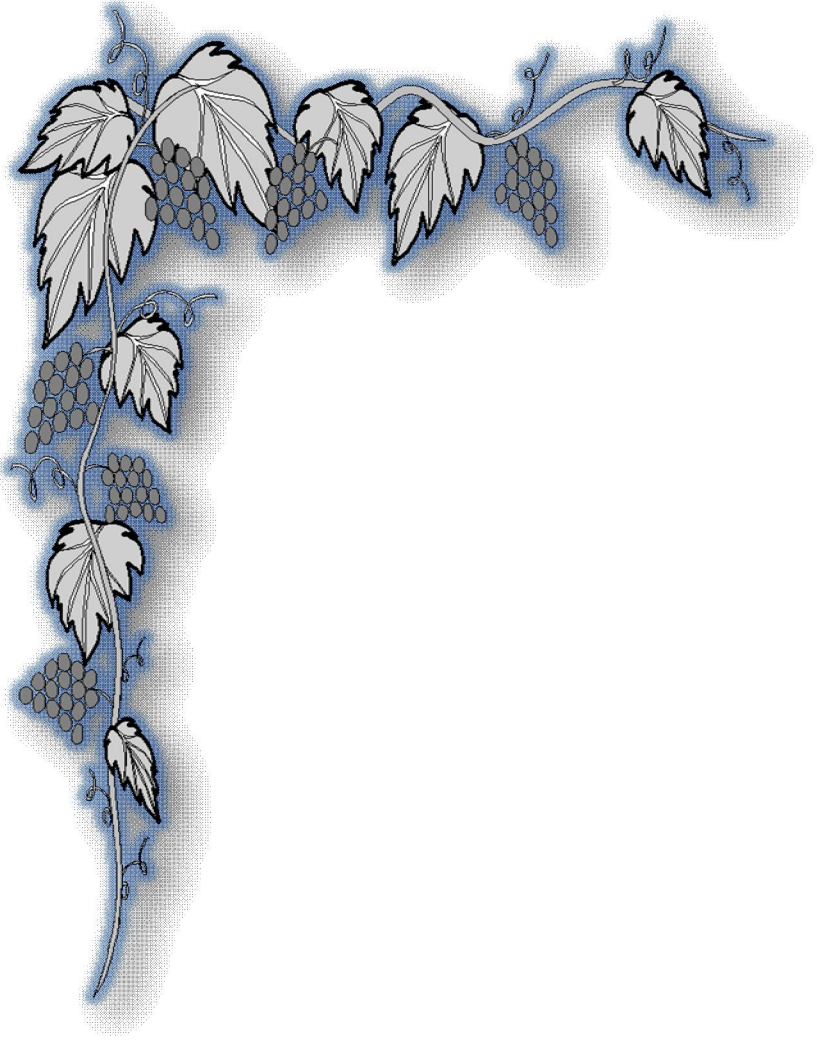
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**Faculty of Horticulture  
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(Vegetable Science)**

**2022**



**Sher-e-Kashmir**  
**University of Agricultural Sciences & Technology of Kashmir**  
**Division of Vegetable Science, Faculty of Horticulture**

**Certificate – I**

This is to certify that the thesis entitled, “**Genetic Divergence Studies in Brinjal (*Solanum melongena* L.)**” submitted in partial fulfilment of the requirements for the award of the degree of **Master of Science in Horticulture (Vegetable Science)**, to the **Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir** is a record of bonafide research work carried out by **Ms. Saima Tabasum (Regd. No. MSH-2020-329)** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that any help or information received during the course of investigation has duly been acknowledged.

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**ABSTRACT**

The present investigation entitled **“Divergence Studies in Brinjal (*Solanum melongena* L.)”** was carried out at the Experimental Field, Division of Vegetable Science, SKUAST-K, Shalimar during Kharif season 2021. The experiment was laid out in randomized complete block design (RCBD) with three replications. Forty genotypes were evaluated for various quantitative and qualitative traits. Analysis of variance revealed significant differences among genotypes for all the traits. For earliness SKAU-B-241 genotype ranked first wherein fruit was set within 55.33 days followed by genotype SKAU-B-193 and SKAU-B-231 which gave first fruit in 58.46 and 58.5 days respectively. Highest fruit yield per hectare was observed in genotype SKAU-B-276 (422.76q/ha.) followed by genotype SKAU-B-279 and SKAU-B-234 which gave fruit yield of 407.4q/ha and 406.16q/ha respectively. The yield of these genotypes was at par or greater than widely grown varieties, after testing their stability over locations these genotypes can be recommended for higher production of fruits. In quality attributing traits, highest TSS were observed in genotype SKAU-B-205 (5.06°Brix), highest vitamin c was observed in genotype IC-089818 (10.51mg/100g) and highest total sugar content was observed in genotype SKAU-B- 234 (3.62%). The estimates of phenotypic coefficient of variance were slightly higher than the corresponding genotypic coefficient of variance for all the characters studied indicating the little influence of environment in the expression of these traits. The highest phenotypic and genotypic coefficient of variation were

observed for average fruit weight (g) (43.69 and 43.69). All the traits had high broad sense heritability value, indicating that the heritability is most likely due to additive gene effects and thus the chances of fixing by selection are more. Correlation studies indicated that days to first fruit picking, plant height (cm), plant spread (cm), fruit length (cm), number of fruits per plant and average fruit weight (g) exhibited significant positive correlation with fruit yield. Diversity analysis showed grouping of genotypes in seven clusters which will help in selection of genetically divergent parents for exploitation in hybridization program and would constitute an essential gene pool for future breeding program

**Key words:** Mean performance, Correlation, PCV, GCV, Genetic gain, Heritability, Diversity analysis

Signature of student

Dated: \_\_\_\_\_

Signature of Major Advisor

Dated: \_\_\_\_\_

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***Saima Tabasum***

Place: Shalimar, Srinagar

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## Chapter- 1

### INTRODUCTION

Typically known as Brinjal in South Asia (particularly India, Pakistan and Bangladesh), Aubergine in Europe, Melongena in the West Indies, Guinea squash in America and Patlican in Turkey, eggplant (*Solanum melongena* L.) is a member of the nightshade family. It is native to Indo-Burmese center of origin where a great genetic diversity of this genus occurs. It also has a high phenolic content, which aids in its potential to absorb free radicals (Cao *et al.*, 1996, Caguiat and Hautea, 2014). Iron, calcium, potassium, magnesium, phenolic phytochemicals, vitamins and other minerals are all abundant in brinjal fruit.

The fruit of eggplant is a good source of vitamins and minerals (especially vitamin C). The following values (per 100 g fresh weight) were obtained from an analysis of fruit portions that might be consumed, excluding the stalk and calyx: 92.7 g of hydration; 1.4 g of protein; 0.3 g of fat; 0.3 g of minerals; 1.3 g of fibre; and 4.0 g of carbohydrates. Ca, 18 mg, Mg, 16 mg, riboflavin, 0.47 mg (phytin P, 3 mg), Fe, 0.9 mg (ionisable Fe, 0.8 mg), Na, 3 mg, Cu, 0.17 mg, S, 44 mg, Cl, 52 mg and Mn, 2.4 mg are the mineral components per 100 g edible parts. There is also a very modest amount of iodine (7 microg/kg). There are 124 IU of vitamin A, 0.4 mg of thiamin (B1), 0.11 mg of riboflavin (B2), 0.9 mg of nicotinic acid (niacin), 12 mg of vitamin C and 25 mg of choline per 100 grammes of edible parts (Singh and Kalda, 2001). Minerals including copper (0.17 mg), magnesium (16 mg), phosphorus (47 mg), iron (0.9 mg), sodium (3 mg) and potassium (200.0 mg) are also present in brinjal. Along with being an excellent source of calories, the fruit's Mn, Mo, Fe and Cu content is crucial for the health of the bones. According to numerous studies, eggplant extracts are incredibly effective at treating a range of conditions, including burns, warts, inflammatory infections, gastritis, stomatitis and arthritis (Im *et al.*, 2016). The main phenolic component chlorogenic acid (5-O-caffeoyl-quinic acid; CGA), which is present in the fruits of

eggplant, has anti-obesity, anti-inflammatory, anti-diabetic and cardio-protective properties (Plazas *et al.*, 2013). By inducing apoptosis in a variety of human cancer cells, including leukaemia and lung cancer cells, chlorogenic acid also exhibits anticarcinogenic properties (Tajik *et al.*, 2017). Anthocyanin molecules are abundant in eggplants and in addition to serving as food dyes, they have important anti-diabetic, anti-cancer and anti-neuronal effects. *In vitro*, the aglycone component (solasodine) in eggplant fruits is effective against human lung cancer (Shen *et al.*, 2017). Additionally, they contain anti-inflammatory properties and are advantageous for lowering blood cholesterol (Friedman, 2006). By eliminating toxins and toxic substances from our stomach, the fibre in eggplant aids in digestion and lowers the risk of stomach and colon cancer (Fraikue, 2016). Additionally, the phytonutrients in eggplant help to improve cognition and protect cell membranes. It protects its cells from being destroyed by free radicals, preserving brain health. Additionally, compounds found in eggplant have the ability to prevent brain tumours.

In India, the total area planted with brinjal is 730,000 hectares, producing 12801,000 MT annually with an average productivity of 16.8 MT/hectare (NHB, 2018-2019). While in Jammu and Kashmir, it covers 2.51 thousand hectares and produces 45.62 thousand metric tonnes annually (NHB, 2017 - 2018).

Natural genetic variability within crop species has been used since the dawn of agriculture to supply as food for subsistence. However, today plant breeders can create new and improved cultivars with desirable qualities, including traits that are valued by both farmers and breeders, thanks to the diversity of available plant genetic resources. By 2050, there will be more than 9 billion people on the planet, so we must maintain a supply of cultivated and arable crop species. A long-term boost in food productivity can be achieved by maintaining or investigating genetic diversity, which can produce adaptive and useful genes. Crops must have genetic diversity in order to improve in the future since it gives breeders alternatives for creating new kinds and hybrids.

Brinjal is an important vegetable crop in India and Indians have a social and economic link with it since ancient times. Despite their low yields and susceptibility to diverse pests and diseases, many indigenous cultivars are well-liked in many different places because of their desirable qualities. In terms of fruit size, shape, colour, growth behaviour, canopy bearing habit, yield, disease & insect-pest resistance, as well as quality and adaptation for different regions and for different growing seasons, there is significant genetic variety in brinjal across the country.

Aside from the significant genetic variation shown in fruit colour, shape and size, there are specialised genotypes suitable for particular preparations. Additionally, among the indigenous material, there are differences in characteristics like vegetative growth, maturity and the presence or lack of spines on leaves, stems and fruit calyxes.

The complete diversity present in a germplasm must be studied and divided into genetic, phenotypic and environmental variability in order for selection and development programmes to be effective. A crucial prerequisite for genetic improvement in a crop is the availability of genetic diversity. This makes it possible for the breeder to implement an effective breeding plan. Therefore, unpredictability plays a crucial role in determining the quantity of advancement anticipated from selection. Crops have an improvement potential directly correlated with the amount of genetic variety in the germplasm.

When determining the extent to which a trait may be passed down from parents to children, heritability has been widely used. Heritability is a metric used to assess the genetic compatibility of parents and offspring. Lush (1973) introduced the idea of heritability and defined it broadly as the ratio of genetic variation to the total amount of phenotypic variation. Heritability was defined by Robinson *et al.* (1949) as the additive genetic variance expressed as a percentage of the total variation. Effective selection requires both high genetic progress and high heritability. Heritability estimations would not be useful in selection based

on phenotypic appearance without genetic advance, so genetic advance should be taken into account in addition to heritability while streamlining the coherent selection breeding programme. Heritability was defined by Wray *et al.* (2008) as a statistical technique used in the fields of breeding and genetics that determines how much genetic variation across individuals in a population contributes to variation in phenotypic traits within that population.

Today, a variety of methodologies are available for analysing divergence. But Mahalanobis generalised distance (Mahalanobis, 1936) stands out among these quantitative trait-based divergence analysis techniques in a big way. This biometric instrument is particularly effective at measuring the degree of biological population divergence. Therefore, this biometric tool will be utilised to measure the extent of biological population divergence as well as to evaluate the relative contributions of various components to the overall divergence at both the inter- and intra-cluster levels.

Estimation of genetic divergence helps in reducing the large data of genotypes to manageable proportions. It is assumed that the parents showing wide genetic divergence are best suited for being used in the hybridization programme. In the process of formulating the brinjal improvement programme through hybridization and creating variability for the improvement of yield and other desirable traits, it is essential to understand the nature and degree of genetic divergence present in the available germplasm.

Keeping in view all the above mentioned facts, the present study was undertaken with the following objectives:

1. To study genetic divergence in brinjal genotypes.
2. To estimate the components of variability.

## Chapter-2

### REVIEW OF LITERATURE

In order to learn more about the current investigation in brinjal, the most recent pertinent literature referring to various parts of the present study has been evaluated in this chapter under the following headings.

- 2.1 Genetic variability
- 2.2 Heritability and genetic advance
- 2.3 Correlation analysis
- 2.4 Genetic divergence studies

#### 2.1 Genetic variability

Planning and carrying out any breeding programme to increase quantitative features heavily depends on the degree of genetic diversity and variability present in the germplasm. Genetic diversity is therefore a requirement for any programme aimed at improving crops.

Significant genotypic differences for each of the investigated traits were reported by Baswana *et al.* in 2002; fruit yield per plant, fruit weight and number of fruits per plant all have high genotypic and phenotypic coefficients of variation.

In year 2002, in their analysis of 15 brinjal cultivars for six economic characteristics, Mohanty and Prusti discovered that PCV was higher than GCV across the board. High heritabilities for yield, average fruit weight, number of fruits and branches per plant were accompanied with moderate to high GCV and genetic gain. Plant height and the number of days before the first harvest showed high heritability, low GCV and genetic gain.

In his 2003 Raipur study of 52 brinjal genotypes, Prasad discovered high PCV combined with GCV for average fruit weight, number of fruits per plant, fruit yield per plant, fruit girth and fruit length.

In an experiment, Naik (2006) examined the genetic diversity of 62 brinjal genotypes in Karnataka. The findings showed that for fruit length, number of fruits in a cluster, number of fruits on a plant, total yield per plant and fruit length to diameter ratio, GCV and PCV were high.

In Kalyanpur, Ram *et al.* (2007) found substantial genotypic and phenotypic coefficients of variation for plant yield, fruit production and parental plant spread. Characters, plant height, days to marketable maturity, plant spread, days to flowering, fruit output per plant, fruit weight and number of branches per plant in F1s, F2s and parent populations showed strong heritability together with high genetic advance, demonstrating additive gene action.

In terms of fruit weight, fruit yield per plant, fruit length, number of flowers per cluster and fruit stalk length, Patel (2007) found high estimations of PCV paired with GCV.

High phenotypic and genotypic coefficients of variance (PCV and GCV) for average fruit weight, number of fruits per plant and yield per plant were found in sixteen brinjal genotypes, according to Islam and Uddin (2009).

For plant spread, plant height, yield per plant and number of fruits per plant among 61 genotypes of brinjal, Naik *et al.* (2009) assessed substantial phenotypic and genotypic variance.

Ansari (2010) found in Raipur high GCV and PCV for the number of flowers per inflorescence, the number of fruits per picking and the size of the fruit, moderate GCV and PCV for the number of fruits per cluster, the average fruit weight, the total number of fruits per plant and low GCV and PCV for the days to first flowering, the days to 50% flowering, the days to first fruiting, the days to first picking, plant height, primary branch count, total fruit output and total soluble solids are all important factors.

High heterogeneity was found across 62 genotypes of egg plant for the various study features, according to Kumar *et al.* (2011). The genotypes SMB-115

for the greatest quantity of fruits, PCPGR-7041 and PCPGR-7028 for most fruits per plant, KS-331 and PCPGR-7030 for earliest maturity, BARI for the greatest fruit length and Sel-6 for yield showed promising results.

For the maximum leaf area index, number of leaves per plant, fruit yield per plant, fruit diameter, fruit length, fruit yield per plot and fruit yield per hectare, Shekar *et al.* (2012) estimated maximum phenotypic and genotypic coefficient of variance (PCV and GCV) on 31 brinjal accessions.

In their study of the genetic variability for various characteristics in brinjal, Singh *et al.* (2013) found high PCV and GCV for primary branches per plant, fruit length, diameter, weight and fruits per plant, as well as moderate PCV (10–25%) for plant height, plant spread, days to first flowering, days to first harvest and yield per plant.

At the Department of Horticulture, Faculty of Agriculture, Annamalai University, Sujjin *et al.* (2017) did an experiment. The number of fruits per plant, fruit weight, fruit girth and shoot and fruit borer incidence were the characters that showed higher genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) and these characters offer selection potential.

Fifty genotypes of brinjal were studied in an experiment by Arti and Sharma (2018) for their variability, including coefficients of variability (phenotypic and genotypic), heritability (in a broad sense) and genetic progress as a percentage of mean (genetic gain). For incidence of fruit rot, incidence of fruit borer, number of marketable fruits per plant, fruit weight and yield per plant, the phenotypic and genotypic coefficients of variability were high.

Yadav *et al.* (2018) discovered significant differences across all examined features when analysing forty genotypes for thirteen quantitative variables. All genotypes and characters under analysis showed highly significant differences, showing that each character has a considerable level of variability. For every character analysed, PCV estimates were greater than their matching GCV. Fruit

weight (63.5, 62.5%), length to width ratio (41.7, 40.7%), diameter (39.1, 35.5%), yield (30.7, 30.5%), fruit length (31.7, 29.9%), fruits per plant (27.5, 24.5%) and flowers per cluster (29.8, 23.65) had high PCV and GCV, whereas plant height, length of peduncle, days to 50% flowering and leaf length had moderate PCV and GCV.

Verma *et al.* (2018) used 36 genotypes in two environments (E1 and E2) for an experiment with the goal of determining the extent of genetic diversity, heritability and genetic progress among 18 yield-related characteristics in brinjal. The results of the analysis of variance showed that there were substantial genetic variations among the brinjal genotypes, indicating the presence of substantial variability and extending the potential for selection to enhance the concerned features.

The genotypes for many characters showed a modest to vast range of mean values. Except for days to 50% flowering, number of primary branches, fruit diameter and days to first fruiting in E2 season, which indicated a predominance of additive gene component in the expression of these traits and arising a chance of genetic improvement through phenotypic selection, moderate to high genotypic coefficient of variation, moderate to high heritability and genetic advance as percent of mean were reported for most of the characters under study. Plant height, number of primary branches per plant, number of flowers per cluster, calyx length, plant spread, number of clusters per plant, fruit yield per hectare, fruit weight, fruit width, pericarp thickness, pedicel length and days to 50% flowering all showed high genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) by Dasmohapatra *et al.* (2019)

In an experiment conducted by Pramali *et al.* (2019), thirty hybrids from thirteen parents were assessed throughout the course of two subsequent years and pooled analysis for twelve yield-related features was also conducted. Because both genotypic and environmental variability are present at the phenotypic level, the phenotypic coefficient of variation (PCV) was higher than the corresponding

genotypic coefficient of variation (GCV). High PCV (44.07%) and high GCV (40.37%) were found in the pooled data for the number of unmarketable fruits per plant and marketable fruit per plant, respectively. For the total number of fruits per plant (67.99%), a high heritability and strong genetic progress as a percentage of mean were observed, showing the significance of additive gene action governing this attribute.

Devaraju *et al.* (2020) evaluated the genetic variability of eleven features in 30 brinjal genotypes. Differentiations between the genotypes under study were found to be quite significant. Flowers per cluster, fruits per cluster, percent fruit set, fruits per plant, fruit length, fruit diameter and fruit production per plant all showed high phenotypic and genotypic coefficients of variation, indicating that the genotypes for these traits are very variable. Branching per plant, days to first flowering, days to 50% flowering, flowers per cluster, fruits per cluster, % fruit set, fruits per plant, fruit length, fruit diameter and fruit yield per plant all showed high heritability in the broad sense along with high genetic advance in percent of mean, indicating that these can be improved through direct selection due to predominance additive gene action

20 different eggplant genotypes were used in the experiment, which Patel and Toppo (2020) carried out in three replications. The analysis of variance showed that the experimental material contained a suitable amount of variability. The study found that for all traits, the phenotypic coefficient of variation was higher than the matching genotypic coefficient of variation, which may be the result of the interaction between genotype and environment.

## **2.2 Heritability and Genetic advance**

The genetic variance to the overall variance in the non-segregating population is measured as heritability. This shows the percentage of phenotypic variation caused by genotypic variation. Heritability is primarily influenced by a number of variables, including sample size, genetic material type, sampling

technique, linkage effect, experiment design and computation method. High heritability is a sign that many traits are the result of additive gene action.

The genetic progress is a metric for agricultural improvement brought about by population-level selection. Genetic advance estimate is based on a number of variables, including heritability, selection intensity and phenotypic variance. When heritability is high and genetic advance is high, this shows an additive gene impact and suggests that selection will be successful. When heritability is high but genetic advance is low, this implies a non-additive gene effect.

In their study of 61 brinjal genotypes, Naik *et al.* (2009) found high genetic progress and high heritability for the number of fruits per cluster, the number of fruits per plant, the length of the fruit, the ratio of the fruit's length to its diameter, the yield per plant and the yield per plot.

Ansari (2010) found strong heritability and genetic progress in brinjal for average fruit weight and total number of fruits produced per plant, but for the amount of fruits per cluster, there is a medium genetic variance and a high genetic advance.

For the major variables, including plant height, number of branches per plant, fruit breadth, fruit length, number of fruits per plant and fruit production per plant, Muniappan *et al.* (2010) found high genetic advance with high heritability, with the exception of days to 50% flowering.

Shekar *et al.* (2012) found that all characters of the brinjal, including the number of fruits per plant, fruit yield per plot, fruit yield per hectare, fruit length, fruit diameter, leaves per plant and leaf area index, had high heritabilities due to genetic advancement. However, the average fruit weight had moderate to low heritabilities.

According to Lokesh *et al.* (2013), high per cent mean of genetic advance was recorded for plant spread (115.07), plant height (25.00), fruit weight (25.23) and shoot and fruit borer incidence (21.53).

Manpreet *et al.* (2013), determined heritability and association coupled with genetic advance for long-styled flower, pseudo styled flower, short-styled flower, medium style flower, flowers per inflorescence, fruits per plant, fruit setting, fruit length and fruit weight.

By measuring high genetic gain with heritability through variability analysis among 21 brinjal genotypes, Nayak and Nagre (2013) showed that the features plant height, yield per plant, number of fruits per plant and fruit weight were under additive influence.

According to Prabakaran *et al.* (2013), the number of primary branches per plant, plant height, leaf area index, fruit length, average fruit weight, fruit width, days to first flowering, fruit yield per plant, number of long-styled flowers per plant, number of fruits per plant, total phenol content, ascorbic acid content, fruit borer infestation and little leaf incidence all showed high heritability with high genetic advance.

Singh *et al.* (2013) noted significant genetic progress in brinjal for fruit length, fruit diameter, fruits per plant, plant spread, plant height, primary branches per plant and yield per plant all showed strong heredity, while days to first fruit set, days to first harvest and days to first blooming showed moderate heritability.

Chaudhary and Kumar (2014) assessed sixteen brinjal genotypes for distinct qualities. The results showed that there was additive gene action for the number of leaves per plant, fruit yield per plant, fruit length, fruit weight, yield per plot, total reducing sugar and yield per hectare due to high heritability and strong genetic gain.

Kumar *et al.* (2014) found high heritability along with high genetic advance as a percentage of mean in 34 genotypes of egg plant, with the exception of days to 50% flowering.

According to Mili *et al.* (2014), pulp/seed, plant height, fruit weight, fruit diameter, seed yield per fruit, total fruit yield per plot, fruit yield per plant and the

number of fruits per plant were estimated for the characteristics. High heritability and high genetic gain were evaluated for these traits.

In 2014, Solaimana *et al.* investigated the variation among 35 different types of egg plants and the results showed that for single fruit weight, heritability was found to be high along with substantial genetic advancement.

According to Yadav *et al.* (2014), strong heritability and genetic advancement were found in brinjal genotypes for fruit yield, average fruit weight and fruit production per plant.

In an experiment by Madhavi *et al.* (2015) on 21 brinjal genotypes, it was found that heritability with genetic advance estimates were high for flowering time per cluster, fruit diameter, fruit volume, pickings, single fruit weight, dry matter content and fruit yield per plant.

According to Shande *et al.* (2015), high heritability coupled with high genetic advance as per cent mean was noticed for fruit yield per plant, number of fruits per plant, number of fruits per cluster and fruit yield per plant.

In their 2016 study of 10 eggplant genotypes, Akpan *et al.* discovered highly significant variations in all of the traits. For late planting, high broad sense heritability ( $h^2bs$ ) was found for fruit yield per hectare (97.98%), fruit yield per plant (99.48%) and fruit circumference (99.16%).

Yadav *et al.* (2016) found that high heritabilities and genetic advance was found for plant height (35.4%), fruits per plant (46.4%), flowers per cluster (58.4%), fruit length (58.4%), fruit diameter (66.6%), fruit weight (127.2%), yield per plant (65.5%), leaf width and fruit length to width ratio (81.9%), whereas genetic advance was found to be moderate for branches per plant, days to 50%

In terms of days to 50% flowering, the number of flower clusters per plant, the number of flowers per cluster, the number of fruits per cluster, the number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight,

fruit yield per plant, total phenol content, shoot and fruit borer infestation, Ravali *et al.* (2017) found high heritability along with high genetic progress.

Sujin *et al.* (2017) also noted significant heritability along with high genetic advance and genetic gain for fruit production per plant, fruit weight, number of secondary branches per plant, shoot and fruit borer incidence.

In brinjal, Arti and Sharma (2018) found strong estimates of heritability (broad sense) and genetic advance for all the characters studied *viz.* incidence of fruit borer (99.39%), incidence of fruit rot (99.23%), Vitamin C content (97.39%), plant height (96.83%), number of branches per plant (96.65%), number of marketable fruits per plant (96.44%), fruit breadth (94.80%), fruit length (94.42%), fruit weight (93.75%), total harvest duration (90.43%), total soluble solids (90.33%), days to 50 percent flowering (85.10%), days to first harvest (84.82%), yield per plant (83.87%), yield per plot (84.72%), yield per hectare (84.72%).

Pujer *et al.* (2018) estimated heritability and genetic advance in brinjal genotypes for all characters ranged from 19.79 per cent to 100 per cent and 0.55 per cent to 70.63 per cent.

Verma *et al.* (2018) investigated variability for 18 different traits in two seasons (E1 and E2) and the results showed that, with the exception of days to 50% flowering, number of primary branches per plant, fruit width and days to first fruiting in E2 season, all traits had moderate to high heritabilities with genetic advance expressed as a percentage of mean.

Incidence of fruit borer (99.60%), number of fruits per plant (96.22%), fruit weight (94.08%), fruit length (94.10%), number of branches per plant (97.43%), plant height (94.36%) and fruit yield per plant (90.82%) were all observed by Balas *et al.* (2019) to have high heritability along with high genetic advance.

In 102 genotypes of egg plants, Jirankali *et al.* (2019) found strong heritability together with significant genetic progress for the quantity of fruits per cluster (99.51), fruit weight (99.16%) and incidence of shoot and fruit borer (92.38 %).

By estimating high genetic advance with heritability through variability study among seventeen brinjal genotypes, Dasmohapatra *et al.* (2019) showed the characters numbers of primary branches per plant, number of flowers per cluster, fruit weight and fruit yield per plant and per hectore were under additive effect.

Bende *et al.* (2019) while working on forty-one brinjal genotypes showed high heritability coupled with high genetic advance as per cent of mean for incidence of fruit borer, incidence of shoot borer, fruit yield per plant, number of fruits per cluster, fruit length.

### **2.3 Correlation analysis**

The attributes number of fruit per plant, average fruit weight, number of clusters per plant and number of tertiary branches per plant should be given the most consideration for the enhancement of fruit yield in brinjal, according to Singh and Singh (2001) at Dhaulakuan.

The average fruit weight had the biggest positive direct effect on fruit output per plant, followed by the quantity of fruits per plant, according to Mohanty's (2001).

Through route analysis, Kumar *et al.* (2002) showed that the great correlation between fruit yield and fruit yield weight and quantity per plant was owing to their highest direct contributions, demonstrating real correlations.

The results of correlation analysis studies conducted by Singh *et al.* (2003) in Ranchi showed that plant spread, followed by fruit breadth, length and number of branches per plant, had the highest direct positive effect on fruit yield per plant, whereas plant height showed positive contribution to fruit yield via plant spread, followed by fruit weight via fruit breadth.

The number of branches, fruit size index and fruit width had positive correlations with fruit yield per plant according to Patel and Sarnaik's (2004) research at Raipur, but the number of fruits per plant, fruit length and weight per fruit had significant positive correlations at the genotypic level.

Nineteen brinjal genotypes were the subject of association research by Katoch *et al.* in 2005 at Palampur. According to the findings, the number of marketable fruits, gross yield and overall number of fruits per plant were all positively and substantially correlated with marketable yield per plant. Days until first harvest were highly correlated with days till blossoming.

In 2005, Kushwah and Bandhyopadhyaya conducted a correlation analysis study for thirteen aubergine features in Tehri Garhwal. The findings demonstrated a substantial positive link between fruit output per plant and the number of fruits per plant, fruit diameter and number of pickings at the genetic level. Fruit yield was positively connected with picking frequency, fruit diameter and quantity of fruits per plant at the phenotypic level, but negatively correlated with days till first picking. The number of fruits per plant, fruit length, number of fruits per cluster and number of flowers per cluster all had a negative correlation with fruit weight and diameter.

Naik studied 61 genotypes of brinjal in Karnataka (2006). The correlation analyses showed a strong and favourably correlated relationship between total yield per plant, fruit yield per plant and average fruit weight.

In an experiment on 20 different aubergine genotypes, Nair and Mehta (2007) found a significant and positive correlation between yield per plant and its phenotypic components, including the number of fruits per plant, percentage of fruit set, leaf area index and plant height.

In sixty-three brinjal genotypes, Patel (2007) evaluated correlation coefficient and discovered that, at the phenotypic level, the number of branches per plant, fruit girth and fruit weight were all positively correlated with fruit

output per plant. However, character fruit girth had a substantial positive genotypic connection with fruit yield per plant.

In 23 genotypes of green fruited brinjal, Lohakare *et al.* (2008) at Akola assessed the connection and reported that yield per plant was closely related to number of fruits per cluster, fruit index, average fruit weight and number of fruits per plant. Additionally, they calculated the number of fruits per plant, average fruit weight, fruit index, days till the first fruit harvest, number of primary branches and plant spread to determine the positive direct influence on yield per plant.

Ansari (2010) at Raipur studied the association analysis in total fruit yield per plant showed positive and significant correlation with marketable fruit yield per plant, number of primary branches per plant, number of fruits per picking and total number of fruit per plant in both seasons; number of fruits per cluster in rainy season only, whereas negative significant correlation with days to first picking, days to first flowering, days to 50% flowering, days to first fruiting and days to first fruiting showed negative correlation with these variables.

In Rabi of 2015–16, Ravali conducted a correlation coefficient analysis on 35 Brinjal types. The findings showed a positive and highly significant correlation between fruit yield and these traits, which were designated as yield components: days to first flowering, days to 50% flowering, number of flower clusters per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, days to last harvest, fruit length, fruit width, average fruit weight and total phenol content. Thus, direct selection of these yield components can result in the genetic improvement of fruit output.

Sujin conducted an experiment between 2014 and 2015 to evaluate the degree of genetic variability, heritability, correlation and path coefficient analysis of 60 genotypes of brinjal for yield and tolerance to shoot and fruit borer. The number of long styled flowers per plant, number of short styled flowers per plant,

number of fruits per plant, fruit weight, days to first harvesting and incidence of shoot and fruit borer revealed positive direct effects among the sixteen morphological features examined. It was shown that there was a positive and substantial association between fruit weight, fruit girth and fruit production per plant. It is considered that these characters' selection should receive more weight.

In the rabi season of 2018, Arti D. *et al.* conducted a field experiment using fifteen genotypes of brinjal. Observations of both quantitative and qualitative features were made and documented. According to a study on the correlation between various characters, selection for fruit yield must be based on plant height, plant spread (E-W), plant spread (N-S), stem girth, fruit length, fruit girth, fruit weight, number of fruits per plant-1, fruit and shoot borer, pericarp thickness, flesh thickness, vitamin C and dry matter. It should also take into consideration the plant's dry matter and girth. For all character combinations, stronger genotypic correlations were found in the current investigation than the corresponding phenotypic correlations, demonstrating that environmental influences can suppress phenotypic expression. Fruit length was found to have the greatest positive direct effect on total fruit yield, followed by vitamin C, pericarp thickness, number of primary branches per plant, fruit weight, days to first flowering, TSS, stem girth and number of fruits per plant, indicating that these traits should be given significant weight in selection programmes for improving brinjal yield.

At the College of Horticulture, SKLTSHU, Hyderabad, during Kharif 2019, Nikitha conducted an experiment to assess the yield and yield-related characteristics of 33 brinjal genotypes. The experiment was set up using a Randomized Block Design with two replications. Fruit yield per plant showed a maximum positive correlation with the number of fruits per plant (0.8997), marketable yield per plant (0.6300), number of branches per plant (0.2293), fruit diameter (0.1339), fruit weight (0.1233) and days to first flowering (0.1233), according to the correlation coefficient analysis (0.1176).

By assessing 22 genotypes of brinjal for thirteen quantitative traits, Shalini (2020) analysis of genotypic and phenotypic correlation coefficients was done. For all the studied traits, analysis of variance indicated a significant difference between all genotypes. There is a considerable intrinsic association between various pairs of features, as evidenced by the magnitudes of genotypic correlation coefficients being higher than their corresponding phenotypic correlation coefficients in general. The correlation coefficient study revealed a significant and positive correlation between fruit output per plant and the quantity of fruits per plant and the length of the fruits at both the genotypic and phenotypic levels.

#### **2.4 Genetic divergence studies**

Multivariate analysis, often known as  $D^2$  statistics, has been successfully applied for the quantitative measurement of genetic diversity among the several statistical techniques created for evaluating the divergence across populations. Rao (1952) proposed its use for the evaluation of genetic diversity in plant breeding and Mahalanobis (1936) claimed that  $D^2$  statistics can be used to estimate the genetic divergence between populations. He developed the concept of a statistical field where each point represents the centre of a density cluster that belongs to a certain normal population, which is defined by (i) the character's means and (ii) the measure of co variances at the specific place in the field.

The term "genetic diversity" refers to the overall amount of genetic variation contained in a population, species, or variety of genes and genotypes found in a certain crop species, or in a germplasm, population, or population set. Typically, phenotypic morphology is used to choose parents. Selecting the parents for hybridization is more practical when genetic divergence in the available germplasm is studied. The  $D^2$  statistic is a way of representing genetic diversity in terms of statistical distance. It calculates the distance between two populations for a variety of attributes.  $D^2$  statistics, also known as multivariate analysis, has been widely utilised to estimate genetic diversity among the several statistical techniques created for evaluating variety. The benefit of  $D^2$  statistics is that it

enables us to estimate the degree to which the sets in repeated measurements differ, as well as the distances in the p-dimensional form at which samples are most dissimilar.

Sharma *et al.* (2000) investigated 34 brinjal genotypes from various origins in Jorhat. Ten groups of genotypes were created. Fruit weight on average and fruit circumference were the key factors influencing genotype grouping. Additionally, they noted that genetic diversity was unrelated to the geographic diversity of the genotypes.

15 genotypes of brinjal were examined by Mohanty and Prusti (2001) for five economic characteristics. Two lone groups were among the six clusters of accessions that were formed. The clusters VI and I have the greatest intercluster distance ( $D^2 = 971.15$ ). Geographic dispersion and genetic divergence have no discernible relationship to one another. The average fruit weight and the quantity of fruits produced by each plant were the main contributors to overall deviation. It was recommended to conduct many crosses between clusters II (BB-26 and Black Beauty), IV (Pusa Kranti and Bhawanipatna Local) and VI (H-8) in order to create high-yielding brinjal cultivars with other desirable features.

For the five economic characteristics of brinjal that Mohanty and Prusti (2002) evaluated at Bhawanipatna, there was enough variation among the accessions. Six clusters of genotypes were created. Cluster V and cluster VI were found to be separated by the greatest inter-cluster distance. The characteristics that contributed the most to divergence were plant height, fruit production per plant and average fruit weight. Additionally, they noted that there was no connection between genetic divergence and geographic distribution.

At Raipur, Prasad (2003) investigated the genetic divergence in 52 brinjal genotypes. The findings demonstrated that clusters I and IV had several genotypes (11 each). Cluster III displayed the greatest intra-cluster distance, but clusters VII and VIII displayed the greatest inter-cluster distance. For the average fruit weight,

days until first flowering, days until first fruit set and fruit output per plant, Cluster III displayed high mean values.

In Bangalore, Prasad and Singh (2003) examined the genetic distance between six parents and their potential 30 F1 offspring, which were organised into ten clusters. Cluster IX had a higher intra-cluster distance while clusters V and X had a higher inter-cluster distance.

For forty aubergine genotypes, Sharma and Maurya (2004) examined the genetic divergence. Seven groups of genotypes were created. The traits that contributed most to genetic divergence included fruit width, fruit number per plant and seed weight per 1000. Clusters V and VII had the greatest inter-cluster distance. Additionally, they discovered that there was no connection between regional dispersion and genetic divergence.

In Ludhiana, 35 brinjal genotypes were evaluated for genetic diversity and they were divided into eleven clusters by Singh *et al.* (2005). There was no difference in the clustering according to location. Compared to other genotypes, three genotypes—Punjab Sadabahar, Punjab Jamunigola and HP-14—exhibited the most variability, making them ideal candidates to serve as one of the parents in a hybrid breeding effort. to exploit heterotic expressions for fruit yield and other economic characters.

Singh *et al.* (2006) conducted a study on genetic divergence in Srinagar using 29 genotypes of brinjal. Regardless of regional variety, the genotypes were divided into six groupings. With a maximum of 14 genotypes, Cluster II rated first, whereas Clusters V and VI were solitary clusters. Clusters I and VI had the greatest inter-cluster distance. The characteristics that contributed most to divergence and played a significant effect in improving fruit yield in brinjal were the number of fruits per plant, plant height, average fruit yield per plant and number of branches per plant.

In Ludhiana, Singh *et al.* investigated the genetic diversity of 35 brinjal genotypes (2006). Regardless of geographic divergence, the genotypes were

divided into eight clusters. Punjab Sadabahar, a genotype that differed greatly from all other genotypes, can be employed as a parent to take advantage of heterotic expressions for yield and other economic characteristics.

Naik (2006) investigated 61 brinjal genotypes in Karnataka and categorised them into 8 groupings. Maximum intra-cluster and inter-cluster distances were seen between clusters III and VIII in cluster III. Out of the sixteen variables, fruit length had the greatest impact on genetic diversity, followed by the quantity of primary branches, plant height and fruit cluster size.

Patel (2007) examined the genetic divergence of 63 brinjal genotypes in Raipur. Cluster IV had the greatest intra-cluster distance, whereas clusters II and III had the greatest inter-cluster distance. Plant height and fruit output per plant showed high cluster mean values in cluster I, but fruit girth, days to 50% blooming and fruit weight showed high cluster mean values in cluster III. In terms of total genetic divergence, fruit output per plant made the biggest contributions.

In Junagadh, Golani *et al.* (2007) evaluated 23 brinjal genotypes. Six clusters were created from the population. Cluster I had six genotypes, followed by clusters II and III, each with five and cluster VI, which was a single cluster. It was reported that clusters II and III had the highest inter-cluster  $D^2$  value. Fruit length, fruit girth and fruit weight all showed high GCV, heritability and genetic advance as a percentage of mean, showing additive gene action that caused the most divergence.

In their 2008 study of genetic diversity in 40 genotypes of brinjal for different features, Dutonde *et al.* at Rahuri found significant variances for each character. The accessions were divided into seven clusters, with Cluster I having 17 genotypes, Cluster IV having 11 genotypes and Cluster III having 3 genotypes (8). Clusters IV and VII had the greatest observed intercluster distance ( $D=104.98$ ).

In their 2009 study, Roosevelt and Shanti used brinjal genotypes from 24 different genetic backgrounds. There were three genotypes in Cluster I, fourteen

in Cluster II, two in Cluster III and five in Cluster IV. Cluster II and Cluster IV had the greatest intercluster distance (43.45), whereas Cluster I and Cluster III had the smallest intercluster distance (24.39). Given the genetic distances and cluster means, it is likely that the genotypes of clusters IV and III were recombined for high yield. Fruit output per plant has the characteristics' influence on genetic divergence.

Patel *et al.* (2014) investigated 35 genotypes for brinjal's genetic diversity. There is no correlation between geographic diversity and genetic diversity, as the genotypes were clustered into six groups regardless of geographic dispersion. While other clusters were solitary clusters, Cluster I was a fairly large cluster with 30 genotypes. Cluster II and Cluster VI, which may be used as prospective genotypes for a hybridization programme, had the greatest intercluster distance, followed by Cluster III and Cluster VI.

Hassan *et al.* (2015) examined 22 different eggplant accessions for various agro-morphological parameters while researching the genetic diversity of brinjal. The majority of the analysed metrics, including fruit weight, branching angle, days to blooming and plant height, showed an average to high variance. Low variance was found for the amount of flowers per axil, petiole thickness, internode length and leaf lobation. There was a substantial link, especially among the traits that contributed to yield. The 22 eggplant genotypes were split into three clusters by cluster analysis, with each cluster being further subdivided into two subclusters. There was no correlation between the clustering pattern and the collection's starting point. When compared to the other genotypes under study, the genotype 19326 continued to perform better. In general, the genotypes in cluster I were tall in stature and had high mean values for a variety of characteristics. Clusters II and III were next. The germplasm accessions' fruit shapes and colours varied, ranging from spherical to elongated, dark purple to white. However, purple (54%) and circular (40.9%) shapes were most common. Even though the

analysed germplasm only included 22 accessions, it showed a variety of patterns depending on several parameters.

Using  $D^2$  statistics, Sanga *et al.* (2017) reported the genetic diversity of fifteen wild brinjal genotypes and nineteen characteristics. The most genotypes are found in Cluster-III, followed by Cluster-I. Cluster-I and Cluster-II had the smallest intercluster distance (12829.31), whereas Cluster-I and Cluster-III had the largest (12829.31). (3933.95). Characteristics with the highest contributions to divergence include total phenol, fruit yield per plant, protein content, total carbohydrate, steroid content and fruit yield per plant.

Forty brinjal genotypes were evaluated by Yadav *et al.* (2018) for genetic divergence based on  $D^2$  values formed seven groupings. Cluster-I displayed the highest intra-cluster distance (4.681), indicating the presence of extremely different genotypes in this cluster, while Cluster-II displayed the lowest intra-cluster distance (3.793). Cluster-V and Cluster-II had the greatest intercluster distance (7.174), whereas Cluster-III and Cluster-IV had the smallest intercluster distance ever measured (4.657).

In a study, genetic divergence among 38 genotypes was analysed by Swadesh *et al.* (2018). Principal component analysis, genetic divergence by multivariate analysis and genetic components analysis were all used to examine the accessions. Seven clusters were formed from the meaningful grouping of 38 genotypes. With fourteen genotypes, Cluster III was the largest cluster, followed by Cluster I, Cluster II, Cluster IV, Cluster V, Cluster VI and Cluster VII, which had the fewest genotypes. Geographic distribution and genetic distance were not directly correlated. The largest intra-cluster distance among the seven clusters was shown by cluster III, followed by cluster II. The genotypes in clusters IV and VII showed the highest divergence based on intra-cluster distances, indicating that these genotypes could be used as parents in a hybridization programme to create high heterotic hybrids. Fruit number per plant demonstrated the greatest impact to variety among the evaluated characteristics.

In their investigation of genetic divergence among 56 brinjal genotypes based on 12 agronomic parameters, Ponsiva *et al.* (2019) found substantial variances among the brinjal genotypes for all the traits examined. Fifty-six genotypes were sorted into eight clusters using D<sup>2</sup> analysis. Cluster V (27 genotypes) had the most genotypes collected, followed by Cluster IV (11 genotypes), Cluster VII (07 genotypes) and Cluster I (11 genotypes) (04 genotypes). Each genotype in Clusters I, III and IV was two. VIII was a monogenotypic cluster. With cluster I, the intra cluster distance was at its greatest. There may be genetic differences among the genotypes in this cluster as well. On the other hand, because of the minimal intra-cluster distance, the genotypes clustered in cluster IX were similar for the traits of interest. The highest intra-cluster distance was found between clusters VI and II. In order to produce heterotic hybrids and superior recombinants, the genotypes gathered in these clusters may be crossed to produce genetically distinct individuals.

According to Pandey *et al.* (2019), clusters V and II had the most genotypes (8), followed by clusters III, IV and VI, which each contained four genotypes. The trait number of fruits per plant and fruit yield per plant had the highest cluster mean in cluster I, followed by cluster III. The maximum inter-cluster distance (1527.7) was discovered between clusters I and VI, indicating that the brinjal's genetic makeup is extremely distinct from one another.

Silambarasan *et al.* (2020) discovered substantial variations among the genotypes for all the traits of interest while analysing genetic divergence across 50 genotypes of brinjal for 12 traits. Based on their current performance, the genotypes VR-2, JBH-3 and Utakalkashari were identified as elite genotypes. The Mahalanobis D<sup>2</sup> statistic was used to cluster 50 genotypes, which resulted in up to seven clusters. There were as many as 21 genotypes in Cluster VII. Clusters VI and VII had the greatest inter-cluster distance. Cluster VI included four genotypes and shown easiness along with a large amount of fruits per cluster. To develop high producing but early lines and/or hybrids, cross breeding programmes may

make use of the genotypes obtained in these groupings. The intra-cluster distance was maximum among the genotypes constelled with the cluster VII.

## Chapter-3

### MATERIALS AND METHODS

The investigation on “**Genetic Divergence Studies in Brinjal (*Solanum melongena* L.)**” was initiated at Vegetable Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar during *kharif* season 2021. The experimental field located at the main campus, Shalimar, Srinagar is 15 km away from Srinagar city on the foot hills of Mahadev. The altitude of the location is 1685 meter above mean sea level with geographic coordinates of 34°N and 74.89°E. The climate is temperate characterized by mild summers. Forty genotypes of brinjal were evaluated in Randomised Complete Block Design with three replications.

|                       |   |            |
|-----------------------|---|------------|
| Total no of genotypes | : | 40         |
| Design of experiment  | : | RCBD       |
| Spacing               | : | 60cm×45 cm |

3.1 Standard package of practices were adopted to raise a healthy crop

#### 3.1.1 Nursery raising

Raised nursery beds of 1 m x 1 m were finely ground. These beds include 30 cm wide canals all around to make irrigation, water drainage, intercultural activities and seedling uprooting easier. Each bed received 6 kg of well-rotten FYM. Following treatment with Bavistin @ 2 g/kg, seeds were sowed in rows at a distance of 5 cm, at a depth of approximately 2 cm. The seeds were completely covered with a fine soil and FYM mixture. After seeding, the beds were covered with nets, which were then removed once the seeds had germinated. Rosecan was used to water the beds.. Ten days after germination, hoeing was done to allow for optimum aeration and then weeding was done to prevent crop-weed competition and produce healthy seedlings. After 10 and 15 days of germination, the nursery was sprayed with Imidacloprid @ 0.5 ml/liter and Bavistin @ 2 g/liter of water to guard against pests and diseases. Unless the seedlings were uprooted for transplanting, the nursery beds received mild but frequent irrigation.

**Table 1: List of brinjal (*Solanum melongena* L.) genotypes used in the present study**

| S. No. | Genotypes   | Source   | S. No. | Genotypes  | Source   |
|--------|-------------|----------|--------|------------|----------|
| 1.     | IC-074207   | SKUAST-K | 21.    | SKAU-B-229 | SKUAST-K |
| 2.     | IC-074244-1 | SKUAST-K | 22.    | SKAU-B-231 | SKUAST-K |
| 3.     | IC-089818   | SKUAST-K | 23.    | SKAU-B-234 | SKUAST-K |
| 4.     | IC-089888   | SKUAST-K | 24.    | SKAU-B-236 | SKUAST-K |
| 5.     | IC-090062   | SKUAST-K | 25.    | SKAU-B-239 | SKUAST-K |
| 6.     | IC-090063   | SKUAST-K | 26.    | SKAU-B-241 | SKUAST-K |
| 7.     | IC-099712   | SKUAST-K | 27.    | SKAU-B-245 | SKUAST-K |
| 8.     | IC-111010   | SKUAST-K | 28.    | SKAU-B-247 | SKUAST-K |
| 9.     | IC-261801   | SKUAST-K | 29.    | SKAU-B-249 | SKUAST-K |
| 10.    | IC-354867   | SKUAST-K | 30.    | SKAU-B-251 | SKUAST-K |
| 11.    | SKAU-B-193  | SKUAST-K | 31.    | SKAU-B-255 | SKUAST-K |
| 12.    | SKAU-B-197  | SKUAST-K | 32.    | SKAU-B-257 | SKUAST-K |
| 13.    | SKAU-B-205  | SKUAST-K | 33.    | SKAU-B-259 | SKUAST-K |
| 14.    | SKAU-B-209  | SKUAST-K | 34.    | SKAU-B-263 | SKUAST-K |
| 15.    | SKAU-B-211  | SKUAST-K | 35.    | SKAU-B-266 | SKUAST-K |
| 16.    | SKAU-B-215  | SKUAST-K | 36.    | SKAU-B-268 | SKUAST-K |
| 17.    | SKAU-B-219  | SKUAST-K | 37.    | SKAU-B-270 | SKUAST-K |
| 18.    | SKAU-B-222  | SKUAST-K | 38.    | SKAU-B-274 | SKUAST-K |
| 19.    | SKAU-B-224  | SKUAST-K | 39.    | SKAU-B-276 | SKUAST-K |
| 20.    | SKAU-B-226  | SKUAST-K | 40.    | SKAU-B-279 | SKUAST-K |

### **3.1.2 Preparation of field**

The field was thoroughly prepared by two ploughing, two cross harrowing and levelling. At a rate of 18-20t/ha, well-rotten farmyard manure was combined in equal parts with the soil.

### **3.1.3 Transplanting**

Nursery beds were irrigated prior to removing the seedlings to lessen harm to the roots. To prevent mortality, thirty-day-old seedlings were transplanted at a distance of 60 cm between rows and 45 cm between plants in the evening. Right after transplanting, a light watering was administered.

### **3.1.4 Gap filling**

In order to maintain the desired plant population, after one week gap filling was done wherever mortality of transplanted seedling was observed.

### **3.1.5 Fertilizer application**

The crop was given well-rotten FYM @ 18t/ha and 80: 50: 40 kg N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O/ha. Before transplanting, the entire amount of FYM, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and half of the N were applied and thoroughly mixed in the soil. The remaining N was added using urea at 30 and 60 days after transplanted in two equal portions.

### **3.1.6 Irrigation**

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

### **3.1.7 Weeding and plant protection**

To prevent crop weed competition, interculture was carried out 30 days after transplanting, followed by weeding and earthing. Additionally, two additional weeding were done 60 and 90 days following transplanted. When

necessary, Imidacloprid and Rogor (Dimethoate) were sprayed on the crop at a rate of 2ml/L to protect it from aphids, jassids and shoot and fruit borer.

### **3.1.8 Harvesting**

Fruits were picked every 7 to 10 days as they reached a marketable stage. Fruits were harvested with the utmost care. Fruits were gathered at least a week following insecticide application because of the insecticide's 48-hour residual duration.

## **3.2 Characters studied and observational procedures**

To measure the level of genetic variability present in the materials under research, observations were made on a variety of yield and quality parameters. From each replication, five true-to-type and healthy plants were randomly chosen and tagged in order to collect the biometric data. All of the characters' means were calculated. According to the description provided below, observations were made at the proper developmental stages of plant growth:

### **3.2.1 Growth parameters**

#### **3.2.1.1 Days to first flowering**

The period from the date of transplanting to the date of first flower appearance was calculated and expressed in number of days. The average values per treatment were calculated.

#### **3.2.1.2 Days to first fruit set**

The days to first fruit set on the tagged plants was recorded from the date of transplanting of seedlings and the average was worked out

#### **3.2.1.3 Days to first fruit picking**

The days to first harvestable fruit was recorded from date of transplanting of seedlings and the average of five plants was worked out.

#### **3.2.1.4 No. of branches per plant**

Branches arising from the main stem were counted on the five selected plants at the end of flowering and the average was calculated.

#### **3.2.1.5 Plant height (cm)**

The height of five tagged plants was measured in centimeters from the ground level to the tip of the plant at the time of final picking and the average was worked out

#### **3.2.1.6 Plant spread (cm)**

Plant spread was measured in centimeters as the average spread from North to South and East to West directions and the average of five plants was worked out.

#### **3.2.1.7 Fruit length (cm)**

Fruit length from five randomly selected harvestable fruits of each plant was measured from base of the fruit to the tip of fruit (leaving the stalk). Observations were averaged

#### **3.2.1.8 Fruit diameter (cm)**

Fruits that were used to measure length were also used to gauge diameter. With the use of a digital vernier caliper, the girth of the fruit was measured at the middle of fruit from and an average was calculated.

#### **3.2.1.9 Number of fruits per plant**

The number of fruits from each picking was pooled and the total Number of fruits per plant was noted.

#### **3.2.1.10 Average fruit weight (g)**

Average fruit weight was calculated in grams by dividing the total fruit yield per plant by total number of fruits.

### **3.2.1.11 Fruit yield per plant (kg)**

The total weight of fruits obtained from each picking of the tagged plants was pooled and the average fruit yield per plant was worked out.

### **3.2.1.12 Fruit 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).

### **3.2.1.13 Fruit yield per hectare (q)**

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

## **3.2.2 Quality parameters**

### **3.2.2.1 Total soluble solids (TSS in °Brix)**

The percent total soluble solids were measured from five randomly selected fruits from each genotype with the help of hand refractometer (Erma), the values were then averaged.

### **3.2.2.2 Total Anthocyanin content (mg/100g)**

The method proposed by Swain and Hillis (1959) was used to assess the total anthocyanin content of the different genotypes of brinjal. A known weight of fresh fruit was ground in alcoholic medium. The homogenate was centrifuged and supernatant was filtered and to it was added 3ml of HCL before the anthocyanin reagent (mix 1 ml of 30% H<sub>2</sub>O<sub>2</sub> with 9ml of methanolic HCL). After 15 minutes of incubation in the dark, at 525nm the colour intensity was colorimetrically measured. The anthocyanin present in samples was calculated from standard curve prepared with cyanin hydrochloride.

### **3.2.2.3 Vitamin C (mg/100gm)**

According to the A.O.A.C (1984) technique of titration, a known weight of material was titrated with 2, 6-dichloro phenol indophenol dye using metaphosphoric acid as a stabilising agent.

Five grammes of sample were ground with a stabilising medium in a pestle and mortar (1:5). The homogenate was centrifuged. Supernatant was gathered, filtered and given stabilising media to increase its volume to 50 ml. Using 10ml of the sample, the aliquot was titrated with the dye 2, 6-dichlorophenol indophenols. The dye factor was calculated using the formula: Standard Vitamin C was mixed with 5 ml of 3% HPO<sub>3</sub>, which was then titrated with a dye solution to a pink colour. The following formula was used to calculate the dye factor, or the amount of Vitamin C per millilitre of dye:

$$\text{Dye factor} = 0.5/\text{titre value}$$

The vitamin C content of the sample was calculated by using the following formula:

$$\text{Vitamin C (mg/100g)} = \frac{\text{Titre value} \times \text{dye factor} \times \text{volume made up} \times 100}{\text{Total weight of the sample} \times \text{aliquot of sample}}$$

#### **3.2.2.4 Phenols (mg/100g)**

1g of sample was ground in 10 times volume of 80% ethanol. The homogenate was centrifuged and supernatant was evaporated to dryness. The residue was dissolved in 5ml of distilled water and from it was taken 2ml into a test tube. 0.5ml of Folin-Ciocalteu reagent was added in test tube and after 3 minutes, 2ml of 20% Na<sub>2</sub>CO<sub>3</sub> was added. The absorbance of sample was measured at 650nm against a reagent blank in spectrophotometer. From the standard curve made by using different concentrations of catechol, the concentration of phenols in test tube was find out.

#### **3.2.2.5 Total Sugars (%)**

Total sugars in fruits were estimated by Fehling's test (H.C. Von Fehling), by using lead acetate, potassium oxalate and Fehling solution A and Fehling solution B. The total sugars were determined by using formula.

$$\text{Total sugars (\%)} = \frac{\text{Dye factor} \times \text{Volume makeup}}{\text{Titration value} \times \text{weight of sample}} \times 100$$



**Plate 1: Brinjal experimental field SKUAST-K, Shalima**



**Plate 2: Photograph of quality analysis of brinjal genotypes**

### 3.2.2.6 Dry Matter (%)

The matured fruits from five randomly selected plants were harvested and dried. Weight was recorded in grams and mean was computed by taking average from five plants.

## 3.3 Statistical and genetical analysis

### 3.3.1 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).

#### ANOVA TABLE

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

Where,

r = Number of replication

t = Number of treatment

SSr = Replication sum of squares

SSt = Treatment sum of squares

SSe = 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

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

Where,

SEd = Standard error of difference between

EMS = Error mean of square

r = Number of replications

**b. Standard error of mean**

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

**c. Coefficient of variation (%)**

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

$$\text{SD Coefficient of variation (CV)} = \frac{SD}{\bar{X}}$$

Where,

SD = standard deviation

$\bar{X}$  = Mean of character

**3.3.2 Genetic variability parameters.**

**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**

According to Lush's formulas, the phenotypic and genotypic components of variance were calculated (1940). However, Burton and De Vane's method was used to compute the percentages of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) (1953).

$$\sigma^2 g = \frac{Mg - Me}{\text{No. of replications}}$$

Where,

$\sigma^2 g$  = Genotype variance,

Mg = Treatment mean square,

Me = Error mean square

#### **a. Phenotypic coefficient of variation (PCV)**

$$\sigma^2 p = \sigma^2 g + \sigma^2 e$$

$$PCV = \frac{\sigma p}{X} \times 100$$

Where,

$\sigma^2 p$  &  $\sigma p$  = Phenotypic variance and its standard deviation,

$\sigma^2 g$  &  $\sigma g$  = Genotypic variance and its standard deviation,

$\sigma^2 e$  = Environmental variance,

X = General mean.

**b. Genotypic coefficient of variation (GCV)**

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

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.

**D. 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).

$$\sigma^2 g h^2 (bs) = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

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

0 - 30 % = Low

31 - 60% = Moderate and

> 60% = High .

**E. 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,

$\sigma_p$  = Phenotypic standard deviation.

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

**F. Genetic advance as percentage of mean**

$$(\text{GA as \% of X}) = \frac{\text{G.A}}{X} \times 100$$

The GA was categorized according to Johnson *et al.* (1955),

>50% = High,

20 - 50% = Moderate, and

< 20% = Low.

**3.3.3 Correlation coefficient analysis**

Correlation coefficient is the mutual link between two variables that occurs without their direct or indirect effects being felt. Numerous researchers, including Al-Jibouri *et al.* (1958) and Panse and Sukhatme (1967), investigated correlation for various factors at the genotypic and phenotypic levels.

**A. Association analysis**

**a. Genotypic correlation co-efficient**

$$r_{xy} (g) = \frac{\hat{\sigma}_{xy}^2 (g)}{\sqrt{\hat{\sigma}_x^2 (g) \hat{\sigma}_y^2 (g)}}$$

**b. Phenotypic correlation coefficient**

$$r_{xy} (p) = \frac{\hat{\sigma}_{xy}^2 (p)}{\sqrt{\hat{\sigma}_x^2 (p) \hat{\sigma}_y^2 (p)}}$$

Where,

- $r_{xy}(g), r_{xy}(p)$  = Genotypic and phenotypic correlation coefficients, respectively, between a pair of characters x and y  
 $\hat{\sigma}^2_{xy}(g), \hat{\sigma}^2_{xy}(p)$  = Genotypic and phenotypic covariances, respectively, for a pair of characters x and y  
 $\hat{\sigma}^2_x(g), \hat{\sigma}^2_y(g)$  = Genotypic variance for characters x and y, respectively and  
 $\hat{\sigma}^2_x(p), \hat{\sigma}^2_y(p)$  = Phenotypic variance for character x and y, respectively.

**c. Test of significance**

The significance of a correlation co-efficient was tested by the following formula :

$$t = \frac{r(n-2)^{0.5}}{(1-r^2)^{0.5}}$$

Where,

- R = Correlation coefficient and  
 N = number of observations

**3.3.4 Genetic divergence analysis**

For each pair-wise combination of the varieties the differences in transformed values for various characters were computed and  $D^2$ -values were calculated according to the following formula:

$$D^2 = \sum_{i=1}^p (\bar{Y}_{ij} - Y_{ik})^2$$

Where,

- P = number of characters studied, and  
 $Y_{ij}$  and  $Y_{ik}$  = are two transformed variables of the  $i^{\text{th}}$  character for two genotypes

For calculating the  $D^2$  values, the variance and covariance were calculated. The genotypes were grouped into different clusters by Tocher's method (Rao, 1952).

#### **3.3.4.1 Clustering**

In order to cluster the genotypes of a data set into a number of mutually exclusive categories, non-hierarchical categorization was used. In GENSTAT, an algorithm was employed to look for the best values for the specified criteria. The algorithm periodically moved genotypes from one group to another so long as such a transfer increased the value of the criterion when no further transfer could be identified to improve the criterion, starting from some initial categorization of the genotypes in the necessary number of groups. The algorithm then moved on to a second step where it looked at the impact of switching two genotypes from various classifications and so forth.

#### **3.3.4.2 Cluster diagram**

The values ( $D^2$ ) of intra- and inter-cluster distance were used to build a cluster diagram. The graphic illustrated the links between various genotypes found in the cluster as well as the pattern variety among genotypes.

#### **3.3.4.3 Intra and inter cluster distances**

For the measure of intracluster  $D^2$  values, the following formula was used;

$$D^2 = \frac{\sum Di^2}{N}$$

$$N = \frac{n(n-1)}{2}$$

Where,  $\sum Di^2$  is the sum of  $D^2$  values between all possible combinations (N) within and between clusters, respectively.

n= number of populations included in a cluster

Intra-and inter cluster genetic distances (d) where computed square root of

average intra-and inter cluster  $D^2$  values i.e.,

$$d = \sqrt{D^2}$$

#### **3.3.4.4 Contribution of different characters to divergence**

The ranking of differences in uncorrelated means between all the characters for all pair-wise combinations of varieties was carried out, with first rank being assigned to the highest differences. Finally relative contribution of a character towards total divergence was estimated by calculating the percentage of first rank in that character.

## **Chapter 4**

### **EXPERIMENTAL FINDINGS**

The experimental results obtained through statistical analysis have been presented under the following headings:

- 4.1 Analysis of variance
- 4.2 Mean performance
- 4.3 Variability, heritability and genetic advance
- 4.4 Correlation
- 4.5 Genetic divergence

#### **4.1 Analysis of variance**

Analysis of variance as given in Table 2a, b and c depicted that mean sum of squares due to genotypes for all the characters were highly significant, revealing significant variation among all the genotypes for all the characters under study.

**Table 2a: Analysis of variance (ANOVA) with respect to MSS for growth, maturity, yield attributing and quality**

| S. No. | Source of variation | Degrees of freedom | Mean Sum of Squares     |                         |                             |                           |                  |                  |                  |
|--------|---------------------|--------------------|-------------------------|-------------------------|-----------------------------|---------------------------|------------------|------------------|------------------|
|        |                     |                    | Days to first flowering | Days to first fruit set | Days to first fruit picking | Number branches per plant | Plant height(cm) | Plant spread(cm) | Fruit length(cm) |
| 1      | Replication         | 2                  | 12.47                   | 15.98                   | 20.00                       | 3.47                      | 42.21            | 36.69            | 6.27             |
| 2      | Genotypes           | 39                 | 25.69**                 | 30.48**                 | 33.20**                     | 7.93**                    | 549.58**         | 186.93**         | 41.47**          |
| 3      | Error               | 78                 | 0.73                    | 0.72                    | 1.66                        | 0.91                      | 0.09             | 0.03             | 0.23             |

\*Significant at 5% probability level  
 \*\*Significant at 1% probability level

**Table-2b: Analysis of variance (ANOVA) with respect to MSS for growth characters in brinjal (*Solanum melongena* L.)**

| S. No. | Source of variation | Degrees of freedom | Mean Sum of Squares |                            |                         |                            |                           |                             |
|--------|---------------------|--------------------|---------------------|----------------------------|-------------------------|----------------------------|---------------------------|-----------------------------|
|        |                     |                    | Fruit diameter (cm) | Number of fruits per plant | Average fruit weight(g) | Fruit yield per plant (kg) | Fruit yield per plot (kg) | Fruit yield per hectare (q) |
| 1      | Replication         | 2                  | 0.05                | 17.53                      | 50.99                   | 0.002                      | 15.24                     | 263.01                      |
| 2      | Genotypes           | 39                 | 0.69**              | 25.21**                    | 14104.98**              | 0.10**                     | 630.30**                  | 14752.67**                  |
| 3      | Error               | 78                 | 0.004               | 0.08                       | 0.11                    | 0.0001                     | 1.13                      | 17.64                       |

\*Significant at 5% probability level

\*\*Significant at 1% probability level

**Table 2c: Analysis of variance (ANOVA) with respect to MSS for quality traits in brinjal (*Solanum melongena* L.)**

| S. No. | Source of variation | Degrees of freedom | Mean Sum of Squares         |                             |                        |                  |                 |               |
|--------|---------------------|--------------------|-----------------------------|-----------------------------|------------------------|------------------|-----------------|---------------|
|        |                     |                    | Total soluble solids(°Brix) | Total anthocyanin (mg/100g) | Ascorbic acid(mg/100g) | Phenols(mg/100g) | Total sugars(%) | Dry matter(%) |
| 1      | Replication         | 2                  | 0.50                        | 0.42                        | 0.42                   | 0.34             | 0.12            | 0.22          |
| 2      | Genotypes           | 39                 | 1.06**                      | 9.95**                      | 16.89**                | 485.34**         | 0.59**          | 16.86**       |
| 3      | Error               | 78                 | 0.008                       | 0.0002                      | 0.002                  | 0.001            | 0.009           | 0.003         |

\*Significant at 5% probability level

\*\*Significant at 1% probability level

## **4.2 Mean performance**

The mean performance of different genotypes and its component characters are presented in Table 3a and 3b.

### **4.2.1 Days to first flowering**

Days to first flowering varied from 40.53 to 50.52 days with average of 46.81 days. The minimum days to first flowering was recorded by SKAU-B-193 (40.53 days) followed by SKAU-B-241 (41.58 days) and IC-089888 (42.08 days). The maximum days to first flowering was recorded for SKAU-B-205 (50.52 days) followed by IC-090063(50.45 days) and SKAU-B-215 (50.25 days).

### **4.2.2 Days to first fruit set**

Days to first fruit set varied from 47.36 to 59.2 days with average of 55.24 days. The minimum days to first fruit set were observed in SKAU-B-241 (47.36 days) followed by SKAU-B-222 (48.52 days) and IC-089818 (49.82 days). The maximum days to first fruit set were recorded in SKAU-B-245(59.2 days) followed by SKAU-B-215 (58.91 days) and SKAU-B-259 (58.73 days).

### **4.2.3 Days to first fruit picking**

Days to first fruit picking varied from 55.33 to 68.46 days with average of 64.30 days. Data on average number of days taken to first fruit picking showed that minimum number of days to first fruit picking were recorded in SKAU-B-241 (55.33 days) followed by SKAU-B-193 (58.46 days) and SKAU-B-231 (58.5 days) and the maximum days to first fruit picking were recorded in SKAU-B-226 (68.46 days) followed by SKAU-B-263 (68.33 days) and SKAU-B-245 (68.3 days).

### **4.2.4 Number of branches per plant**

Number of branches per plant varied from 8.81 to 14.86 with average of 12.43 branches. The highest number of branches per plant were noted in SKAU-B-209 (14.86) followed by SKAU-B-197 (14.76) and IC-261801(14.2). Whereas,

the lowest number of branches per plant were noted in SKAU-B-234 (8.81) followed by IC-090062(9.26) and IC-074244 (9.31).

#### **4.2.5 Plant height (cm)**

Plant height (cm) varied from 44.3 to 103.54 cms with average of 77.78 cms. The maximum plant height (cm) was observed in SKAU-B-276 (103.54 cm) followed by SKAU-B-274(100.47cm) and IC-099712 (94.33 cm). The minimum plant height (cm) was observed in IC-354867 (44.3 cm) followed by SKAU-B-193 (51.45 cm) and SKAU-B-263 (54.44 cm).

#### **4.2.6 Plant spread (cm)**

Plant spread (cm) varied from 38.45 to 74.52 cms with average of 57.20 cms. The maximum plant spread (cm) was observed in IC-11010 (74.52 cm) followed by IC-074207 (70.53 cm) and SKAU-B-294 (69.41 cm). The minimum plant spread (cm) was observed in SKAU-B-197 (38.45 cm) followed by SKAU-B-209 (42.46 cm) and IC-354867 (44.62 cm).

#### **4.2.7 Fruit length(cm)**

Fruit length(cm) varied from 7.27 to 18.96 cm with average of 14.13 cm. Highest fruit length of (18.96 cm) was observed in SKAU-B-274 followed by SKAU-B-249 (18.83 cm) and SKAU-B-259 (18.82 cm). While minimum fruit length was observed in SKAU-B-241 (7.27 cm) followed by SKAU-B-193 (8.08 cm) and SKAU-B-215 (8.07 cm).

#### **4.2.8 Fruit diameter (cm)**

Fruit diameter (cm) varied from 3.15 to 4.66 cm with average of 4.05 cm. Highest fruit diameter of (4.66 cm) was observed in SKAU-B-276 followed by IC-111010 (4.62 cm) and IC-089818 (4.52 cm). While minimum fruit diameter was observed in SKAU-B-251 (3.15 cm) followed by SKAU-B-197 (3.16 cm) and SKAU-B-229 (3.23 cm).

#### **4.2.9 Number of fruits per plant**

Number of fruits per plant varied from 7.26 to 19.82 with average of 10.27 fruits. The highest Number of fruits per plant were noted in SKAU-B-226 (19.83) followed by SKAU-B-224 (19.56) and SKAU-B-268 (15.52). Whereas, the lowest Number of fruits per plant were noted in SKAU-B-257 (7.26) followed by SKAU-B-211 (7.45) and SKAU-B-219 (7.45).

#### **4.2.10 Average fruit weight (g)**

The maximum value for average fruit weight (g) was recorded for SKAU-B-231 (307.36 g) followed by SKAU-B-274 (282.56 g) and SKAU-B-279 (274.36 g). While minimum value was recorded in SKAU-B-211 (49.44 g) followed by SKAU-B-247 (52.24 g) and SKAU-B-197 (60.33 g). The average fruit weight for all the genotypes was 159.63 g with a range of 49.44 to 307.36

#### **4.2.11 Fruit yield per plant (kg)**

The genotype SKAU-B-276 (1.14 kg) recorded the highest fruit yield per plant followed by SKAU-B-268 (1.1 kg) and SKAU-B-279 (1.1 kg). While as, SKAU-B-193 (0.38 kg) recorded the lowest fruit yield per plant followed by SKAU-B-257 (0.56 kg) and IC-090062 (0.57 kg). The average fruit yield per plant for all the genotypes was 0.90 kg with a range of 0.38 to 1.14

#### **4.2.12 Fruit yield per plot (kg)**

The genotype SKAU-B-276 (87.01 kg) recorded the highest fruit yield per plot followed by SKAU-B-268 (83.97 kg) and SKAU-B-279 (83.97 kg). While as, SKAU-B-193 (29.01 kg) recorded the lowest fruit yield per plot followed by SKAU-B-257 (42.89 kg) and IC-090062 (43.49 kg). The average fruit yield per plot for all the genotypes was 69.06 kg with a range of 29.01 to 87.01

#### **4.2.13 Fruit yield per hectare (q)**

The highest fruit yield per hectare(q) was recorded in SKAU-B-276 (422.76 q) followed by SKAU-B-268 (407.4 q) and SKAU-B-279 (407.4 q).

Whereas, the lowest fruit yield per hectare(q) was recorded in SKAU-B-193 (140.7 q) followed by SKAU-B-257 (208.43 q) and SKAU-B-209 (211.1 q). The average fruit yield per hectare for all the genotypes was 334.54 q with a range of 140.7 to 422.76

#### **4.2.14 TSS content (°Brix)**

Highest TSS was recorded in SKAU-B-205 (5.96°Brix) followed by SKAU-B-222 (4.9°Brix) and SKAU-B-247 (4.6°Brix). Lowest TSS was recorded in SKAU-B-259 (2.6°Brix) followed by SKAU-B-257 (2.9°Brix) and SKAU-B-274 (3°Brix). The average TSS for all the genotypes was 3.93°Brix with a range of 2.6 to 5.96

#### **4.2.15 Total anthocyanin (mg/100g)**

Highest anthocyanin (mg/100g) content was recorded in SKAU-B-255 (7.8 mg/100g) followed by SKAU-B-263 (7.6 mg/100g) and SKAU-B-226 (7.4 mg/100g). Whereas the lowest anthocyanin (mg/100g) content was recorded in IC-354867 (0.21 mg/100g) followed by SKAU-B-257 (0.26 mg/100g) and IC-089818 (2.13 mg/100g). The average anthocyanin (mg/100g) content for all the genotypes was 4.65 mg/100g with a range of 0.21 to 7.8

#### **4.2.16 Vitamin C (mg/100g)**

Highest Vitamin C was recorded in IC-111010 (10.33 mg/100g) followed by IC-090062 (10.23 mg/100g) and IC-089818 (10 mg/100g). While as, the lowest Vitamin C was recorded in IC-074244 (2.30 mg/100g) followed by SKAU-B-268 (2.62 mg/100g) and SKAU-B-274 (3.21mg/100g). The average Vitamin C for all the genotypes was 7.46 mg/100g with a range of 2.30 to 10.33

#### **4.2.17 Phenols (mg/100g)**

Highest phenol (mg/100g) content was recorded in SKAU-B-266 (114.1 mg/100g) followed by IC-090063 (113.1 mg/100g) and SKAU-B-209 (113.1 mg/100g). While as, IC-111010(77.1 mg/100g) recorded the lowest phenol

(mg/100g) content followed by SKAU-B-249 (78.1 mg/100g) and SKAU-B-215 (79.1 mg/100g). The average phenol (mg/100g) content for all the genotypes were 95.24 (mg/100g) with a range of 77.1 to 114.1

#### **4.2.18 Total sugars (%)**

The highest total sugars (%) was observed in SKAU-B-234 (3.62%) followed by IC-089888 (3.52%) and SKAU-B-239 (3.52%). Whereas, the lowest total sugars (%) was observed in IC-354867 (2.08%) followed by IC-11010 (2.08%) and SKAU-B-209 (2.10%). The average total sugars (%) for all the genotypes was 2.65 with a range of 2.08 to 3.62

#### **4.2.19 Dry matter (%)**

Highest dry matter (%) was recorded in IC-089888 (10.3%) followed by IC-354867 (10.2%) and SKAU-B-279 (10.1%) and the lowest dry matter (%) was recorded in SKAU-B-205(1.4%) followed by SKAU-B-209 (1.6%) and SKAU-B-224 (1.8%). The average dry matter (%) for all the genotypes was 5.60 with a range of 1.4 to 10.2.

Table 3a: Mean performance of brinjal genotypes for various growth, maturity, yield attributing and quality characters

| S. No. | Genotypes   | Days to first flowering | Days to first fruit set | Days to first fruit picking | No. of branches/plant | Plant height (cm) | Plant spread (cm) | Fruit length (cm) | Fruit diameter (cm) | No. of fruits per plant | Average fruit weight (g) |
|--------|-------------|-------------------------|-------------------------|-----------------------------|-----------------------|-------------------|-------------------|-------------------|---------------------|-------------------------|--------------------------|
| 01     | IC-074207   | 46.14                   | 53.48                   | 62.9                        | 13.73                 | 92.27             | <b>70.57</b>      | 11.04             | 5.41                | 12.36                   | 131.38                   |
| 02     | IC-074244-1 | 46.30                   | 54.6                    | 65.33                       | 9.31                  | 71.26             | 65.6              | 16.07             | 4.3                 | 8.06                    | 214.26                   |
| 03     | IC-089818   | 44.26                   | <b>49.82</b>            | 60.3                        | 12.84                 | 68.71             | 52.66             | 10.90             | <b>4.52</b>         | 10.62                   | 91.45                    |
| 04     | IC-089888   | <b>42.08</b>            | 56.53                   | 64                          | 10.36                 | 75.44             | 60.38             | <b>18.75</b>      | 4.24                | 10.47                   | 86.50                    |
| 05     | IC-090062   | 44.40                   | 53.55                   | 67.26                       | 9.26                  | 82                | 57.26             | 16.88             | 4.25                | 7.72                    | 135.43                   |
| 06     | IC-090063   | 50.45                   | 56.3                    | 65.33                       | 12.03                 | 83.3              | 60.41             | 11.88             | <b>4.52</b>         | 9.4                     | 97.46                    |
| 07     | IC-099712   | 49.46                   | 54.47                   | 64.4                        | 9.72                  | <b>94.33</b>      | 63.43             | 12.03             | 4.32                | 7.54                    | 106.46                   |
| 08     | IC-111010   | 43.66                   | <b>50.66</b>            | 60.73                       | 10.84                 | 87.61             | 74.52             | 12.98             | <b>4.62</b>         | 11.33                   | 188.54                   |
| 09     | IC-261801   | 50.00                   | 56.48                   | 66.13                       | <b>14.2</b>           | 82.34             | <b>66.36</b>      | 10.86             | 4.13                | 8.37                    | 82.14                    |
| 10     | IC-354867   | 44.56                   | 54.3                    | 63.23                       | 13                    | 44.3              | 44.62             | 9.15              | 3.96                | 8.34                    | 187.88                   |
| 11     | SKAU-B-193  | <b>40.53</b>            | <b>50.53</b>            | <b>58.46</b>                | 12.62                 | 51.45             | 47.57             | 8.03              | 3.92                | 7.58                    | 81.03                    |
| 12     | SKAU-B-197  | 50.14                   | 58.03                   | 66.66                       | <b>14.76</b>          | 80.3              | 38.45             | 12.44             | 3.16                | <b>15.37</b>            | 60.33                    |
| 13     | SKAU-B-205  | 50.52                   | 58.16                   | 67.43                       | 11.44                 | 73.60             | 59.4              | 17.11             | 4                   | 9.5                     | 234.41                   |
| 14     | SKAU-B-209  | 49.43                   | 58.48                   | 66.46                       | 14.86                 | 85.47             | 42.46             | 8.63              | 4.06                | 7.75                    | 119.1                    |
| 15     | SKAU-B-211  | 48.48                   | 56.66                   | 66.33                       | 13.44                 | 63.34             | 54.63             | 14.02             | 4.11                | 7.45                    | 49.44                    |
| 16     | SKAU-B-215  | 50.25                   | 58.91                   | 67.63                       | 13.44                 | 71.2              | 63.47             | 8.07              | 4.03                | 8.33                    | 189.85                   |
| 17     | SKAU-B-219  | 48.40                   | 58.53                   | 67.6                        | 13.41                 | 65.48             | 46.45             | 11.26             | 4.5                 | 7.45                    | 80.31                    |
| 18     | SKAU-B-222  | <b>42.36</b>            | <b>48.52</b>            | <b>59.23</b>                | 13.41                 | 91.37             | 63.28             | 18.11             | 4.43                | 9.33                    | 201                      |
| 19     | SKAU-B-224  | 46.58                   | 55.58                   | 65.26                       | 13.8                  | 83.47             | 56.47             | 16.82             | 4.41                | <b>19.56</b>            | 140.57                   |
| 20     | SKAU-B-226  | 44.36                   | 58.53                   | 68.46                       | <b>14.02</b>          | 90.37             | 62.55             | 17.3              | 4.35                | 19.83                   | 103.55                   |
| 21     | SKAU-B-229  | 49.52                   | 57.5                    | 65.5                        | 13.55                 | 77.23             | 64.32             | 11.07             | 3.23                | <b>12.55</b>            | 150.48                   |

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Table 3a: contd....

| S. No. | Genotypes   | Days to first flowering | Days to first fruit set | Days to first fruit picking | No. of branches/plant | Plant height (cm) | Plant spread (cm) | Fruit length (cm) | Fruit diameter (cm) | No. of fruits per plant | Average fruit weight (g) |
|--------|-------------|-------------------------|-------------------------|-----------------------------|-----------------------|-------------------|-------------------|-------------------|---------------------|-------------------------|--------------------------|
| 22     | SKAU-B-231  | 43.62                   | 50.71                   | <b>58.5</b>                 | 10.78                 | 85.43             | 56.26             | 16.6              | 4.48                | 9.23                    | 307.36                   |
| 23     | SKAU-B-234  | 49.66                   | 56.97                   | 64.9                        | 8.81                  | 66.58             | 55.5              | 17.66             | 4.38                | 9.5                     | 186.65                   |
| 24     | SKAU-B-236  | 46.48                   | 54.26                   | <b>59</b>                   | 9.48                  | 85.3              | 59.4              | 11.83             | 3.28                | 10.3                    | 187.53                   |
| 25     | SKAU-B-239  | 49.58                   | 55.4                    | 66.33                       | 12.85                 | 73.15             | 49.67             | 16.8              | 4.25                | 11.44                   | 138.43                   |
| 26     | SKAU-B-241  | <b>41.58</b>            | 47.36                   | 55.33                       | <b>14.13</b>          | 62.23             | 55.33             | 7.27              | 3.44                | 10.44                   | 152.31                   |
| 27     | SKAU-B-245  | 50.13                   | 59.2                    | 68.3                        | 12                    | 56.58             | 53.46             | 12                | 3.27                | 10.13                   | <b>247.66</b>            |
| 28     | SKAU-B-247  | 48.58                   | 56.62                   | 66.7                        | 12.96                 | 58.47             | 51.70             | 10.22             | 3.72                | 9.44                    | 52.24                    |
| 29     | SKAU-B-249  | 43.52                   | 55.58                   | 66.4                        | 13.7                  | 83.45             | <b>69.41</b>      | <b>18.83</b>      | 3.53                | 9.33                    | 119.43                   |
| 30     | SKAU-B-251  | <b>43.33</b>            | 51.47                   | 60.36                       | 11.55                 | 76.23             | 51.4              | 18.32             | 3.15                | 9.44                    | 111.33                   |
| 31     | SKAU-B-255  | 49.47                   | 58.65                   | 66.46                       | 12.33                 | 81.37             | 59.57             | 12.91             | 3.84                | 11.36                   | 155.33                   |
| 32     | SKAU-B-257  | 49.23                   | 56.3                    | 65.33                       | 13.36                 | 72.58             | 47.26             | 11.87             | 3.93                | 7.26                    | 74.32                    |
| 33     | SKAU-B-259  | 48.26                   | 58.73                   | 66.5                        | 12.96                 | <b>92.55</b>      | 54.42             | <b>18.82</b>      | 3.81                | 7.52                    | 237.5                    |
| 34     | SKAU-B-263  | 49.33                   | 58.61                   | 68.33                       | 11.46                 | 54.44             | <b>67.45</b>      | 10.65             | 4.33                | 10.33                   | 143.36                   |
| 35     | SKAU-B-266  | 46.36                   | 53.47                   | 63.36                       | 12.61                 | 83.36             | 54.49             | 16.22             | 3.73                | 10.33                   | <b>248.35</b>            |
| 36     | SKAU-B-268  | 43.58                   | 51.54                   | 60.43                       | 13.17                 | 84.47             | 57.35             | <b>18.73</b>      | 3.41                | <b>15.52</b>            | 245.66                   |
| 37     | SKAU-B-270  | 46.46                   | 58.62                   | 67.2                        | 13.42                 | 82.51             | 53.23             | 18.7              | 4.23                | 10.41                   | 169.54                   |
| 38     | SKAU-B-274  | 45.4                    | 53.52                   | 61.3                        | 13.96                 | <b>100.47</b>     | 54.32             | 18.96             | 4.13                | 10.3                    | <b>282.56</b>            |
| 39     | SKAU-B-276  | 49.45                   | 58.55                   | 67.56                       | 10.33                 | 103.54            | 65.55             | 17.88             | <b>4.66</b>         | 10.41                   | 211.57                   |
| 40     | SKAU-B-279  | 46.43                   | 54.58                   | 63.36                       | 13.38                 | <b>93.54</b>      | 57.37             | 17.57             | 4.13                | 9.44                    | <b>274.36</b>            |
|        | <b>Mean</b> | <b>46.81</b>            | <b>55.24</b>            | <b>64.36</b>                | <b>12.43</b>          | <b>77.78</b>      | <b>57.20</b>      | <b>14.13</b>      | <b>4.05</b>         | <b>10.27</b>            | <b>156.93</b>            |
|        | <b>CD</b>   | <b>2.09</b>             | <b>2.38</b>             | <b>3.42</b>                 | <b>1.85</b>           | <b>2.5</b>        | <b>3.1</b>        | <b>1.07</b>       | <b>0.90</b>         | <b>1.46</b>             | <b>7.11</b>              |

**Table 3b: Mean performance of brinjal genotypes for various growth, maturity, yield attributing and quality characters**

| S. No. | Genotypes   | Fruit yield/ plant (kg) | Fruit yield/ plot (kg) | Fruit yield/ hectare (q) | TSS content (°Brix) | Total anthocyanin content (mg/100g) | Ascorbic acid (mg/100g) | Phenols (mg/100g) | Total sugars (%) | Dry matter (%) |
|--------|-------------|-------------------------|------------------------|--------------------------|---------------------|-------------------------------------|-------------------------|-------------------|------------------|----------------|
| 01     | IC-074207   | 1.07                    | 81.7                   | 396.2                    | 4.5                 | 5.7                                 | 8.53                    | 95.03             | 2.92             | 5.8            |
| 02     | IC-074244-1 | 1.05                    | 80.17                  | 388.53                   | 4                   | 5.5                                 | 2.30                    | 105               | 2.30             | 4.8            |
| 03     | IC-089818   | 1.06                    | 81.19                  | 393.73                   | 3.8                 | 2.13                                | 10.51                   | 85                | 3.22             | 3.8            |
| 04     | IC-089888   | 0.95                    | 72.51                  | 351.86                   | 4.3                 | 2.5                                 | 8.70                    | 109.1             | <b>3.52</b>      | 10.3           |
| 05     | IC-090062   | 0.57                    | 43.49                  | 212.06                   | 3.7                 | 5.1                                 | <b>10.23</b>            | 82.1              | 2.22             | 8              |
| 06     | IC-090063   | 0.96                    | 73.80                  | 335.5                    | 4.3                 | 3.1                                 | <b>9.75</b>             | <b>113.1</b>      | 2.30             | 4.2            |
| 07     | IC-099712   | 1.01                    | 77.6                   | 376.46                   | 3.9                 | 5.7                                 | 3.53                    | 84.1              | 2.41             | 6.8            |
| 08     | IC-111010   | 1.09                    | 83.22                  | <b>403.66</b>            | 3.9                 | 3.4                                 | <b>10.33</b>            | 77.1              | 2.08             | 9.03           |
| 09     | IC-261801   | 0.81                    | 61.81                  | 299.93                   | <b>4.5</b>          | 4.4                                 | 9.32                    | 80.1              | 2.6              | 3.8            |
| 10     | IC-354867   | 0.84                    | 64.11                  | 311.1                    | 3.8                 | 0.214                               | <b>9.62</b>             | 108.1             | 2.08             | <b>10.2</b>    |
| 11     | SKAU-B-193  | 0.38                    | 29.01                  | 140.7                    | 3.9                 | 4.8                                 | 7.64                    | 94.1              | 2.11             | 6              |
| 12     | SKAU-B-197  | 0.86                    | 65.65                  | 318.46                   | 4                   | 5.7                                 | 9                       | <b>112.1</b>      | 2.4              | 6.02           |
| 13     | SKAU-B-205  | 0.78                    | 59.55                  | 289.4                    | 5.96                | 6.7                                 | 9.5                     | 80.1              | 2.41             | 1.4            |
| 14     | SKAU-B-209  | 0.57                    | 43.52                  | 211.1                    | 4                   | 3.5                                 | 9.5                     | <b>113.1</b>      | 2.10             | 1.6            |
| 15     | SKAU-B-211  | 0.66                    | 50.39                  | 244.26                   | 3.4                 | 5.2                                 | 7.71                    | 109.1             | 2.81             | 4.6            |
| 16     | SKAU-B-215  | 0.89                    | 67.95                  | 330.4                    | 4                   | <b>7</b>                            | 4.12                    | 79.1              | <b>3.52</b>      | 4.4            |
| 17     | SKAU-B-219  | 0.69                    | 52.68                  | 255.66                   | 4.1                 | <b>7.26</b>                         | 7.31                    | 100.1             | 2.30             | 3.6            |
| 18     | SKAU-B-222  | 0.86                    | 65.65                  | 318.33                   | <b>4.9</b>          | 4.5                                 | 7.41                    | 81.1              | 2.4              | 6.2            |
| 19     | SKAU-B-224  | 1.09                    | 83.22                  | 403.66                   | 3                   | 3.8                                 | 3.62                    | 92.1              | 2.41             | 1.8            |
| 20     | SKAU-B-226  | 1.08                    | 82.71                  | 401.16                   | 4.3                 | <b>7.4</b>                          | 9.12                    | 84.1              | 2.4              | 3.8            |
| 21     | SKAU-B-229  | 1.00                    | 76.61                  | 371.53                   | 3.5                 | 3.1                                 | 9.01                    | 111.1             | <b>3.42</b>      | 4.2            |

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Table 3b: contd....

| S. No.      | Genotypes  | Fruit yield/ plant (kg) | Fruit yield/ plot (kg) | Fruit yield/ hectare (q) | TSS content (°Brix) | Total anthocyanin content (mg/100g) | Ascorbic acid (mg/100g) | Phenols (mg/100g) | Total sugars (%) | Dry matter (%) |
|-------------|------------|-------------------------|------------------------|--------------------------|---------------------|-------------------------------------|-------------------------|-------------------|------------------|----------------|
| 22          | SKAU-B-231 | 1.08                    | 82.46                  | 399.93                   | 3.8                 | 4.8                                 | 6.42                    | 110.1             | 2.5              | 4              |
| 23          | SKAU-B-234 | <b>1.09</b>             | <b>83.73</b>           | <b>406.16</b>            | 3.2                 | 3                                   | 6.12                    | 95.1              | 3.62             | 5.2            |
| 24          | SKAU-B-236 | 1.05                    | 80.17                  | 388.8                    | 4.26                | 4.8                                 | 7.8                     | <b>112.1</b>      | 3.10             | 3.87           |
| 25          | SKAU-B-239 | 0.99                    | 75.59                  | 366.6                    | 4.1                 | 4.2                                 | 9.6                     | 80.1              | <b>3.52</b>      | 4.6            |
| 26          | SKAU-B-241 | 0.83                    | 63.34                  | 307.33                   | 3.5                 | 6.1                                 | 4.62                    | 92.1              | 2.51             | 4.94           |
| 27          | SKAU-B-245 | 0.87                    | 66.48                  | 322.36                   | 4.23                | 4.3                                 | 9.3                     | 89.1              | 2.4              | <b>9.6</b>     |
| 28          | SKAU-B-247 | 0.71                    | 54.74                  | 265.5                    | <b>4.6</b>          | 6.9                                 | 7.5                     | 97.1              | 2.55             | 4.6            |
| 29          | SKAU-B-249 | <b>1.09</b>             | <b>83.22</b>           | 403.66                   | <b>4.6</b>          | 3.1                                 | 5.21                    | 78.1              | 2.35             | 3.4            |
| 30          | SKAU-B-251 | 0.7                     | 53.44                  | 259.2                    | 3.6                 | 6.3                                 | 9.4                     | 98.1              | 2.34             | 6.1            |
| 31          | SKAU-B-255 | 0.99                    | 75.95                  | 368.93                   | 3.9                 | 7.8                                 | 8.2                     | 95.1              | 2.6              | 8.5            |
| 32          | SKAU-B-257 | 0.56                    | 42.89                  | 208.43                   | 2.9                 | 0.26                                | 9.6                     | 82.13             | 2.13             | 4.2            |
| 33          | SKAU-B-259 | 0.74                    | 56.76                  | 276.16                   | 2.6                 | 5.4                                 | 9.12                    | 112.13            | 2.57             | 7.8            |
| 34          | SKAU-B-263 | 0.85                    | 64.86                  | 314.86                   | 3.8                 | <b>7.6</b>                          | 6.73                    | 82.1              | 3                | 5.8            |
| 35          | SKAU-B-266 | 1.08                    | 82.46                  | 399.93                   | 4.4                 | 4.7                                 | 7.41                    | 114.1             | 3                | 5.2            |
| 36          | SKAU-B-268 | <b>1.1</b>              | <b>83.97</b>           | <b>407.4</b>             | 4                   | 4.3                                 | 2.62                    | 111.1             | 2.75             | 7.8            |
| 37          | SKAU-B-270 | 0.82                    | 63.12                  | 306.46                   | 4                   | 6                                   | 9.42                    | 83.1              | 3.16             | 4.1            |
| 38          | SKAU-B-274 | 1.07                    | 81.7                   | 396.2                    | 3                   | 4.1                                 | 3.21                    | 87.1              | 2.57             | <b>9.4</b>     |
| 39          | SKAU-B-276 | 1.14                    | 87.01                  | 422.76                   | 3.9                 | 2.7                                 | 5.72                    | 90.1              | 2.52             | 4.6            |
| 40          | SKAU-B-279 | <b>1.1</b>              | <b>83.97</b>           | <b>407.4</b>             | 3.4                 | 3.3                                 | 4.31                    | 106.1             | 2.78             | <b>10.1</b>    |
| <b>Mean</b> |            | <b>0.90</b>             | <b>69.06</b>           | <b>334.54</b>            | <b>3.93</b>         | <b>4.65</b>                         | <b>7.49</b>             | <b>95.24</b>      | <b>2.65</b>      | <b>5.60</b>    |
| <b>CD</b>   |            | <b>0.22</b>             | <b>1.73</b>            | <b>6.82</b>              | <b>0.51</b>         | <b>0.51</b>                         | <b>1.56</b>             | <b>5.76</b>       | <b>0.23</b>      | <b>1.54</b>    |

### **4.3 Variability, heritability and genetic advance**

The genetic variability estimates including mean, range, genotypic variance (GV), phenotypic variance (PV), phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (bs) and genetic advance as a per cent of mean are presented in Table 4.

#### **4.3.1 Variability**

The phenotypic coefficients of variation were found to be higher than the corresponding genotypic coefficients of variation. The phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) in present investigation were high for the traits; average fruit weight (43.69% and 43.69%), total anthocyanin content (39.10 % and 39.10%), ascorbic acid (31.73 % and 31.73) and dry matter (42.31% and 42.29). Moderate phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) was recorded for plant height (17.40 and 17.39 %), fruit length (26.45 % and 26.23%), number of fruits per plant (28.29% and 28.15%), fruit yield per plant (21% and 20.94%), fruit yield per plot (21.02% and 20.96%), fruit yield per hectare (20.98% and 20.94%), total soluble solids (15.23 % and 15.04%) and total sugars (17.06 % and 16.67%) whereas, it was low for days to first flowering (6.42 % and 6.16%), days to first fruit set (5.90 % and 5.70%), days to first fruit picking (5.42 % and 5.30%), number of branches per plant (14.50% and 12.29%), plant spread (13.80% and 13.79%), fruit diameter (11.97% and 11.85%) and phenols (13.53% and 13.35%). Estimates of phenotypic variances were observed to be higher than the corresponding genotypic variances for all the traits under study. Highest phenotypic and genotypic variances were recorded for fruit yield per hectare (4929.32, 4911.67) followed by fruit weight (4701.73, 4701.62), fruit yield per plot (210.85, 209.72), plant height (183.25, 183.16) and phenols (161.78, 161.78). Rest of the characters recorded lower values of phenotypic and genotypic variances.

#### **4.3.2 Heritability and genetic advance**

Heritability in broad sense was found to be high for all traits (greater than 70 per cent). Highest genetic advance as percentage of mean was recorded in average fruit weight (90) followed by dry matter (87.11) and total anthocyanin content (80.55). Whereas the lowest genetic advance as percent of mean was observed for days to first fruit picking (9.64)

**Table 4: Estimates of mean, range, phenotypic variance, genotypic variance, phenotypic and genotypic coefficients of variation, heritability (bs) and genetic advance (as % of mean) for growth, maturity, yield attributing and quality characters in brinjal (*Solanum melongena* L.)**

| S. No. | Parameters                          | Mean   | Range        | Phenotypic variance (PV) | Genotypic variance (GV) | Phenotypic coefficient of variation (PCV) | Genotypic coefficient of variation (GCV) | Heritability (bs) | Genetic advance (as % of mean) |
|--------|-------------------------------------|--------|--------------|--------------------------|-------------------------|---|--|-------------------|--------------------------------|
| 1      | Days to first flowering             | 46.81  | 40.53-50.52  | 9.05                     | 8.31                    | 6.42                                      | 6.16                                     | 0.91              | 12.16                          |
| 2      | Days to first fruit set             | 55.24  | 47.36-59.2   | 10.64                    | 9.92                    | 5.90                                      | 5.70                                     | 0.93              | 11.34                          |
| 3      | Days to first fruit picking         | 64.30  | 55.33-68.46  | 12.18                    | 10.51                   | 5.42                                      | 5.03                                     | 0.86              | 9.64                           |
| 4      | No. of branches per plant           | 12.43  | 8.81-14.86   | 3.25                     | 2.33                    | 14.50                                     | 12.29                                    | 0.71              | 21.47                          |
| 5      | Plant height (cm)                   | 77.78  | 44.3-103.54  | 183.25                   | 183.16                  | 17.40                                     | 17.39                                    | 0.99              | 35.83                          |
| 6      | Plant spread (cm)                   | 57.20  | 38.45-74.52  | 62.33                    | 62.29                   | 13.80                                     | 13.79                                    | 0.99              | 28.41                          |
| 7      | Fruit length(cm)                    | 14.13  | 7.27-18.96   | 13.98                    | 13.74                   | 26.45                                     | 26.23                                    | 0.98              | 53.58                          |
| 8      | Fruit diameter (cm)                 | 4.05   | 3.15-4.66    | 0.23                     | 0.23                    | 11.97                                     | 11.85                                    | 0.98              | 24.19                          |
| 9      | No. of fruits per plant             | 10.27  | 7.26-19.83   | 8.45                     | 8.37                    | 28.29                                     | 28.15                                    | 0.99              | 57.71                          |
| 10     | Average fruit weight (g)            | 156.93 | 49.44-307.36 | 4701.73                  | 4701.62                 | 43.69                                     | 43.69                                    | 0.98              | 90.00                          |
| 11     | Fruit yield per plant (kg)          | 0.90   | 0.38-1.14    | 0.036                    | 0.035                   | 21.00                                     | 20.94                                    | 0.99              | 43.07                          |
| 12     | Fruit yield per plot (kg)           | 69.06  | 29.01-87.01  | 210.85                   | 209.72                  | 21.02                                     | 20.96                                    | 0.99              | 43.07                          |
| 13     | Fruit yield ha <sup>-1</sup> (q)    | 334.54 | 140.7-422.76 | 4929.32                  | 4911.67                 | 20.98                                     | 20.94                                    | 0.99              | 43.07                          |
| 14     | TSS content (°Brix)                 | 3.93   | 2.6-5.96     | 0.35                     | 0.35                    | 15.23                                     | 15.04                                    | 0.97              | 30.63                          |
| 15     | Total anthocyanin content (mg/100g) | 4.65   | 0.21-7.8     | 3.32                     | 3.31                    | 39.10                                     | 39.10                                    | 0.99              | 80.55                          |
| 16     | Ascorbic acid (mg/100g)             | 7.46   | 2.30-10.33   | 5.63                     | 5.63                    | 31.73                                     | 31.73                                    | 0.99              | 65.35                          |
| 17     | Phenols (mg/100g)                   | 95.24  | 77.1-114.1   | 161.78                   | 161.78                  | 13.53                                     | 13.35                                    | 0.98              | 27.50                          |
| 18     | Total sugars (%)                    | 2.65   | 2.08-3.62    | 0.20                     | 0.19                    | 17.06                                     | 16.67                                    | 0.95              | 33.56                          |
| 19     | Dry matter (%)                      | 5.60   | 1.4-10.3     | 5.62                     | 5.61                    | 42.31                                     | 42.29                                    | 0.99              | 87.11                          |

#### 4.4 Correlation

The correlation coefficients were determined using variances and co variances to obtain relationship among various characters and their relationship with fruit yield per hectare at genotypic level.

The genotypic correlation coefficients ( $r_g$ ) among the various characters of brinjal genotypes are presented in Table 5a and 5b. The days to first flowering was positively and significantly correlated with days to first fruit set ( $r_g = 0.763$ ) and days to first fruit picking ( $r_g = 0.720$ ); days to first fruit set was found to be positively and significantly correlated with days to first fruit picking ( $r_g = 0.923$ ); days to first fruit picking was positively correlated with number of branches per plant(0.044), plant spread (0.017), fruit length(0.087), fruit diameter(0.093); number of branches per plant was positively correlated with plant spread(0.230) and number of fruits per plant( $r_g = 0.283$ ); plant height was positively and significantly correlated with plant spread ( $r_g = 0.369$ ), fruit length (0.528), average fruit weight (0.312),fruit yield per plant (0.473) and fruit yield per hectare( $r_g = 0.470$ ); plant spread was positively and significantly correlated with fruit diameter (0.362),fruit yield per plant (0.520) and fruit yield per hectare( $r_g = 0.516$ ); fruit length was positively and significantly correlated with average fruit weight ( $r_g = 0.414$ ),fruit yield per plant (0.377) and fruit yield per hectare( $r_g = 0.380$ ); fruit diameter was positively correlated with fruit yield per plant (0.212) and fruit yield per hectare( $r_g = 0.202$ ); Number of fruits per plant was positively and significantly correlated with fruit yield per plant (0.494) and fruit yield per hectare( $r_g = 0.495$ ); average fruit weight was positively and significantly correlated with fruit yield per plant (0.459) and fruit yield per hectare( $r_g = 0.466$ ). Number of branches per plant was negatively and significantly correlated with plant spread ( $r_g = -0.330$ ). Rest of the characters exhibited non-significant correlations with each other.

The economically important trait i.e., fruit yield per hectare was positively and significantly correlated with plant height ( $r_g = 0.473$ ), plant spread ( $r_g =$

0.520), fruit length ( $r_g = 0.377$ ), Number of fruits per plant ( $r_g = 0.494$ ), average fruit weight ( $r_g = 0.459$ ) and fruit yield per plant ( $r_g = 0.998$ ).

Among quality traits significant positive correlation was also found to exist between total anthocyanin content and Vitamin C ( $r_g = 3.17$ ) ; positive correlation was found between TSS and total sugars (0.124) ; between total anthocyanin content and phenols (0.060) ; negative significant correlation was found to exist between TSS and phenols (-1.145) ; between total anthocyanin content and total sugars (-3.058); between vitamin C and dry matter (-1.464); between phenols and total sugars (-0.738); between total sugars and dry matter (-0.0362). Association between other quality traits were found to be either positive or negative but non-significant.

**Table 5a: Estimates of genotypic (above diagonal) correlation coefficients among different growth, maturity and yield attributing characters in brinjal (*Solanum melongena* L.)**

| S. No | Parameters                  | Days to first flowering | Days to first fruit set | Days to first fruit picking | No. of branches/plant | Plant height(cm) | Plant spread(cm) | Fruit length (cm) | Fruit diameter (cm) | No. of fruits/plant | Average fruit weight (g) | Fruit yield plant/(kg) | Fruit yield/hectare(q) |
|-------|-----------------------------|-------------------------|-------------------------|-----------------------------|-----------------------|------------------|------------------|-------------------|---------------------|---------------------|--------------------------|------------------------|------------------------|
| 1     | Days to first flowering     | <b>1.00</b>             | 0.763**                 | 0.720**                     | 0.023                 | 0.008            | -0.070           | -0.199            | -0.005              | -0.108              | -0.0918                  | -0.015                 | -0.022                 |
| 2     | Days to first fruit set     |                         | <b>1.00</b>             | 0.923**                     | 0.075                 | -0.020           | -0.069           | 0.015             | -0.041              | 0.040               | -0.146                   | -0.079                 | -0.078                 |
| 3     | Days to first fruit picking |                         |                         | <b>1.00</b>                 | 0.044                 | -0.030           | 0.017            | 0.087             | 0.093               | 0.370*              | -0.225                   | 0.106*                 | -0.101                 |
| 4     | No. of branches/plant       |                         |                         |                             | <b>1.00</b>           | 0.000            | 0.230            | -0.247            | -0.176              | 0.283               | -0.234                   | -0.203                 | -0.171                 |
| 5     | Plant height(cm)            |                         |                         |                             |                       | <b>1.00</b>      | 0.368*           | 0.528**           | 0.251               | 0.244               | 0.312*                   | 0.473*                 | 0.470*                 |
| 6     | Plant spread(cm)            |                         |                         |                             |                       |                  | <b>1.00</b>      | 0.169             | 0.362*              | 0.104               | 0.192                    | 0.520**                | 0.516**                |
| 7     | Fruit length (cm)           |                         |                         |                             |                       |                  |                  | <b>1.00</b>       | 0.072               | 0.228               | 0.414*                   | 0.377*                 | 0.380*                 |
| 8     | Fruit diameter (cm)         |                         |                         |                             |                       |                  |                  |                   | <b>1.00</b>         | -0.030              | -0.014                   | 0.212                  | 0.202                  |
| 9     | No. of fruits per plant     |                         |                         |                             |                       |                  |                  |                   |                     | <b>1.00</b>         | -0.002                   | 0.494*                 | 0.495*                 |
| 10    | Average fruit weight (g)    |                         |                         |                             |                       |                  |                  |                   |                     |                     | <b>1.00</b>              | 0.459*                 | 0.466*                 |
| 11    | Fruit yield/plant (kg)      |                         |                         |                             |                       |                  |                  |                   |                     |                     |                          | <b>1.00</b>            | 0.998**                |
| 12    | Fruit yield/hectare (q)     |                         |                         |                             |                       |                  |                  |                   |                     |                     |                          |                        | <b>1.00</b>            |

\*, \*\* = Significant at 5% and 1% respectively

**Table 5b: Estimates of genotypic (above diagonal) correlation coefficients among quality characters in brinjal (*Solanum melongena* L.)**

| S. No. | Parameters                          | TSS content (°Brix) | Total anthocyanin content (mg/100g) | Ascorbic acid (mg/100g) | Phenols (mg/100g) | Total sugars (%) | Dry matter (%) |
|--------|-------------------------------------|---------------------|-------------------------------------|-------------------------|-------------------|------------------|----------------|
| 1      | TSS content (°Brix)                 | <b>1.00</b>         | -0.033                              | 0.214                   | -1.145**          | 0.124            | 0.295          |
| 2      | Total anthocyanin content (mg/100g) |                     | <b>1.00</b>                         | 3.17**                  | 0.060             | -3.058**         | 0.286          |
| 3      | Ascorbic acid (mg/100g)             |                     |                                     | <b>1.00</b>             | -0.194            | 0.024            | -1.464**       |
| 4      | Phenols (mg/100g)                   |                     |                                     |                         | <b>1.00</b>       | -0.738**         | -0.010         |
| 5      | Total sugars (%)                    |                     |                                     |                         |                   | <b>1.00</b>      | -0.362*        |
| 6      | Dry matter (%)                      |                     |                                     |                         |                   |                  | <b>1.00</b>    |

\*, \*\* = Significant at 5% and 1% respectively

#### 4.5 Genetic divergence

Analysis of variance for dispersion revealed that the genotypes expressed significant variability for traits under study. Genetic divergence was estimated for forty genotypes of brinjal. Based upon the performance of genotypes, forty brinjal genotypes were grouped into seven clusters (Table 6) as per Mahalanobis  $D^2$  analysis employing Wards method. The dendrogram (Fig.1) indicated that the maximum number of genotypes fall in cluster VI (9) followed by cluster V containing 8 genotypes, followed by cluster VII containing 6 genotypes, followed by cluster III and IV each containing 5 clusters each then cluster I containing 4 genotypes and cluster II consisted of 3 genotypes. Cluster I consisted of SKAU-B-205, SKAU-B-245, SKAU-B-274 and SKAU-B-276 genotypes. IC-354867, SKAU-B-229 and SKAU-B-236 genotypes were falling in cluster II. Cluster III consisted of IC-089888, IC-090063, SKAU-B-197, SKAU-B-209 and SKAU-B-211 genotypes. The cluster IV included IC-089818, IC-099712, IC-261801, SKAU-B-226 and SKAU-B-255 genotypes. Cluster V consisted of IC-090026, IC-111010, SKAU-B-215, SKAU-B-222, SKAU-B-239, SKAU-B-249, SKAU-B-263 and SKAU-B-270 genotypes. IC-074207, SKAU-B-193, SKAU-B-219, SKAU-B-224, SKAU-B-234, SKAU-B-241, SKAU-B-247, SKAU-B-251 and SKAU-B-255 genotypes falls in VI cluster. Cluster VII consisted of IC-074244-1, SKAU-B-231, SKAU-B-259, SKAU-B-266, SKAU-B-268 and SKAU-B-279 genotypes.

The average intra and inter cluster distance ( $D^2$ ) values (Table 7, Fig.2) revealed that cluster V had the highest intra cluster distance ( $D^2$ ) value of 40242.92 followed by cluster III (29117.82), cluster II (22985.97), cluster IV (22672.85), cluster I (18386.08), cluster VI (11182.95) and cluster VII (10256.34). The inter cluster distance  $D^2$  values were highest between cluster II and VI (280335.30) followed by cluster IV and V (252012.10), cluster I and II (219988.30), cluster I and IV (195750.30), cluster V and VII (192122.40) and cluster I and VII (1891140.90).

Cluster means for different characters (Table 8a and 8b) revealed that the cluster I consisted of 4 genotypes. In cluster I days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 46.83, 56.09 and 66.60 days respectively. The number of branches per plant was 12.45. Plant height and plant spread was 84.02cm and 60.28cm respectively. The fruit length, fruit diameter was 15.92 cm and 4.15 cm respectively. The Number of fruits per plant and average fruit weight was 10.67 and 122.14 g. The average fruit yield per plant, fruit yield per plot and fruit yield per hectare was 0.91kg, 69.65 kg and 338.05q respectively. TSS, total anthocyanin content and vitamin C was 4.16 °Brix, 5.13 mg/100g and 8.06 mg/100g respectively. Phenols, total sugars and dry matter was 81.67 mg/100g, 2.67% and 4.93% respectively.

Cluster II consisted of minimum number of genotypes (i.e., 3) in which days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 45.87, 53.99 and 62.36 days respectively. The number of branches per plant was 11.67. Plant height and plant spread was 85.13cm and 57.84 cm respectively. The fruit length, fruit diameter was 16.55 cm and 3.8 cm respectively. The Number of fruits per plant and average fruit weight was 10.06 and 245.01 g. The average fruit yield per plant, fruit yield per plot and fruit yield per hectare was 1.03kg, 78.57 kg and 381.17q respectively. TSS, total anthocyanin content and vitamin C was 3.78°Brix, 4.69 mg/100g and 5.71 mg/100g respectively. Phenols, total sugars and dry matter was 110.09 mg/100g, 2.72% and 6.22% respectively.

The cluster III consisted of 5 genotypes in which days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 46.04, 54.36 and 63.11 days respectively. The number of branches per plant was 12.60. Plant height and plant spread was 70.84 cm and 54.95 cm respectively. The fruit length, fruit diameter was 12.62 cm and 4.09 cm respectively. The Number of fruits per plant and average fruit weight was 10.80 and 121.24 g. The average fruit yield per

plant, fruit yield per plot and fruit yield per hectare was 0.84 kg, 64.21 kg and 311.49 q respectively. TSS, total anthocyanin content and vitamin C was 3.81°Brix, 5.74 mg/100g and 7 mg/100g respectively. Phenols, total sugars and dry matter was 95.43 mg/100g, 2.60% and 5.17% respectively.

The cluster IV consisted of 5 genotypes in which days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 48.35, 57.25 and 65.72 days respectively. The number of branches per plant was 13.17. Plant height and plant spread was 77.52 cm and 53.45 cm respectively. The fruit length, fruit diameter was 12.80 cm and 3.89 cm respectively. The Number of fruits per plant and average fruit weight was 10.50 and 93.89 g. The average fruit yield per plant, fruit yield per plot and fruit yield per hectare was 0.84 kg, 63.75 kg and 305.46 q respectively. TSS, total anthocyanin content and vitamin C was 3.92°Brix, 3.85 mg/100g and 8.95 mg/100g respectively. Phenols, total sugars and dry matter was 111.27 mg/100g, 2.76% and 5.15 % respectively.

The cluster V consisted of 8 genotypes in which days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 47.64, 55.77 and 65.07 days respectively. The number of branches per plant was 12.11. Plant height and plant spread was 79.86 cm and 62.68 cm respectively. The fruit length, fruit diameter was 14.47 cm and 4.19 cm respectively. The Number of fruits per plant and average fruit weight was 9.96 and 212.37 g. The average fruit yield per plant, fruit yield per plot and fruit yield per hectare was 0.94 kg, 72.06 kg and 349.75 q respectively. TSS, total anthocyanin content and vitamin C was 4.21°Brix, 5.04 mg/100g and 7.04 mg/100g respectively. Phenols, total sugars and dry matter was 83.23 mg/100g, 2.61% and 6.30 % respectively.

The cluster VI consisted of 9 genotypes in which days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 46.75, 53.06 and 62.83 days respectively. The number of branches per plant was 13.11. Plant height and plant spread was 70.65 cm and 49.97 cm respectively. The fruit length, fruit diameter was 11.39 cm and 4.23 cm respectively. The Number of fruits per

plant and average fruit weight was 8.95 and 82.89 g. The average fruit yield per plant, fruit yield per plot and fruit yield per hectare was 0.81 kg, 62.04 kg and 301.08 q respectively. TSS, total anthocyanin content and vitamin C was 3.35°Brix, 1.20 mg/100g and 10.06 mg/100g respectively. Phenols, total sugars and dry matter was 83.57 mg/100g, 2.68% and 4 % respectively.

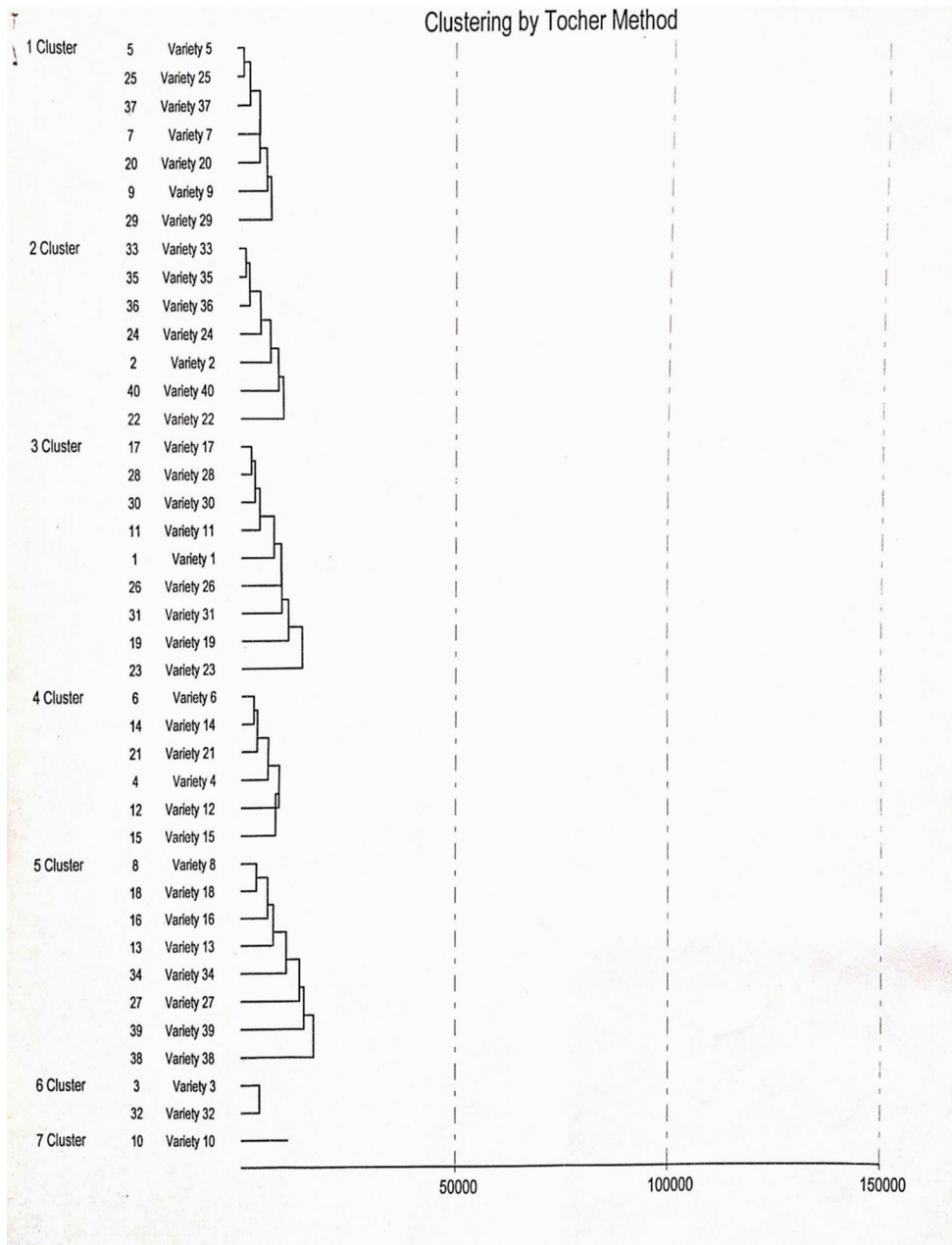
The cluster VII consisted of 6 genotypes in which days to first flowering, days to first fruit set and days to first fruit picking was recorded to be 44.57, 54.30 and 63.23 days respectively. The number of branches per plant was 13. Plant height and plant spread was 44.30 cm and 44.62 cm respectively. The fruit length, fruit diameter was 9.15 cm and 3.97 cm respectively. The Number of fruits per plant and average fruit weight was 8.34 and 187.89 g. The average fruit yield per plant, fruit yield per plot and fruit yield per hectare was 0.84 kg, 64.11 kg and 311.10 q respectively. TSS, total anthocyanin content and vitamin C was 3.80°Brix, 0.21 mg/100g and 9.62 mg/100g respectively. Phenols, total sugars and dry matter was 108.10 mg/100g, 2.08% and 10.20 % respectively.

**Table 6: Distribution of brinjal (*Solanum melongena* L.) genotypes into clusters based on D<sup>2</sup> Statistics**

| S. No. | Cluster | No. of genotypes in the cluster | Name of genotypes   |
|--------|---------|---------------------------------|---|
| 1      | I       | 4                               | SKAU-B-205, SKAU-B-245, SKAU-B-274, SKAU-B-276  |
| 2      | II      | 3                               | IC-354867, SKAU-B-229, SKAU-B-236   |
| 3      | III     | 5                               | IC-089888, IC-090063, SKAU-B-197, SKAU-B-209, SKAU-B-211  |
| 4      | IV      | 5                               | IC-089818, IC-099712, IC-261801, SKAU-B-226, SKAU-B-255   |
| 5      | V       | 8                               | IC-090026, IC-111010, SKAU-B-215, SKAU-B-222, SKAU-B-239, SKAU-B-249, SKAU-B-263, SKAU-B-270              |
| 6      | VI      | 9                               | IC-074207, SKAU-B-193, SKAU-B-219, SKAU-B-224, SKAU-B-234, SKAU-B-241, SKAU-B-247, SKAU-B-251, SKAU-B-255 |
| 7      | VII     | 6                               | IC-074244-1, SKAU-B-231, SKAU-B-259, SKAU-B-266, SKAU-B-268, SKAU-B-279                                   |

**Table 7: Average intra cluster (Diagonal) and inter cluster (Above Diagonal) distance values in brinjal (*Solanum melongena* L.)**

| S. No. | Cluster | I               | II              | III             | IV              | V               | VI              | VII             |
|--------|---------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1      | I       | <b>18386.08</b> | 219988.30       | 59843.87        | 195750.30       | 57274.22        | 48939.36        | 189140.90       |
| 2      | II      |                 | <b>22985.97</b> | 118740.30       | 118766.20       | 167083.60       | 280335.30       | 76826.20        |
| 3      | III     |                 |                 | <b>29117.82</b> | 82031.77        | 96679.68        | 87508.34        | 100124.50       |
| 4      | IV      |                 |                 |                 | <b>22672.85</b> | 252012.10       | 170511.70       | 60717.75        |
| 5      | V       |                 |                 |                 |                 | <b>40242.92</b> | 130345.00       | 192122.40       |
| 6      | VI      |                 |                 |                 |                 |                 | <b>11182.95</b> | 156479.90       |
| 7      | VII     |                 |                 |                 |                 |                 |                 | <b>10256.34</b> |



**Fig. 1: Clustering by Tocher method (Dendrogram)**

**Table 8a: Cluster means for various growth, maturity, yield attributing and quality characters in different clusters of brinjal (*Solanum melongena* L.) genotypes**

| S. No. | Cluster | Days to first flowering | Days to first fruit set | Days to first fruit picking | No. of branches/plant | Plant height(cm) | Plant spread(cm) | Fruit length (cm) | Fruit diameter (cm) | No. of fruits per plant | Average fruit weight (g) | Fruit yield/plant (kg) | Fruit yield/plot (kg) | Fruit yield/hectare (q) |
|--------|---------|-------------------------|-------------------------|-----------------------------|-----------------------|------------------|------------------|-------------------|---------------------|-------------------------|--------------------------|------------------------|-----------------------|-------------------------|
| 1      | I       | 46.83                   | 56.09                   | 66.60                       | 12.45                 | 84.02            | 60.28            | 15.92             | 4.15                | 10.67                   | 122.14                   | 0.91                   | 69.65                 | 338.05                  |
| 2      | II      | 45.87                   | 53.99                   | 62.36                       | 11.67                 | 85.13            | 57.84            | 16.55             | 3.88                | 10.06                   | 245.01                   | 1.03                   | 78.57                 | 381.17                  |
| 3      | III     | 46.04                   | 54.36                   | 63.11                       | 12.60                 | 70.84            | 54.95            | 12.62             | 4.09                | 10.80                   | 121.24                   | 0.84                   | 64.21                 | 311.49                  |
| 4      | IV      | 48.35                   | 57.25                   | 65.72                       | 13.17                 | 77.52            | 53.45            | 12.80             | 3.89                | 10.50                   | 93.89                    | 0.84                   | 63.75                 | 305.46                  |
| 5      | V       | 47.64                   | 55.77                   | 65.07                       | 12.11                 | 79.86            | 62.68            | 14.47             | 4.19                | 9.96                    | 212.37                   | 0.94                   | 72.06                 | 349.75                  |
| 6      | VI      | 46.75                   | 53.06                   | 62.83                       | 13.11                 | 70.65            | 49.97            | 11.39             | 4.23                | 8.95                    | 82.89                    | 0.81                   | 62.04                 | 301.08                  |
| 7      | VII     | 44.57                   | 54.30                   | 63.23                       | 13                    | 44.30            | 44.62            | 9.15              | 3.97                | 8.34                    | 187.89                   | 0.84                   | 64.11                 | 311.10                  |

**Table 8b: Cluster means for various quality characters in different clusters of brinjal (*Solanum melongena* L.) genotypes**

| <b>S. No.</b> | <b>Cluster</b> | <b>TSS (°Brix)</b> | <b>Total anthocyanin content (mg/100g)</b> | <b>Ascorbic acid (mg/100g)</b> | <b>Phenols (mg/100g)</b> | <b>Total sugars (%)</b> | <b>Dry matter (%)</b> |
|---------------|----------------|--------------------|--|--------------------------------|--------------------------|-------------------------|-----------------------|
| 1             | I              | 4.16               | 5.13                                       | 8.06                           | 81.67                    | 2.67                    | 4.93                  |
| 2             | II             | 3.78               | 4.69                                       | 5.71                           | 110.09                   | 2.72                    | 6.22                  |
| 3             | III            | 3.81               | 5.74                                       | 7.00                           | 95.43                    | 2.60                    | 5.17                  |
| 4             | IV             | 3.92               | 3.85                                       | 8.95                           | 111.27                   | 2.76                    | 5.15                  |
| 5             | V              | 4.21               | 5.04                                       | 7.04                           | 83.23                    | 2.61                    | 6.30                  |
| 6             | VI             | 3.35               | 1.20                                       | 10.06                          | 83.57                    | 2.68                    | 4.00                  |
| 7             | VII            | 3.80               | 0.21                                       | 9.62                           | 108.10                   | 2.08                    | 10.20                 |

#### 4.6 Contribution of characters towards divergence

The per cent contributions of the traits towards total genetic divergence (Table 9) revealed that fruit yield per hectare was the main factor contributing to divergence accounting for (50.21%) followed by average fruit weight (32.82%), Number of fruits per plant(11.41%), number branches per plant(1.03%),fruit yield per plot(0.84%),fruit yield per plant(0.71%), plant height (0.51%), fruit length (0.51%), days to first fruit picking (0.50%), plant spread (0.50%), fruit diameter (0.50%), days to first flowering (0.41) and days to first fruit set (0.12%).

**Table 9: Percent contribution of individual traits towards total genetic divergence**

| S. No. | Traits                               | % contribution towards total divergence |
|--------|--------------------------------------|---|
| 1      | Days to first flowering              | 0.41                                    |
| 2      | Days to first fruit set              | 0.12                                    |
| 3      | Days to first fruit picking          | 0.50                                    |
| 4      | No. of branches per plant            | 1.03                                    |
| 5      | Plant height (cm)                    | 0.51                                    |
| 6      | Plant spread (cm)                    | 0.50                                    |
| 7      | Fruit length(cm)                     | 0.51                                    |
| 8      | Fruit diameter (cm)                  | 0.50                                    |
| 9      | No. of fruits plant <sup>-1</sup>    | 11.41                                   |
| 10     | Average fruit weight (g)             | 32.82                                   |
| 11     | Fruit yield plant <sup>-1</sup> (kg) | 0.71                                    |
| 12     | Fruit yield per plot (kg)            | 0.84                                    |
| 13     | Fruit yield per hectare (q)          | 50.21                                   |

## Chapter 5

### DISCUSSION

In the angiospermic Solanaceae family, eggplant (*Solanum melongena* L.), often known as brinjal or aubergine, is a diploid plant with chr. No.  $2n=24$ . One of the most widely produced vegetables in the tropics and subtropics, brinjal is thought to have its origins in southern India (Roychowdhury and Tah, 2011). India and China are thought to be the world's two most diverse countries (Kashyap *et al.*, 2003). Asia, Europe, Africa and America—consume it the most. One of the most significant vegetable crops in India is the brinjal, which has long social and economic impact on people. The majority of regional cultivars are well-known throughout the nation for their superior qualities, but many of them also produce low yields and are vulnerable to a wide range of pests and diseases. Utilizing potential sources of diversity in several brinjal genotypes can help improve eggplant Prabakaran 2010. Information about the "genetic variability and diversity" of the specific crop that serves as the basis for each crop breeding programme is essential for systematic work and advancement in agricultural plants (Gobu *et al.*, 2017). Crop genetic diversity is required to maintain production levels (Tripathy *et al.*, 2017). The development of a new variety involves gathering various genetic stocks of any crop. A good breeding programme requires evaluation of the level of environmental variability. A collection of germplasm's phenotypic variation can be used to predict prospective genotypic variation, although the environment has a significant impact on the quantitative traits. As a result, the degree of "variability" together with "heritability and genetic progress" should be taken into consideration while choosing the critical features for an effective breeding programme. When we use correlation coefficient analysis to determine the relationship between various plant characteristics and yield, selection competency will be more effective (Rekha and Celine, 2013). The level of a certain environment's influence on the expression of genotypes is measured by heritability. Calculating the proportion of

variability that is inherited vs acquired is useful. Consequently, it becomes imperative to use a bio-metrical strategy to separate the entire computed "variability" into "heritable and non-heritable" components by using several genetical factors, including "genetic heritability, coefficient of variation and genetic progress." Characters that do not correlate with one another highlight their relationship and aid in the selection of elite genotypes. Selection can be aided by the association of multiple economic traits like yield and associated component characteristics. Without identifying the underlying reason of the link, correlation quantifies the interdependence of several plant characteristics and identifies the constituent traits on which selection might be based for genetic improvement in yield. With the aid of Mahalanobis'  $D^2$  analysis, genetic diversity can be calculated (1936). It is a highly effective method for determining genetic divergence. Using  $D^2$  statistics, one can distinguish between various cultivars based on the diversity present (Mahalanobis, 1936). It provides a clear picture of the populations' diversity. The distances between and within the clusters were determined using the clusters created using Ward's approach. These findings may shed light on the variety of genotypes within a cluster. The degree of differences between genotypes that belong to various clusters is also provided by cluster means. Additionally, the identification of the selection parameter to be utilised as criteria for the improvement in the yield is aided by the relative contribution of several yield components to overall divergence using Mahalanobis  $D^2$  analysis. For detecting genetic divergence in plants, it is consistently and widely used (Shinde *et al.*, 2012; Shinde *et al.*, 2013; Vidhya and Kumar, 2014). In order to create a new breeding programme, some genotypes obtained from various sources have been researched in light of the aforementioned facts. Therefore, the two goals were the driving forces behind the current study project, "Genetic Divergence Studies in Brinjal (*Solanum melongena* L.)". Forty distinct genotypes were used in the current investigation for various horticultural and qualitative parameters. These qualities have been covered in the simple discussion below.

## **5.1 Mean performance of genotypes**

The analysis of variance revealed extremely significant variations in genotypes for each attribute examined, indicating that the germplasm contained enough variety. In Tables 3a to 3b, the average performance of all the genotypes for all the traits under study is displayed and reported.

### **5.1.1 Days to first flowering, days to first fruit set and days to first fruit picking**

Comparison of the genotypes for days to first flowering revealed that; SKAU-B-193 (40.53 days) showed minimum days to first flower followed by genotype SKAU-B-241 (41.58 days) followed by IC-089888 (42.08 days) followed by genotype SKAU-B-222 (42.36 days) followed by SKAU-B-251 (43.33days) and followed by genotype SKAU-B-249 (43.52days).The genotype SKAU-B-205 showed maximum days to first flowering (50.52days). Similarly the genotypes which took least days to first fruit set were SKAU-B-241 (47.36days) followed by SKAU-B-222 (48.52days) followed by IC-089818(49.82days) followed by SKAU-B-193 (50.33days) followed by IC-11010 (50.66days) and followed by genotype SKAU-B-231 (50.71days). Maximum days to first fruit set was shown by genotype SKAU-B-245 (59.2days).The study revealed that genotype SKAU-B-241 (55.33days) showed minimum days to first fruit picking followed by genotype SKAU-B-193 (58.46days) followed by SKAU-B-231 (58.5days) followed by SKAU-B-236 (59days) and followed by genotype SKAU-B-222 (59.23days). The maximum days to first fruit picking was shown by genotype SKAU-B-226 which took 68.46 days. The results were in accordance with Mohanty (2002), Dhaka and Soni (2014), Shekar *et al.* (2012), Patel *et al.* (2015) and Ravali *et al.* (2017) who harvested first fruits between 52.33 to 109.30 days after transplanting.

### **5.1.2 Number of branches per plant**

The number of branches per plant ranged from 8.81 (SKAU-B-234) to 14.86 (SKAU-B-209). General mean for the character was 12.43. Similar wide variations for number of branches in brinjal ranging between 3.87 and 17.20 have also been observed by earlier researchers *viz.* Prabhu *et al.* (2009), Bora *et al.* (2011), Shekar *et al.* (2012), Kumar and Arumugam (2013), Lokesh *et al.* (2013), Nayak and Nagre (2013) and Dhaka and Soni (2014), Madhavi *et al.* (2015) and Ravali *et al.* (2017).per plant

### **5.1.3 Plant height (cm) and spread (cm)**

Plant height is most important trait in determining the harvest duration and total yield of the crop. Significant variations for plant height were observed among all the genotypes which ranged from 44.3 cm (IC-354867) – 103.54 cm (SKAU-B-276).General mean for the character was 77.78cm. Similarly plant spread ranged from 38.45cm (SKAU-B-197)-74.52cm (IC-111010) with a general mean of 57.20 cm. These results are in conformity with Chaudhary and Kumar (2014), Patel *et al.* (2004), Kamani *et al.* (2008), Lokesh *et al.* (2013) and Nayak and Nagre (2013), Vidhya and Kumar (2015), Das *et al.* (2017), Ravali *et al.* (2017), Patel *et al.* (2017), Sujin *et al.* (2017), who also observed variable heights and spread in their respective set of genotypes in brinjal

### **5.1.4 Fruit length (cm) and diameter (cm)**

After measuring the length of different genotypes by vernier caliper, it was seen that fruit length showed a general mean of 14.13cm with highest fruit length shown by genotype SKAU-B-274 (18.96cm) and minimum length shown by genotype SKAU-B-241 (7.27cm). Also fruit diameter ranged from 3.15cm (SKAU-B-251) to 4.66cm (SKAU-B-276) with a general mean of 4.05cm. The length and diameter of fruits in different genotypes of brinjal varied according to their shape i.e round fruited genotypes and long fruited genotypes. Trend of such variation in fruit length and spread have also been reported by Golani *et al.*

(2007), Prabhu *et al.* (2009), Kumar *et al.* (2011), Shekar *et al.* (2012), Kumar and Arumugam (2013), Lokesh *et al.* (2013) and Nayak and Nagre (2013) Begum *et al.* (2013), Vandana *et al.* (2014), Uddin *et al.* (2014), Gavade and Ghadge (2015), Ravali *et al.* (2017) in brinjal.

#### **5.1.5 Number of fruits per plant**

All the genotypes screened in the present investigation revealed significant variations for this character as well. Number of fruits per plant ranged from 7.26 (SKAU-B-257) to 19.83 (SKAU-B-226) with a mean of 10.27. Top six genotypes with maximum fruits per plant were SKAU-B-226 (19.83), SKAU-B-224 (19.56), SKAU-B-268 (15.52), SKAU-B-197 (15.37), SKAU-B-229 (12.55) and IC-074207(12.36). Similar trend w. r. t fruiting behavior has been indicated earlier also by different workers like Chattopadhyay *et al.* (2011), Dhaka and Soni (2014), Vidhya and Kumar (2015), Kumar *et al.* (2016), Das *et al.* (2017), Ravali *et al.* (2017), who reported as minimum as 2.33 to as high as 70.33 fruits per plant in their respective variability studies.

#### **5.1.6 Fruit weight (g)**

A pool of 40 genotypes under scrutiny for variability comprised long, oblong and round/ oval fruited genotypes. Fruit weight varied according to shape of fruits. Maximum fruit weight was seen in genotype SKAU-B-231 (307.36g) and minimum fruit weight was seen in genotype SKAU-B-211 (49.44g). The grand mean was seen to be 156.93g. Corresponding, variability in average fruit weight of brinjal have also been noticed by Mohanty (2002), Prabhu *et al.* (2009), Shekar *et al.* (2012), Karak *et al.* (2012), Kumar and Arumugam (2013), Lokesh *et al.* (2013), Nayak and Nagre (2013), Yadav *et al.* (2014), Vidhya and Kumar (2015), Patel *et al.* (2015), Kumar *et al.* (2016) and Patel *et al.* (2017).

#### **5.1.7 Fruit yield per plant (kg), per plot (kg) and per ha (q)**

The observation recorded on fruit yield (kg/ plant, kg/ plot and q/ ha) are presented in Table 4. Maximum fruit yield per plant was observed in SKAU-B-

276 (1.14 kg) closely followed by another 5 genotypes namely SKAU-B-268 (1.1kg), SKAU-B-279 (1.1kg), SKAU-B-224 (1.09kg), SKAU-B-234 (1.09kg) and IC-11010(1.09kg). Further, comparison of mean data recorded on yield from the plot area and its further transformation to hectare basis revealed that genotype SKAU-B-276 (422.76q/ha) recorded highest yield/hectare followed by genotype SKAU-B-268 (407.4q/ha) and genotype SKAU-B-279 (407.4q/ha). A wide variation in yield of brinjal to the tune of 32.50 to 548.50 q/ha has also been demonstrated by earlier investigators *viz.* Mohanty (2002), Kushwah and Bandhyopadhyaya (2005), Shekar *et al.* (2012), Kumar and Arumugam (2013), Panwar *et al.* (2013), Lokesh *et al.* (2013) and Nayak and Nagre (2013), Chaudhary and Kumar (2014) and Das *et al.* (2017).

#### **5.1.8 Total soluble solids (°Brix)**

Significant variations were recorded among all the genotypes for this quality trait also. Total soluble solids (TSS) ranged from 2.6 °B(SKAU-B-259) to 5.96 °B (SKAU-B-205) as enumerated in Table 4.2. The other genotypes; SKAU-B-222 (4.9°B), SKAU-B-247 (4.6°B), SKAU-B-249 (4.6°B) and IC-074207 (4.5°B), also estimated content of TSS statistically similar to the top TSS rich SKAU-B-205. General mean for this character was found to be 3.39 °B. These finding can be supported by finding of earlier workers like Ansari *et al.* (2010), Chaudhary and Kumar (2014), Tripathy *et al.* (2017), Tirkey *et al.* (2018), who also estimated TSS content in brinjal fruit ranging between 2.83-8.83 °B. 4.1-1.12°B

#### **5.1.9 Ascorbic acid content (mg/100 g)**

The mean values w. r. t ascorbic acid content in different brinjal genotypes are presented through Table 4. The comparison of mean performance of genotypes showed maximum ascorbic acid in IC-111010 (10.33 mg/100 g), while SKAU-B-268 (2.62 mg/100 g) estimated least content of it. Patel *et al.* (2015) had found it in the range of 9.93-16.27 mg/100 g, while Kumar *et al.* (2016), Ravali *et*

*al.* (2017) and Tirkey *et al.* (2018) estimated at between 7.38-13.47, 3.27-9.52 and 4.94-9.03 mg/100 g, respectively in their respective set of genotypes screened by them.

#### **5.1.10 Phenols (mg/100g), total anthocyanin content (mg/100g), total sugars (%) and dry matter (%)**

Phenol content was maximum seen in genotype SKAU-B-266 (114.1mg/100g) and least was seen in genotype IC-111010 (77.1mg/100g) with a grand mean of 95.24mg/100g. Total anthocyanin content was maximum seen in dark violet coloured fruits and least was seen in white coloured ones. Top six genotypes showing maximum anthocyanin content in mg/100g were SKAU-B-255(7.8), SKAU-B-263 (7.6), SKAU-B-226 (7.4), SKAU-B-219 (7.2), SKAU-B-215 (7) and SKAU-B-247 (6.9). The genotypes under study showed lesser sugar content in the range of 2.08 % (IC-354867) to 3.62 % (SKAU-B-234). Dry matter content was maximum in IC-354867 (10.2%), IC-089888 (10.1%), SKAU-B-279 (10.1%), SKAU-B-245 (9.6%) and SKAU-B-274 (9.4%) genotypes with least dry matter content shown by genotype SKAU-B-205 (1.4%). The results of these quality parameters were in accordance with Karak *et al* (2012), Patel *et al* (2014), Madhavi *et al* (2015) and Ravali *et al* (2017).

#### **5.2 Analysis of variance**

The analysis of variance indicated highly significant differences among the genotypes due to genotypes for all traits *viz.*, Days to first flowering, Days to first fruit set, Days to first fruit picking, Number of branches per plant, Plant height(cm), Plant spread(cm), Fruit length (cm), Fruit diameter (cm), Number of fruits per plant, Average fruit weight (g), Fruit yield per plant (kg), Fruit yield per plot (kg), Fruit yield per hectare (q), Total soluble solids (°Brix), Total Anthocyanin content (mg/100g), Vitamin C (mg/100g), Phenols (mg/100g), Total sugars (%) and Dry matter (%). Same results were found by Hassan *et al.*(2015), Madhavi *et al.*(2015), Milli *et al.* (2014), Praveen *et al.* 2020 and Dhaka and Soni

(2014), Kumar *et al.*(2014), Singh *et al.* (2013), Ansari *et al.* (2010). It indicated sufficient variability existed for all these characters and which provide the potential for selection of suitable genotypes having desirable traits for further crop improvement. However, analysis of variance by itself is not enough and conclusive to explain all the inherent genotypic variance in the genotype.

### **5.3 Genetic parameters of variability**

The degree of variety present in crop plants, which is one of the most crucial selection criteria in the breeding programme, heavily influences the breeding program's success. A number of metrics, including GCV, PCV,  $h^2$ , genetic progress and GA%, were used to estimate variance. Environment played a critical effect in how a characteristic appeared phenotypically. The genotypic (heritable) and environmental (non-heritable) components of phenotypic variability are combined. In current study various genetical parameters like GCV, PCV heritability in broad sense and GA has been explained and is depicted in Table 4 . The results of the finding have been discussed as below;

For both quantitative and qualitative qualities, the phenotypic coefficient of variation (PCV) was higher than the genotypic counterpart (GCV), indicating that the influence of environment is also a factor in the apparent variance in addition to genotype. 2007; Ukkund *et al.* The magnitude of the coefficients of variability varies from character to character, being either low, moderate, or high (Sharma, 1994). In our situation, the levels of variability across all variables were low (15%), moderate (15–30%) and high (> 30%), indicating a higher degree of diversity in the sample employed in the study. High phenotypic coefficient of variation (PCV) indicates the existence of greater scope for selection of the trait under consideration, which is dependent on the amount of variability present, while high genetic coefficient of variation (GCV) indicates the presence of high genetic variability for the traits which may facilitate selection (Yandav *et al.* 2009). As can be perused from Table 4.3, the phenotypic coefficient of variation (PCV) in our present investigation were high for the traits; average fruit weight

(43.69%), total anthocyanin content (39.10 %), ascorbic acid (31.73 %) and dry matter (42.31%). Moderate phenotypic coefficient of variation (PCV) was recorded for plant height (17.40 %), fruit length (26.45 %), number of fruits per plant (28.29%), fruit yield per plant (21%), fruit yield per plot (21.02%), fruit yield per hectare (20.98%), total soluble solids (15.23 %) and total sugars (17.06 %) whereas, it was low for days to first flowering (6.42 %), days to first fruit set (5.90 %), days to first fruit picking (5.42 %), number of branches per plant (14.50%), plant spread (13.80%), fruit diameter (11.97%) and phenols (13.53%)

Similarly, the genotypic coefficient of variation (GCV) was high for average fruit weight (43.69%), total anthocyanin content (39.10 %), ascorbic acid (31.73 %) and dry matter (42.29%), moderate for plant height (17.39 %), fruit length (26.23 %), number of fruits per plant (28.15%), fruit yield per plant (20.94%), fruit yield per plot (21.96%), fruit yield per hectare (20.94%), total soluble solids (15.04 %) and total sugars (16.67 %) and low in case of days to first flowering (6.16 %), days to first fruit set (5.70%), days to first fruit picking (5.03%), number of branches per plant (12.29%), plant spread (13.79%), fruit diameter (11.85%) and phenols (13.35%)

. The presence of high GCV for the traits as above indicates that there is considerable genetic variation present in these traits to warrant selection for better eggplant genotypes. In the earlier studies also, the high estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation have been observed for different characters by Prasad and Singh (2003), Ram *et al.* (2007), Akpan *et al.* (2016), Sujjin *et al.* (2017), Kaundinya *et al.* (2017), Arti and Sharma (2018), Pujer *et al.* (2018), Balas *et al.* (2019), Bende *et al.* (2019), Dasmohapatra *et al.* (2019) and Jirankali *et al.* (2019) while moderate PCV and GCV were observed by Muniappan *et al.* (2010), Ansari *et al.* (2010), Lokesh *et al.* (2013), Yadav *et al.* (2014), Vidya and Kumar (2015), Shande *et al.* (2015), Akpan *et al.* (2016), Sujjin *et al.* (2017), Patel *et al.* (2017), Ravali *et al.* (2017) and Tirkey *et al.* (2018) Low PCV and GCV obtained for different characters were supported by the

findings of Lokesh *et al.* (2013), Mili *et al.* (2014), Madhavi *et al.* (2015), Vidya and Kumar (2015), Mangi *et al.* (2016), Verma *et al.* (2018), Jirankali *et al.* (2019) and Bende *et al.* (2019)

### 5.3.1 Heritability

Heritability, which is important in evaluating the expression of phenotype connected to the genetic contribution of the trait, has a major impact on how effective a given breeding strategy is for different traits. According to Johansen *et al.* (1955), the genetic advance and heritability values helped predict the anticipated advancement through selection. The estimates of heritability (broad sense) were found to be high for all the characters studied *viz.* Days to first flowering (91%), Days to first fruit set(93%), Days to first fruit picking(86%), Number of branches per plant(71%), Plant height(99%), Plant spread(99%), Fruit length (98%), Fruit diameter (98%), Number of fruits per plant(99%), Average fruit weight (98%), Fruit yield per plant (99%), Fruit yield per plot (99%), Fruit yield per hectare (99%), Total soluble solids (97%), Total Anthocyanin content (99%), Vitamin C (99%), Phenols (98%), Total sugars (95%) and Dry matter (99%). High heritability for different traits indicated that large proportion of phenotypic variance was attributed to genotypic variance and therefore, reliable selection could be made for these traits on the basis of phenotypic expression. Corroborating with the result of present investigation, Mohanty (2002) estimated heritability in broad sense and it ranged from 56.8 per cent for plant height to 92.9 per cent for number of fruits per plant and illustrated that due to such a high values of heritability these traits were least influenced by environmental modification. Similarly, Shekar *et al.* (2012) also reported high heritability in fruit length (99.00 %), fruit diameter (97.00 %), day to first flowering (97.00 %), days to first picking (97.00 %), number of fruits per plant (89.00 %), fruit yield per plant (83.00 %), fruit yield per plot (83.00 %), fruit yield per hectare (83.00 %) and number of branches per plant (81.00 %). Akpan *et al.* (2016) reported high broad sense heritability estimates for fruit circumference (98.37 %), fruit diameter

(97.44 %), number of fruits per plant (83.27 %) in brinjal grown in early season, while the late season planting experiment showed that fruit yield per hectare (98.08 %), number of fruits per plant (99.48 %), fruit circumference (99.16 %) and fruit diameter (98.50 %) were among traits with high broad sense heritability.

### **5.3.2 Genetic advance and genetic gain**

An inquisition of data in Table 4 revealed that genetic gain (expressed as per cent of population mean) was low to high in nature and ranged from 9.64 to 90 per cent for different characters under study. It was found high for the traits *viz.* Number of branches per plant(21.47%), Plant height(35.83%), Plant spread(28.41%), Fruit length (53.58%), Fruit diameter (24.19%), Number of fruits per plant(57.71%), Average fruit weight (90%), Fruit yield per plant (43.07%), Fruit yield per plot (43.07%), Fruit yield per hectare (43.07%), Total soluble solids (30.63%), Total Anthocyanin content (80.55%), Vitamin C (65.35%), Phenols (27.50%), Total sugars (33.56%) and Dry matter (87.11%). Moderate genetic gain was observed for days to first flowering (12.16 %) and days to first fruit set (11.34 %) while, low genetic gain was observed for days to first fruit picking (9.64 %)

A reliable selection could be made for these qualities based on phenotypic expression since high heritabilities for various traits suggested that a significant amount of phenotypic variation was related to genotypic variance. High heritability (> 60 %) coupled with high genetic advance as per cent over mean (> 20 %) were observed for Number of branches per plant, Plant height, Plant spread, Fruit length, Fruit diameter, Number of fruits per plant, Average fruit weight, Fruit yield per plant, Fruit yield per plot, Fruit yield per hectare, Total soluble solids, Total Anthocyanin content, Vitamin C, Phenols, Total sugars and Dry matter and the results were in accordance with Vidhya and Kumar (2015), Shande *et al.* (2015), Verma *et al.* (2018), Dasmohapatra *et al.* (2019), Balas *et al.* (2019), Jirankali *et al.*(2019) and Bende *et al.* (2019). This indicates the predominance of

additive gene component. Thus, there is scope for improving these characters with direct selection.

#### **5.4 Correlation studies**

When developing superior cultivars of any crop, a plant breeder must always keep yield as the primary criterion in mind. Yield, however, is a polygenic trait that is strongly impacted by the environment. During the selection process, understanding the relationships between quantitative aspects that are especially related to yield and its characteristics is extremely useful. Variability studies shed light on the extent of character improvement that is conceivable, but they are silent on the size and nature of the relationship that already exists between various economically significant characteristics and the various contributing characters. Therefore, in order to make indirect selections for the improvement of economical characters, understanding of the relationships between various characters and economic character is required. Studies of correlation help us understand how highly heritable traits often correlate with the most valuable traits economically and how each characteristic contributes to the genetic make-up of a crop. The degree of the observed association between two features is shown by the phenotypic correlations. Due to the fact that it shows both heredity and environmental factors, this does not provide a true genetic picture of the connection. Genotypic correlations measure the relationship between the genes governing any two characters that are inherently associated. As a result, it is more important and might be used to create a successful selection process.

The genotypic correlation coefficients ( $r_g$ ) among the various characters of brinjal genotypes are presented in Table-5a and 5b. The days to first flowering was positively and significantly correlated with days to first fruit set and days to first fruit picking. Days to first fruit set was positively and significantly correlated with days to first fruit picking. Days to first fruit picking with number of fruits per plant. Plant height with plant spread, fruit length, average fruit weight and fruit yield per plant. Plant spread with fruit diameter and fruit yield per plant. Fruit

length with average fruit weight and fruit yield per plant. Number of fruits per plant with fruit yield per plant. Average fruit weight with fruit yield per plant. Days to first flowering exhibited highly significant positive correlation with days to first fruit set. Similar results were reported by Vadivel and Kannabapu (1988), Saraswathi *et al.* (1996), Pratibha *et al.* (2004) and Patel and Sarnaik (2004). Plant height showed significant positive correlation with plant spread, similar to the results of Randhawa *et al.* (1989), Deka *et al.* (1992), Sharma and Krishan Swaroop (2000) and Singh *et al.* (2003).

The economically important trait i.e., fruit yield per hectare was positively and significantly correlated with fruit yield per plant followed by plant spread, number of fruits per plant, plant height, average fruit weight and fruit length. The result were in conformity with the findings of Angadi *et al.*(2017), Ravali *et al.* (2017), Sujjin *et al.* (2017), Tripathy *et al.* (2017), Jirankali *et al.* (2019), Onyia *et al.* (2019) and Bende *et al.* (2019).

## **5.5 Genetic divergence**

. It is essential to assess a large number of current genotypes as a first step in the development of high yielding and better quality brinjal cultivars for cultivation under temperate conditions of the Kashmir valley. These genotypes must have been chosen from a variety of sources based on their individual performance. In hybridization programmes, superior genotypes are chosen and employed as parents. However, it can be challenging to choose superior parents from a wide pool of genotypes. In order to identify the genetically diverse parents who are most likely to result in crosses with high levels of heteroticism as well as those who are also likely to produce a wide range of variability during the segregation and recombination of genes at heterozygous polygenic blocks, genetic divergence analysis among genotypes is helpful. The multivariate strategy employing  $D^2$  statistics (Mahalanobis, 1928) is an effective method for determining the degree of genotype divergence. In order to successfully implement a breeding strategy to produce high heterotic response and

transgressive segregants, this would aid in the identification of putative parents. Estimating genetic divergence enables the huge genotype data to be broken down into more digestible chunks. The parents with the greatest genetic divergence are thought to be the most suitable for use in the hybridization programme. Understanding the type and level of genetic divergence contained in the available germplasm is crucial when developing the brinjal improvement programme through hybridization and producing diversity for the development of yield and other desirable qualities.

In the present study, forty genotypes of brinjal were evaluated to estimate the genetic divergence for identification of potential parents using Mahalanobis  $D^2$  statistics. The use of Mahalanobis  $D^2$  statistic (Rao, 1952) for estimating genetic divergence have also been emphasized by many workers in brinjal (Patil *et al.* 1994 and Mishra *et al.* 1998) because it permits precise comparison among all possible pairs of population. Accordingly, genetic divergence among the forty brinjal genotypes was studied under following subheads:

#### **5.5.1 Composition of clusters**

On the basis of performance of various traits, the clustering pattern of forty genotypes of brinjal has been presented in the Table 6. All the genotypes were grouped into 7 (I-VII) clusters. Maximum numbers of genotypes were accommodated in cluster VI (9) followed by cluster V which contain eight genotypes followed by cluster VII containing six genotypes followed by cluster III and IV containing five genotypes each followed by cluster I with four genotypes and cluster II with three genotypes. Group constellation of Brinjal genotypes through genetic divergence has been also reported by Singh *et al.* (2006), Polignano *et al.* (2009), Shekar *et al.* (2012), Hassan *et al.* (2015), Kumar *et al.* (2016), Mangi *et al.* (2016) and Nand *et al.* (2018).

### **5.5.2 Intra and Inter cluster genetic divergence ( $D^2$ )**

Average intra and inter cluster divergence ( $D^2$ ) values are presented in the Table 7. The diagonal figures in the table represent the intra cluster distances. The intra cluster distance was maximum in cluster V (40242.92) and minimum in cluster VII (10256.34). High intra cluster distance indicated that the genotypes included in V cluster were genetically heterogeneous to a great extent. The maximum inter cluster distance was recorded between cluster II and VI (280335.30) indicated wide diversity between these two clusters, while lowest (60717.75) was observed between cluster IV and VII indicating their close relationship. Das and Das (2017) studied the genetic divergence in brinjal and grouped 26 genotypes into 11 clusters and also reported maximum and minimum inter and intra cluster distances.

### **5.5.3 Mean performance of cluster**

Further, for getting the reliable conformity on the basis of cluster means, it was calculated for various horticultural traits and has been presented in Table 8a and 8b. The flower appeared at the earliest (days) in cluster VII (44.57) followed by gradual delay as observed in cluster; II (45.87), III (46.04), VI (46.75), I (46.83), V(47.64) and IV (48.35). Similarly, the fruits were earliest (days) set in cluster VI (53.06) followed by cluster II (53.99), VII(54.30), III (54.36), V (55.77), I (56.09) and IV (57.25). The smallest harvest duration (days) was observed in cluster II (62.36), cluster VI (62.83), cluster III (63.11), cluster VII (63.23), cluster V (65.07), cluster IV (65.72) and cluster I (66.60). Maximum number of branches per plant was observed in cluster IV (13.17) followed by cluster VI (13.11), cluster VII (13), cluster III (12.60), cluster I (12.45), cluster V (12.11) and cluster II (11.67). The tallest plants (cm) were observed in cluster II (85.13), cluster I (84.02), cluster V (79.86), cluster IV (77.52), cluster III (70.84), cluster VI (70.65) and cluster VII (44.30). The widest plant spread (cm) was seen in cluster V (62.68) followed by cluster I(60.28), cluster II (57.84), cluster III (54.95), cluster IV (53.45), cluster VI (49.97), cluster VII (44.62). Maximum fruit

length (cm) was recorded in cluster II (16.55) followed by cluster I (15.92), cluster V (14.47), cluster IV (12.80), cluster III (12.62), cluster VI (11.39) and cluster VII (9.15), while breadth (cm) was highest in cluster VI (4.23) followed by cluster V (4.19), cluster I (4.15), cluster III (4.09), cluster VII (3.97), cluster IV (3.243.89) and cluster II (3.88). Number of fruits per plant was observed highest through cluster III (10.80) followed by cluster I (10.67), cluster IV (10.50), cluster II (10.06), cluster V (9.96), cluster VI (8.95) and cluster VII (8.34). The fruit weight (g) was maximum in cluster II (245.01) followed by cluster V (212.37), cluster I (122.14), cluster III (121.24), cluster VII (187.89), cluster IV (93.89) and cluster VI (82.89). Maximum fruit yield per plant (kg) was obtained in cluster II (1.03) followed by cluster V (0.94), cluster I (0.91), cluster III (0.84), cluster IV (0.84), cluster VII (0.84) and cluster VI (0.81). Highest total soluble solids ( $^{\circ}$ Brix) was estimated in cluster V (4.21), cluster I (4.16), cluster IV (3.92), cluster III (3.81), cluster VII (3.80), cluster II (3.78) and cluster VI (3.35). Similarly, maximum anthocyanin content (mg/ 100 g) was observed in cluster III (5.74), cluster I (5.13), cluster V (5.04), cluster II (4.69), cluster IV (3.85), cluster VI (1.20) and cluster VII (0.21). Maximum ascorbic acid content (mg/ 100 g) was observed in cluster VI (10.06), cluster VII (9.62), cluster IV (8.95), cluster I (8.06), cluster V (7.04), cluster III (7) and cluster II (5.71). Maximum phenols (mg/ 100 g) were observed in cluster IV (111.27), cluster II (110.09), cluster VII (108.10), cluster III (95.43), cluster VI (83.57), cluster V (83.23) and cluster I (81.67). The total sugars (%) were observed highest in cluster IV (2.76), cluster II (2.72), cluster VI (2.68), cluster I (2.67), cluster V (2.61), cluster III (2.60) and cluster VII (2.08). The dry matter content (%) was observed highest in cluster VII (10.20), cluster V (6.30), cluster II (6.22), cluster III (5.17), cluster IV (5.15), cluster I (4.93) and cluster VI (4). Variable cluster mean for different plant growth and fruit yield characters have also been reported by Singh *et al.* (2006), Golani *et al.* (2007), Quamruzzaman *et al.* (2009), Muniappan *et al.* (2010), Shekar *et al.* (2012), Begum *et al.* (2013), Rahman *et al.* (2014), Vidhya and Kumar (2014), Ullah *et al.* (2014), Uddin *et al.* (2014), Rekha and Celine (2015), Madhavi *et al.*

(2015), Prabakaran *et al.* (2015), Sadarunnisa *et al.* (2015), Gupta *et al.* (2015), Karim *et al.* (2016), Kumar *et al.* (2016), Das and Das (2017), Gupta *et al.* (2017) and Nand *et al.* (2018).

## **5.6 Contribution of characters towards divergence**

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 hectare, average fruit weight and number of fruits per plant which were in confirmation to the findings of ; Sharma *et al.* (2000) for fruit weight; Mohanty and Prusti (2001) for fruit weight and number of fruits per plant; Sharma and Maurya (2004), Singh *et al.* (2006) for number of fruits per plant; and Singh *et al.* (2013) for fruit weight and number of fruits per plant, Arti *et al.* (2018), Sanga *et al.* (2017) and Pandey *et al.* (2019) for number of fruits per plant.

## Chapter 6

### SUMMARY AND CONCLUSION

The proposed investigation on “**Genetic Divergence Studies in Brinjal (*Solanum melongena* L.)**” was initiated at Vegetable Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar during *kharif* season 2021. Forty genotypes of brinjal were evaluated in Randomised Complete Block Design with three replications. Standard package of practices were adopted to raise a healthy crop. The observations were recorded on Days to first flowering, Days to first fruit set, Days to first fruit picking, Number of branches per plant, Plant height(cm), Plant spread(cm), Fruit length (cm), Fruit diameter (cm), Number of fruits per plant, Average fruit weight (g), Fruit yield per plant (kg), Fruit yield per plot (kg), Fruit yield per hectare (q), Total soluble solids (°Brix), Total Anthocyanin content (mg/100g), Vitamin C (mg/100g), Phenols (mg/100g), Total sugars (%) and Dry matter (%).

The results obtained from present investigations are summarized here-under:

#### **Mean performance**

The analysis of variance showed highly significant variations among the genotypes for all the horticultural traits under study. The earliest flowers were produced in SKAU-B-193 however; earliest fruit were set in SKAU-B-241 and fruits were earliest harvested in SKAU-B-241. SKAU-B-209 recorded maximum number of branches per plant. Maximum plant height was recorded in the SKAU-B-276 and plant spread was maximum in IC-111010. Maximum fruit length was recorded in the genotype SKAU-B-274 while SKAU-B-276 has widest fruits. SKAU-B-226 produced highest number of fruit per plant whereas, SKAU-B-231 recorded highest average fruit weight. The yield per plant, per plot and per hectare was highest in genotype SKAU-B-276. Maximum TSS was recorded in SKAU-B-205 whereas; maximum anthocyanin content was recorded in SKAU-B-225 and

maximum ascorbic acid content was estimated in IC-111010. Maximum phenols were recorded in SKAU-B-266. Total sugars were highest present in SKAU-B-234 and highest dry matter was recorded in IC-089888.

### **Parameters of variability**

Amongst the various parameters of variability, high phenotypic and genotypic coefficients of variability were found in average fruit weight, total anthocyanin content, ascorbic acid and dry matter, indicating wide range of variations and offered better scope for improvement through selection. Moderate phenotypic as well as genotypic coefficients of variability were recorded in traits; plant height, fruit length, number of fruits per plant, fruit yield per plant, fruit yield per plot, fruit yield per hectare, total soluble solids and total whereas, low phenotypic and genotypic coefficients of variability were found in; days to first flowering, days to first fruit set, days to first fruit picking, number of branches per plant, plant spread, fruit diameter and phenols. High heritability coupled with high genetic gain was observed for Number of branches per plant, Plant height, Plant spread, Fruit length, Fruit diameter, Number of fruits per plant, Average fruit weight, Fruit yield per plant, Fruit yield per plot, Fruit yield per hectare, Total soluble solids, Total Anthocyanin content, Vitamin C, Phenols, Total sugars and Dry matter. This implies that these features are controlled by additive gene action and that direct selection for these traits could result in a significant improvement in the ability to recognise superior genotypes of brinjal. Days to first flowering and days to first fruit set showed high heritability and modest genetic gain, respectively. Therefore, although selection will be less successful, these characters also suggest some room for development. Days to first fruit picking was shown to have a high heritability and low genetic gain, indicating a substantial influence of genotype x environment interaction. Since these qualities were controlled by non additive gene action, recombinant breeding would be an efficient method for improving them.

### **Correlation studies**

The correlation coefficients among the different characters were worked out at both genotypic and phenotypic levels. The results indicated that the economically important trait i.e., fruit yield per plant was positively and significantly correlated with plant spread followed by number of fruits per plant, plant height, average fruit weight and fruit length.

### **Genetic divergence**

In the present studies, on the basis of genetic divergence, forty diverse genotypes of brinjal were grouped into seven clusters. The resultant seven clusters showed genetic diversity and maximum number of genotypes were accommodated in cluster VI, V and VII. The maximum inter cluster distance was recorded between cluster II and VI, Therefore, the hybridization between the genotypes of cluster II and VI can be made for getting superior hybrids or recombinants in segregating populations.

### **CONCLUSION**

Based on the findings of the present investigation it could be concluded that sufficient amount of genetic variation existed in the present set of material and the genotypes could be used in future breeding programmes for bringing about improvement in the crop.

- Analysis of variance indicated that mean sum of squares due to genotypes were significant for all the characters indicating the presence of sufficient amount of variability in the genotypes.
- The phenotypic coefficient of variation was in general higher than the genotypic coefficient of variation for all the characters, indicating that the influence of environment is also a factor in the apparent variance in addition to genotype.
- Correlation coefficient helps a breeder in determining the direction of selection and number of characters to be considered in improving the

desired characters. Positive and significant correlation existed for fruit yield per hectare with number of fruits per plant, plant height, average fruit weight and fruit length. Positive correlations between desirable characters could help in simultaneous selection of both the characters. Negative correlations could however, be broken by repeated hybridization between random individuals or more preferably between selected ones.

- From the present investigation, it can be concluded that genotypes SKAU-B-276, SKAU-B-268, SKAU-B-279, SKAU-B-234, IC-111010, SKAU-B-224 and SKAU-B-249 produced greater yields than other genotypes. The high yielding potential registered in these genotypes was primarily on account of either more number of fruit and increased weigh per fruit and longer harvest durations. A highly significant positive genotypic and phenotypic correlation of yield was found with fruit yield per plant followed by plant spread, number of fruits per plant, plant height, average fruit weight and fruit length. Therefore, main emphasis should be given on these characters, while making selection in brinjal genotypes.
- Morphological cluster analysis revealed considerable genetic diversity and grouped genotypes into 7 clusters.
- Out of the seven clusters formed, maximum inter-cluster distance was observed between cluster II and cluster VI followed by cluster IV and V, which suggested that members of these clusters are genetically more diverse to each other and therefore, the hybridization between the genotypes of these two clusters will be more rewarding for getting superior hybrids or recombinants in segregating populations for future breeding programmes.
- Maximum contribution towards the genetic divergence was shown by fruit yield per hectare, average fruit weight and number of fruits per plant indicating exploitation of these traits for hybrid development.

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**CERTIFICATE**

Certified that all the corrections/amendments as suggested by External Examiner **Dr. Geetika Malik**, Scientist (ARS) & I/C Head, Division of Vegetable Science & Floriculture, ICAR, CITH, Srinagar during Viva-Voce examination held on **17-12-2022** have been incorporated in the manuscript entitled, “**Genetic Divergence Studies in Brinjal (*Solanum melongena* L.)**” submitted by **Ms. Saima Tabasum (Regd. No. MSH-2020-329)**

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