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Genetic parameters for different characters of the brinjal (*Solanum melongena* L.) in F₄, F₅ and F₆ generation of the cross (EC-169084 × Bhagyamati)

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Abstract

The present investigation entitled “Genetic studies in advanced generations for yield and yield contributing traits in brinjal (*Solanum melongena* L.)” was conducted at College of Horticulture, Venkataramannagudem, Andhra Pradesh during *Kharif-2020*, *Rabi-2020* and *Kharif-2021*. The F₄, F₅ and F₆ generations of the cross (EC-169084 × Bhagyamati) were evaluated with the objective of selecting superior genotypes through pedigree method of selection for economically important traits and to assess the various genetic parameters for the brinjal crop improvement. The data from advanced generations were collected and statistically analyzed to compute mean, range, phenotypic and genotypic coefficients of variance, heritability, expected genetic advance, genetic advance as per cent mean, genetic gain.

The pedigree of the cross (EC-169084 × Bhagyamati) recorded the per cent genetic gain from F₄ to F₅ and F₅ to F₆ generation; yield per plant (39.60 and 6.17), number of primary branches (5.46 and 3.23), plant spread N-S (26.29 and 1.90), plant spread E-W (25.34 and 2.79), number of fruits per inflorescence (9.21 and 7.22), fruit length (24.02 and 1.27), number of fruits per plant (25.59 and 7.15), fruit volume (2.16 and 1.51), average fruit weight (12.51 and 1.41), fruit firmness (6.66 and 1.83) respectively. Six promising plants were selected in F₆ generation and selfed for further preliminary yield trials.

Keywords: Genetic studies, mean, range, PCV, GCV, heritability, genetic advance and genetic gain

Introduction

Brinjal (*Solanum melongena* L.) is a solanaceous vegetable with chromosome number $2n=2x=24$. It is a perennial vegetable but commercially grown as annual crop. Because of its highest production potential and availability to consumers, it is often referred as poor man’s vegetable. It is essentially tropical and sub-tropical crop grown extensively in India, Bangladesh, Pakistan, China, Japan and Philippines.

In India, egg plant occupies an area of 7.36 lakh hectares with an annual production of 127.77 lakh tonnes and the productivity stands at 17.36 tonnes per hectare. In Andhra Pradesh, it is grown over an area of 0.69 lakh hectares with annual production of 12.40 lakh tonnes and productivity of 17.97 tonnes per hectare (NHB, 2019-20). In initial days of crop improvement mass selection was practiced by the breeders and resulting varieties were non uniform in terms of many traits. Consumer demand for uniform, good quality produce is increasing day by day and obviously the farmer should produce market demanded produce and at the same time the cultivated genotypes should be high yielding and resistant to biotic and abiotic stresses.

For achieving uniformity, pure line selection, hybridization followed by pedigree/bulk selection and heterosis breeding (F₁ hybrids) are the best methods. But in often cross-pollinated crops like brinjal, pure lines are mostly preferred by the farmers because of ease of seed production. Hybridization followed by selection is widely followed method for developing high yielding genotypes in solanaceous vegetables. After hybridization, selfing is done to get the variability. Recombination and segregation leads to release of genetic variability in segregating populations. Estimation of nature and magnitude of variability, heritability of yield contributing and other traits is immense importance. The available variability can be portioned into heritable and non-heritable components.

If greater the available genetic variability more is the chance for getting better genotypes by direct selection (Vavilov, 191) [20].

Heritability can be measured by the genetic relationship between the parent and offspring. Greater the heritable variation, the possibility of fixing the characters by selection methods is higher. Genetic advance is helpful to devise the effect of selection. Heritability and genetic advance studies are of immense use to identify whether the observed variation for a particular character is due to genotype or environment. Hybridization followed by selection in the segregation generations (pedigree/ bulk method of breeding) is one of the widely used breeding methods to develop varieties in self-pollinated as well as often cross-pollinated vegetable crops including brinjal. There are fair chances of isolation of transgressive segregants also in this procedure (Briggs and Allard, 1953 and Singh, 2002) [3, 17]. Many high yielding varieties in brinjal viz., Pusa purple long, Pusa purple cluster, Pusakranti, Pusabhairav, PusaShymala, PusaAnmol, Arka shirish, Arka sheel, Arka keshav, Arka Nidhi, Arka Neelkanth, Arka Kusumkaretc., have been developed through hybridization followed by pedigree selection.

Materials and Methods

In order to develop superior recombinant genotypes in brinjal, hybridization programme was initiated with the cross EC-169084 × Bhagyamati at College of Horticulture, Venkataramannagudem, during *Kharif*, 2016 and selection was exercised in F₂, F₃ generations during *Kharif*, 2019 and *Rabi*, 2019 respectively. The 20 top performing plants selected from F₃ generation were selfed to get F₄ generation for the present study.

Evaluation of F₄ generation

During *Kharif*, 2020-21, 20 progenies of EC-169084 × Bhagyamati were raised with a spacing of 75 cm × 75 cm in a Randomized Block Design with three replications. Each progeny in each replication had 10 individual plants and a total of 30 plants over three replications per progeny were accommodated to exercise selection and 14 top performing plants were selected and selfed to get F₅ generation for the present study.

Evaluation of F₅ generation

During *Rabi*, 2020-21, nine progenies of EC-169084 × Bhagyamati were raised with a spacing of 75 cm × 75 cm in a Randomized Block Design with three replications. Each progeny in each replication had 10 individual plants and a total of 30 plants over three replications per progeny were accommodated to exercise selection and six top performing plants were selected and selfed to get F₆ generation for the present study.

Evaluation of F₆ generation

During *kharif*, 2021-22, six progenies of EC-169084 × Bhagyamati were raised with a spacing of 75 cm × 75 cm in a Randomized Block Design with three replications. Each progeny in each replication had 10 individual plants and a total of 30 plants over three replications per progeny were accommodated to exercise selection and six promising plants were selected and selfed to get F₇ seed.

Results and Discussion

Observations were taken for all the individual plants separately and the data was statistically analyzed to compute

mean, range, phenotypic and genotypic coefficients of variance, heritability, expected genetic advance, genetic advance as per cent mean, genetic gain in F₄, F₅ and F₆ generation for the cross EC-169084 × Bhagyamati (Table) was presented as follows.

Plant height (cm)

The values of plant height ranged from 90.73 to 109.23 with a mean of 98.75 in F₄ generation. In F₅ generation, the values for plant height ranged from 94.76 to 106.63 with a mean of 99.30. The per cent of genetic gain for plant height was 0.55 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 96.26 to 103.63 with a mean of 99.52. The per cent of genetic gain for plant height was 0.22 per cent from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values for plant height were low (6.92 and 2.84) respectively. In F₅ generation, the PCV value was 3.65 and GCV value was 1.73 and the values of PCV and GCV were low (3.78 and 2.40) respectively in F₆ generation. The heritability for this trait was 16.90, 22.60 and 40.20 per cent in F₄, F₅ and F₆ respectively. Genetic advance for this trait was 2.38 per cent in F₄, while genetic advance in F₅ was 1.68 per cent and in F₆ generation it was 3.12 per cent. Genetic advance expressed as per cent of mean was 2.41, 1.70 and 3.13 in F₄, F₅ and F₆ respectively.

Plant spread N-S (cm)

The variation for this character ranged from 49.00 to 87.03 with an average of 68.60 in F₄ generation. In F₅ generation, the values for the trait ranged from 79.00 to 92.33 with a mean of 86.64. The per cent of genetic gain for plant spread N-S was 26.29 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 82.90 to 92.33 with a mean of 88.29. The per cent of genetic gain for plant spread N-S was 1.90 per cent from F₅ to F₆ generation.

In F₄ population, the PCV and GCV values were moderate (18.11 and 15.73) respectively. In F₅ generation the PCV value was 5.37 and GCV value was 4.78 and the estimates of PCV and GCV were low (4.44 and 3.29) respectively in F₆ generation. The heritability for this trait was 75.40, 79.40 and 55.00 per cent in F₄, F₅ and F₆ generations respectively. Genetic advance for this trait was 19.30 per cent in F₄, 7.60 per cent in F₅ and it was 4.44 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 28.13, 8.78 and 5.03 in F₄, F₅ and F₆ generations respectively.

Plant spread E-W (cm)

The variation for this character ranged from 50.26 to 80.40 with an average of 66.56 in F₄ generation. In F₅ generation, the values for the trait ranged from 71.03 to 90.40 with a mean of 83.43. The per cent of genetic gain for plant spread was 25.34 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 76.13 to 90.40 with a mean of 85.76. The per cent of genetic gain for plant spread was 2.79 per cent from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 16.40 and 8.63 respectively. In F₅ generation, the PCV value was 7.20 and GCV value was 6.70 and the estimates of PCV and GCV were low (5.90 and 5.45) respectively in F₆ generation. The heritability for this trait was 27.70, 86.70 and 85.40 per cent in F₄, F₅ and F₆ generations respectively. Genetic advance for this trait was 6.23 per cent in F₄, 10.72 per cent in F₅ and it was 8.91 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 9.36, 12.85 and 10.39 in F₄, F₅ and F₆ generations respectively.

Number of primary branches

The number of primary branches ranged from 6.50 to 9.53 with an average of 7.32 in F₄ generation. In F₅ generation, the values for the trait ranged from 6.33 to 9.33 with a mean of 7.72. The per cent of genetic gain for number of primary branches was 5.46 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 6.33 to 9.33 with a mean of 7.97. The per cent of genetic gain for number of primary branches was 3.23 per cent from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 13.43 and 7.30 respectively. In F₅ generation, the PCV value was 10.65 and GCV value was 10.01 and the estimates of PCV and GCV were moderate (11.69 and 11.19) respectively in F₆ generation. The heritability for this trait was 29.50, 88.40 and 91.70 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.59 per cent in F₄, 1.49 per cent in F₅ and it was 1.76 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 8.17, 19.38 and 22.09 in F₄, F₅ and F₆ generations respectively

Days to 50% flowering

The days to 50 % flowering ranged from 36.00 to 48.66 with an average of 42.50 in F₄ generation. In F₅ generation, the values for the trait ranged from 36.66 to 46.33 with a mean of 42.09. The per cent of genetic gain for number of days to 50 % flowering was -0.96 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 36.66 to 43.33 with a mean of 40.47. The per cent of genetic gain for number of days to 50 % flowering was -3.84 per cent from F₅ to F₆ generation.

In F₄ population, the PCV and GCV values were low (8.42 and 7.08) respectively. In F₅ generation, the PCV value was 7.09 and GCV value was 6.10 and the estimates of PCV and GCV were low (6.43 and 5.58) respectively in F₆ generation. The heritability for this trait was 70.60, 74.00 and 75.30 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 5.20 per cent in F₄, 4.55 per cent in F₅ and it was 4.03 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 12.25, 10.81 and 9.97 in F₄, F₅ and F₆ generations respectively

Number of flowers per inflorescence

The range of variation observed for this trait was 2.20 to 5.70 with a mean of 2.97 in F₄ generation. In F₅ generation, the values for the trait ranged from 2.73 to 5.13 with a mean of 3.35. The per cent of genetic gain for number of flowers per inflorescence was 12.79 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 2.93 to 4.10 with a mean of 3.56. The per cent of genetic gain for number of flowers per inflorescence was 6.26 per cent from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 35.11 and 19.74. In F₅ generation the PCV value was 24.96 and GCV value was 24.40 and the estimates of PCV and GCV were moderate (18.34 and 17.26) respectively in F₆ generation. The heritability for this trait was 31.60, 95.60 and 88.60 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.68 per cent in F₄, 1.75 per cent in F₅ and it was 1.12 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 22.87, 49.16 and 33.46 in F₄, F₅ and F₆ generations respectively

Number of fruits per inflorescence

The range of variation observed for this trait was 1.30 to 3.70 with a mean of 2.28 in F₄ generation. In F₅ generation, the

values for the trait ranged from 1.46 to 3.53 with a mean of 2.49. The per cent of genetic gain for number of fruits per inflorescence was 9.21 per cent from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 1.83 to 3.13 with a mean of 2.67. The per cent of genetic gain for number of fruits per inflorescence was 7.22 per cent from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 30.30 and 15.50 respectively. In F₅ the PCV value was 31.58 and GCV value was 29.55 and the estimates of PCV and GCV were high (32.06 and 30.06) respectively in F₆ generation. The heritability for this trait was 26.20, 87.60 and 87.90 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.43 per cent in F₄, 1.41 per cent in F₅ and it was 1.32 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 16.33, 56.97 and 58.05 in F₄, F₅ and F₆ generations respectively

Days to first harvest

Days to first harvest ranged from 48.00 to 58.00 with a mean of 52.55 in F₄ generation. In F₅ generation, the values for the trait ranged from 48.66 to 55.66 with a mean of 52.38. The per cent of genetic gain for this trait was -0.32 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 48.66 to 55.00 with a mean of 51.23. The per cent of genetic gain for days to first harvest was -2.19 from F₅ to F₆ generation.

In F₄ population, the PCV and GCV values were low (6.56 and 5.33) respectively. In F₅ the PCV value was 4.61 and GCV value was 3.73 and the estimates of PCV and GCV were low (4.55 and 4.20) respectively in F₆ generation. The heritability for this trait was 66.00, 65.40 and 85.40 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 4.69 per cent in F₄, 3.25 per cent in F₅ and it was 4.10 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 8.93, 6.21 and 8.01 in F₄, F₅ and F₆ generations respectively

Days to final harvest

Days to final harvest ranged from 150.66 to 177.66 with a mean of 166.51 in F₄ generation. In F₅ generation, the values for the trait ranged from 158.00 to 172.66 with a mean of 163.97. The per cent of genetic gain for this trait was -1.52 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 158.00 to 170.00 with a mean of 162.42. The per cent of genetic gain for days to final harvest was -0.94 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were low (4.81 and 4.06) respectively. In F₅ the PCV value was 3.37 and GCV value was 2.69 and the estimates of PCV and GCV were low (3.55 and 2.54) respectively in F₆ generation. The heritability for this trait was 71.30, 63.40 and 51.30 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 11.66 per cent in F₄ generation, 7.24 per cent in F₅ and it was 6.10 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 7.06, 4.41 and 3.76 in F₄, F₅ and F₆ generations respectively

Fruit length (cm)

Fruit length ranged from 5.54 to 12.86 with a mean of 8.20 in F₄ generation. In F₅ generation, the values for the trait ranged from 8.27 to 13.86 with a mean of 10.17. The per cent of genetic gain for this trait was 24.02 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 8.27 to 11.11 with a mean of 10.30. The per cent of genetic gain for this trait was 1.27 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 26.36 and 23.61 respectively. In F₅ the PCV value was 14.39 and GCV value was 13.07 and the estimates of PCV and GCV were 11.30 and 9.89 respectively in F₆ generation. The heritability for this trait was 80.20, 82.50 and 76.70 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 3.57 per cent in F₄, 2.52 per cent in F₅ and it was 1.81 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 43.56, 24.45 and 17.84 in F₄, F₅ and F₆ generations respectively

Fruit girth (cm)

Fruit girth ranged from 9.56 to 19.93 with a mean of 15.61 in F₄ generation. In F₅ generation, the values for the trait ranged from 11.56 to 18.20 with a mean of 15.28. The per cent of genetic gain for this trait was -2.11 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 13.33 to 19.30 with a mean of 14.61. The per cent of genetic gain for this trait was -4.38 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 17.82 and 11.76 respectively. In F₅ the PCV value was 12.98 and GCV value was 11.63 and the estimates of PCV and GCV were 11.15 and 10.30 respectively in F₆ generation. The heritability for this trait was 43.60, 80.30 and 85.40 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 2.44 per cent in F₄, 3.27 per cent in F₅ and it was 3.06 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 16.00, 21.48 and 19.61 in F₄, F₅ and F₆ generations respectively

Fruit length to girth ratio

Fruit length to girth ratio ranged from 0.56 to 0.88 with a mean of 0.72 in F₄ generation. In F₅ generation, the values for the trait ranged from 0.55 to 0.83 with a mean of 0.68. The per cent of genetic gain for this trait was -5.55 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 0.55 to 0.74 with a mean of 0.65. The per cent of genetic gain for this trait was -4.41 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 19.51 and 5.65 respectively. In F₅ the PCV value was 13.81 and GCV value was 12.62 and the estimates of PCV and GCV were 11.20 and 9.30 respectively in F₆ generation. The heritability for this trait was 8.40, 83.60 and 68.90 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.02 per cent in F₄, 0.16 per cent in F₅ and 6.10 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 3.37, 23.78 and 15.90 in F₄, F₅ and F₆ generations respectively

Fruit volume (cm³)

Fruit volume ranged from 276.66 to 383.33 with a mean of 339.33 in F₄ generation. In F₅ generation, the values for the trait ranged from 306.66 to 400.00 with a mean of 346.66. The per cent of genetic gain for this trait was 2.16 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 330.00 to 400.00 with a mean of 351.90. The per cent of genetic gain for this trait was 1.51 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 10.54 and 7.44 respectively. In F₅ the PCV value was 8.91 and GCV value was 6.72 and the estimates of PCV and GCV were 8.51 and 6.56 respectively in F₆ generation. The heritability for this trait was 49.90, 56.90 and 59.60 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 36.77 per cent in F₄, 36.20 per cent in F₅ and 36.74 per cent in F₆ generation. Genetic advance expressed as per cent of mean

was 10.83, 10.44 and 10.44 in F₄, F₅ and F₆ generations respectively

Number of fruits per plant

The mean number of fruits per plant was recorded 44.27 and it ranged from 29.26 to 67.80 in F₄ generation. In F₅ generation, the values for the trait ranged from 33.23 to 68.66 with a mean of 55.60. The per cent of genetic gain for this trait was 25.59 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 4.00 to 68.66 with a mean of 59.58. The per cent of genetic gain for this trait was 7.15 from F₅ to F₆ generation. In F₄ generation, the PCV and GCV values were 25.87 and 24.50. In F₅ the PCV value was 18.27 and GCV value was 17.69 and the estimates of PCV and GCV were 15.36 and 14.99 respectively in F₆ generation. The heritability for this trait was 89.70, 93.70 and 95.40 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 21.17 per cent in F₄, 19.62 per cent in F₅ and 17.97 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 47.82, 35.29 and 30.17 in F₄, F₅ and F₆ generations respectively

Average fruit weight (g)

The average fruit weight was recorded 58.57 and it ranged from 37.33 to 97.50 in F₄ generation. In F₅ generation, the values for the trait ranged from 54.43 to 96.06 with a mean of 65.90. The per cent of genetic gain for this trait was 12.51 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 54.43 to 82.11 with a mean of 64.97. The per cent of genetic gain for this trait was -1.41 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 27.69 and 27.01 respectively. In F₅ the PCV value was 19.09 and GCV value was 18.81 and the estimates of PCV and GCV were 17.01 and 16.87 respectively in F₆ generation. The heritability for this trait was 95.20, 97.10 and 98.30 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 31.80 per cent in F₄, 25.16 per cent in F₅ and 22.39 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 54.29, 38.18 and 34.46 in F₄, F₅ and F₆ generations respectively

Number of seeds per fruit

The mean variation for number of seeds per fruit ranged from 296.00 to 440.00 with a mean of 358.85 in F₄ generation. In F₅ generation, the values for the trait ranged from 290.00 to 432.33 with a mean of 353.19. The per cent of genetic gain for this trait was -1.39 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 251.33 to 360.00 with a mean of 320.23. The per cent of genetic gain for this trait was -9.33 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 14.16 and 13.85 respectively. In F₅ the PCV value was 11.95 and GCV value was 11.61 and the estimates of PCV and GCV were 12.56 and 6.76 respectively in F₆ generation. The heritability for this trait was 95.70, 94.30 and 29.00 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 98.61 per cent in F₄ generation, whereas genetic advance in F₅ was 83.35 per cent and 24.04 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 27.92, 23.22 and 7.50 in F₄, F₅ and F₆ generations respectively

Seed weight per fruit (g)

The mean variation for Seed weight per fruit ranged from 3.50 to 4.99 with a mean of 4.45 in F₄ generation. In F₅ generation, the values for the trait ranged from 4.00 to 5.20

with a mean of 4.44. The per cent of genetic gain for this trait was -0.22 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 4.00 to 5.00 with a mean of 4.42. The per cent of genetic gain for this trait was -0.45 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 12.59 and 6.65 respectively. In F₅ the PCV value was 8.77 and GCV value was 8.19 and the estimates of PCV and GCV were 8.75 and 7.98 respectively in F₆ generation. The heritability for this trait was 27.90, 87.20 and 83.10 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.32 per cent in F₄, 0.70 per cent in F₅ and 0.66 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 7.24, 15.77 and 14.98 in F₄, F₅ and F₆ generations respectively

Firmness of the fruit (kg/cm²)

The firmness of the fruit ranged from 1.95 to 3.52 with a mean of 2.55 in F₄ generation. In F₅ generation, the values for the trait ranged from 1.79 to 3.23 with a mean of 2.72. The per cent of genetic gain for this trait was 6.66 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 1.79 to 3.76 with a mean of 2.77. The per cent of genetic gain for this trait was 1.83 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 19.61 and 12.15. In F₅ the PCV value was 19.27 and GCV value was 18.85 and the estimates of PCV and GCV were 20.18 and 19.74 respectively in F₆ generation. The heritability for this trait was 38.40, 95.70 and 95.70 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.43 per cent in F₄, 0.97 per cent in F₅ and 1.08 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 15.51, 38.00 and 39.77 in F₄, F₅ and F₆ generations respectively

Phenols (mg 100 g⁻¹)

The phenol values ranged from 3.90 to 6.97 with a mean of 4.64 in F₄ generation. In F₅ generation, the values for the trait ranged from 3.60 to 5.12 with a mean of 4.56. The per cent of genetic gain for this trait was -1.72 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 3.88 to 4.22 with a mean of 4.25. The per cent of genetic gain for this trait was -6.79 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 11.10 and 2.58. In F₅ the PCV value was 10.45 and GCV value was 9.72 and the estimates of PCV and GCV were 10.35 and 9.49 respectively in F₆ generation. The heritability for this trait was 5.40, 86.60 and 84.10 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 0.05 per cent in F₄, 0.82 per cent in F₅ and 0.82 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 1.23, 18.63 and 17.94 in F₄, F₅ and F₆ generations respectively

Yield per plant (Kg)

The mean yield per plant was recorded 2.55 and it ranged from 1.32 to 3.86 in F₄ generation. In F₅ generation, the values for the trait ranged from 3.04 to 4.04 with a mean of 3.56. The per cent of genetic gain for this trait was 39.60 from F₄ to F₅ generation, whereas in F₆ generation, it ranged from 3.61 to 4.04 with a mean of 3.78. The per cent of genetic gain for this trait was 6.17 from F₅ to F₆ generation.

In F₄ generation, the PCV and GCV values were 32.11 and 29.36. In F₅ the PCV value was 9.37 and GCV value was 7.36 and the estimates of PCV and GCV were 5.50 and 3.38 respectively in F₆ generation. The heritability for this trait was

83.60, 61.70 and 37.80 per cent in F₄, F₅ and F₆ generations respectively Genetic advance for this trait was 1.41 per cent in F₄ generation, 0.42 per cent in F₅ and 0.16 per cent in F₆ generation. Genetic advance expressed as per cent of mean was 55.30, 11.91 and 4.28 in F₄, F₅ and F₆ generations respectively

In the present study, high PCV and moderate to high GCV values were observed for yield per plant, number of flowers per inflorescence, number of fruits per inflorescence, number of fruits per plant, average fruit weight and fruit length in F₄ generation. In F₅ generation, number of flowers per inflorescence and number of fruits per inflorescence recorded high variability. The traits like, number of fruits per inflorescence and firmness of the fruit in F₆ generation noticed high PCV and GCV. High PCV and GCV values were observed for the characters indicating large amount of variation and consequently more scope for their improvement through selection. These results are in consonance with finding of earlier workers, Vidya and Kumar (2015) [21] for yield per plant, Ravali *et al.* (2017) [14] for number of flowers per inflorescence, Jyothi *et al.* (2019) [9] for number of fruits per inflorescence and Balasubramaniam *et al.* (2021) [2] for number of flowers per inflorescence.

In F₄ generation, moderate PCV and GCV values were observed for plant spread N-S, fruit girth, number of seeds per fruit and firmness of the fruit, whereas in F₅ the characters like number of primary branches, fruit length, fruit girth, fruit length to girth ratio, average fruit weight, number of flowers per inflorescence, number of seeds per fruit and firmness of the fruit recorded moderate PCV and GCV. In F₆ generation, number of primary branches, number of flowers per inflorescence, fruit girth, average fruit weight and number of fruits per plant recorded moderate variability. The results are in line with Nilakh *et al.* (2017) [12] for number of primary branches, days to 50 % flowering, fruit length in F₅ generation of brinjal, Shilpa *et al.* (2018) [16] for number of fruits per inflorescence, Sureshkumara *et al.* (2018) [19] for fruit firmness in tomato, Neelambika *et al.* (2020) [19] for yield per plant in F₄ generation for yield per plant.

Low GCV and PCV values were observed in F₄ generation for plant height, plant spread E-W, number of primary branches, days to 50% flowering, days to first harvest, days to final harvest, fruit length to girth ratio, fruit volume, seed weight per fruit and phenols. In F₅ generation, the characters like plant height, days to 50% flowering, days to first harvest, plant spread, number of primary branches, fruit volume, days to final harvest, fruit length to girth ratio, seed weight per fruit, phenols and yield per plant were observed low variability. In F₆ generation, yield per plant, plant height, plant spread, days to 50% flowering, days to final harvest, fruit length, fruit length to girth ratio, fruit volume, number of seeds per fruit, seed weight per fruit and phenols recorded low variability. These results are in consonance with findings of earlier workers, Prabhu *et al.* (2009) [13] for plant height, number of primary branches, fruit length, fruit girth, fruit weight, number of fruits per plant and yield per plant in F₅ and F₆ generation, Nilakh *et al.* (2017) [12] for days to 50% flowering, days to first harvest in F₅ generation, Neelambika *et al.* (2020) [19] for fruit length, plant height, fruit girth and days to 50% flowering in F₄ generation for plant height.

With the genotypic coefficient of variation alone, it is difficult to determine the relative amount of heritable and non-heritable components of variations present in the population. Estimates of heritability and genetic advance would supplement this parameter.

High heritability coupled with high genetic advance as per cent of mean was observed for fruit length, number of fruits per plant, average fruit weight, number of seeds per fruit and yield per plant in F₄ generation. High heritability coupled with high genetic advance as per cent of mean was observed for number of flowers per inflorescence, number of fruits per inflorescence, fruit length, fruit girth, fruit length to girth ratio, number of seeds per fruit and firmness of the fruit in F₅ generation. In F₆ generation, number of flowers per inflorescence, number of fruits per inflorescence and firmness of the fruit recorded high heritability and high genetic advance as per cent of mean indicating the predominance of additive gene action and hence, direct phenotypic selection may be useful with respect to these traits. These findings are in agreement with the findings of Reshmika *et al.* (2014) [15] for fruit length to girth ratio, Neha *et al.* (2016) [10] for fruit length to girth ratio, Jyothi *et al.* (2019) [9] for fruit length, fruit girth and average fruit weight, Balasubramaniyam *et al.* (2021) [2] for fruit length, Neelambika *et al.* (2020) [19] for yield per plant in F₄ generation, Surabhi *et al.* (2020) [18] for average fruit weight and for fruit girth and fruit length.

High heritability coupled with moderate genetic advance as per cent of mean was observed for days to 50 % flowering in F₄ generation and in F₅ the traits like yield per plant, plant spread E-W, number of primary branches, days to 50 % flowering, fruit volume, seed weight per fruit and phenols, whereas the traits like plant spread E-W, fruit length, fruit girth, fruit length to girth ratio, seed weight per fruit and phenols in F₆ generation exhibited high heritability coupled with moderate genetic advance as per cent of mean revealing the role of additive and non-additive gene action. Further improvement of these traits would be possible through cyclic hybridization, diallel selective mating and biparental mating. These findings are in accordance with different workers viz., Prabhu *et al.* (2009) [13] for plant height, number of primary branches, fruit length, number of fruits and yield per plant in F₅ and F₆ generation, Madhavi *et al.* (2015) [7] for days to first harvest and days to final harvest, Nilakh *et al.* (2017) [12] for yield per plant in F₅ generation, Ravali *et al.* (2017) [14] for plant height, Muktilata *et al.* (2018) for number of primary branches, Shilpa *et al.* (2018) [16] for number of fruits per plant and Surabhi *et al.* (2020) [18] for plant height.

The high heritability coupled with low GAM was observed for the characters like days to first harvest and days to final harvest in F₄ generation and plant spread N-S, number of primary branches, days to first harvest and days to final harvest in F₅, whereas in F₆ generation, days to 50 % flowering and days to first harvest recorded high heritability coupled with low GA indicating that a little improvement would be possible by selection for these characters. Similar results are reported by Prabhu *et al.* (2009) [13] for plant height, fruit length and number of fruits per plant in F₅ and F₆ generation, Madhavi *et al.* (2015) [7] for fruit length, Balas *et al.* (2019) [1] for days to final harvest and Surabhi *et al.* (2020) [18] for plant spread.

The moderate heritability and moderate GAM was observed for number of flowers per inflorescence, fruit girth, fruit volume and firmness of the fruit in F₄ generation and fruit volume in F₆ generation indicating that, these characters are governed by non-additive gene actions or to the presence of high genotypic environmental interactions and simple selection will not be effective for improvement of these characters. Similar results are reported by Prabhu *et al.* (2009) [13] for yield per plant in F₅ and F₆ generation, Nilakh *et al.* (2017) [12] for plant height, primary branches, days to 50 % flowering, fruit length and number of fruits per plant in F₅ generation, Shilpa *et al.* (2018) [16] for number of fruits per plant and Surabhi *et al.* (2020) [18] for plant spread N-S.

Moderate heritability and low genetic advance as per cent of mean was recorded in case of plant height, plant spread N-S, days to final harvest and yield per plant in F₆ generation indicating the operation of non-additive gene action. These characters are governed by non-additive gene action which need to be exploited by heterosis breeding or population improvement through various forms of recurrent selection. The results are in line with the findings of Prabhu *et al.* (2009) [13] for plant height, primary branches, fruit length, fruit weight, fruit girth, number of fruits per plant and yield per plant in F₅ and F₆ generation, Nilakh *et al.* (2017) [12] for days to first harvest in F₅ generation, Ravali *et al.* (2017) [14] for days to first harvest, Shilpa *et al.* (2018) [16] for number of primary branches and Neelambika *et al.* (2020) [19] for plant height, fruit girth and days to 50% flowering in F₄ generation.

Table 1: Mean, variability and heritability parameters for different characters in F₄, F₅ and F₆ generation of cross (EC-169084 × Bhagyamati).

Character	Generation	Mean	Range	PCV	GCV	Heritability (%)	GA at 5%	GAM at 5%	% GG
Plant height (cm)	F ₄	98.75	90.73-109.23	6.92	2.84	16.90	2.38	2.41	
	F ₅	99.30	94.76-106.63	3.65	1.73	22.60	1.68	1.70	0.55
	F ₆	99.52	96.26-103.63	3.78	2.40	40.20	3.12	3.13	0.22
Plant spread N-S (cm)	F ₄	68.60	49.00-87.03	18.11	15.73	75.40	19.30	28.13	
	F ₅	86.64	79.00-92.33	5.37	4.78	79.40	7.60	8.78	26.29
	F ₆	88.29	82.90-92.33	4.44	3.29	55.00	4.44	5.03	1.90
Plant spread E-W (cm)	F ₄	66.56	50.26-80.40	16.40	8.63	27.70	6.23	9.36	
	F ₅	83.43	71.03-90.40	7.20	6.70	86.70	10.72	12.85	25.34
	F ₆	85.76	76.13-90.40	5.90	5.45	85.40	88.91	10.39	2.79
Number of primary branches	F ₄	7.32	6.50-9.53	13.43	7.30	29.50	0.59	8.17	
	F ₅	7.72	6.33-9.33	10.65	10.01	88.40	1.49	19.38	5.46
	F ₆	7.97	6.33-9.33	11.69	11.19	91.70	1.76	22.09	3.23
Days to 50 % flowering	F ₄	42.50	36.00-48.66	8.42	7.08	70.60	5.20	12.25	
	F ₅	42.09	36.66-46.33	7.09	6.10	74.00	4.55	10.81	-0.96
	F ₆	40.47	36.66-43.33	6.43	5.58	75.30	4.03	9.97	-3.84
Number of flowers per inflorescence	F ₄	2.97	2.20-5.70	35.11	19.74	31.60	0.68	22.87	
	F ₅	3.35	2.73-5.13	24.96	24.40	95.60	1.75	49.16	12.79
	F ₆	3.56	2.93-4.10	18.34	17.26	88.60	1.12	33.46	6.26
Number of fruits per inflorescence	F ₄	2.28	1.30-3.70	30.30	15.50	26.20	0.43	16.33	
	F ₅	2.49	1.46-3.53	31.58	29.55	87.60	1.41	56.97	9.21
	F ₆	2.67	1.83-3.13	32.06	30.06	87.90	1.32	58.05	7.22

Table Cont....

Character	Generation	Mean	Range	PCV	GCV	Heritability (%)	GA at 5%	GAM at 5%	% GG
Days to first harvest	F ₄	52.55	48.00-58.00	6.56	5.33	66.00	4.69	8.93	
	F ₅	52.38	48.66-55.66	4.61	3.73	65.40	3.25	6.21	-0.32
	F ₆	51.23	48.66-55.00	4.55	4.20	85.40	4.10	8.01	-2.19
Days to final harvest	F ₄	166.51	150.66-177.66	4.81	4.06	71.30	11.66	7.06	
	F ₅	163.97	158.00-172.66	3.37	2.69	63.40	7.24	4.41	-1.52
	F ₆	162.42	158.00-170.00	3.55	2.54	51.30	6.10	3.76	-0.94
Fruit length (cm)	F ₄	8.20	5.54-12.86	26.36	23.61	80.20	3.57	43.56	
	F ₅	10.17	8.27-13.86	14.39	13.07	82.50	2.52	24.45	24.02
	F ₆	10.30	8.27-11.11	11.30	9.89	76.70	1.81	17.84	1.27
Fruit girth (cm)	F ₄	15.61	9.56-19.93	17.82	11.76	43.60	2.44	16.00	
	F ₅	15.28	11.56-18.20	12.98	11.63	80.30	3.27	21.48	-2.11
	F ₆	14.61	13.33-19.30	11.15	10.30	85.40	3.06	19.61	-4.38
Fruit length to girth ratio	F ₄	0.72	0.56-0.88	19.51	5.65	8.40	0.02	3.37	
	F ₅	0.68	0.55-0.83	13.81	12.62	83.60	0.16	23.78	-5.55
	F ₆	0.65	0.55-0.74	11.20	9.30	68.90	6.10	15.90	-4.41
Fruit volume (cm ³)	F ₄	339.33	276.66-383.33	10.54	7.44	49.90	36.77	10.83	
	F ₅	346.66	306.66-400.00	8.91	6.72	56.90	36.20	10.44	2.16
	F ₆	351.90	330.00-400.00	8.51	6.56	59.60	36.74	10.44	1.51
Number of fruits per plant	F ₄	44.27	29.26-67.80	25.87	24.50	89.70	21.17	47.82	
	F ₅	55.60	33.23-68.66	18.27	17.69	93.70	19.62	35.29	25.59
	F ₆	59.58	44.00-68.66	15.36	14.99	95.40	17.97	30.17	7.15

Table Cont....

Character	Generation	Mean	Range	PCV	GCV	Heritability (%)	GA at 5%	GAM at 5%	% GG
Average fruit weight (g)	F ₄	58.57	37.33-97.50	27.69	27.01	95.20	31.80	54.29	
	F ₅	65.90	54.43-96.06	19.09	18.81	97.10	25.16	38.18	12.51
	F ₆	64.97	54.43-82.11	17.01	16.87	98.30	22.39	34.46	-1.41
Number of seeds per fruit	F ₄	358.85	296.00-440.00	14.16	13.85	95.70	98.61	27.92	
	F ₅	353.19	290.00-432.33	11.95	11.61	94.30	83.35	23.22	-1.39
	F ₆	320.23	251.33-360.00	12.56	6.76	29.00	24.04	7.50	-9.33
Seed weight per fruit (g)	F ₄	4.45	3.50-4.99	12.59	6.65	27.90	0.32	7.24	
	F ₅	4.44	4.00-5.20	8.77	8.19	87.20	0.70	15.77	-0.22
	F ₆	4.42	4.00-5.00	8.75	7.98	83.10	0.66	14.98	-0.45
Firmness of the fruit (Kg/cm ²)	F ₄	2.55	1.95-3.52	19.61	12.15	38.40	0.43	15.51	
	F ₅	2.72	1.79-3.23	19.27	18.85	95.70	0.97	38.00	6.66
	F ₆	2.77	1.79-3.76	20.18	19.74	95.70	1.08	39.77	1.83
Phenols (mg 100 g ⁻¹)	F ₄	4.64	3.90-6.97	11.10	2.58	5.40	0.05	1.23	
	F ₅	4.56	3.60-5.12	10.45	9.72	86.60	0.82	18.63	-1.72
	F ₆	4.25	3.88-4.22	10.35	9.49	84.10	0.82	17.94	-6.79
Yield per plant (Kg)	F ₄	2.55	1.32-3.86	32.11	29.36	83.60	1.41	55.30	
	F ₅	3.56	3.04-4.04	9.37	7.36	61.70	0.42	11.91	39.60
	F ₆	3.78	3.61-4.04	5.50	3.38	37.80	0.16	4.28	6.17



Conclusion

The pedigree of the cross (EC-169084 × Bhagyamati) recorded the per cent genetic gain from F₄ to F₅ and F₅ to F₆ generation; yield per plant (39.60 and 6.17), number of primary branches (5.46 and 3.23), plant spread N-S (26.29 and 1.90), plant spread E-W (25.34 and 2.79), number of fruits per inflorescence (9.21 and 7.22), fruit length (24.02 and 1.27), number of fruits per plant (25.59 and 7.15), fruit volume (2.16 and 1.51), average fruit weight (12.51 and 1.41), fruit firmness (6.66 and 1.83) respectively. Six promising plants were selected in F₆ generation as given below.

Salient features of six promising lines in F₆ for further evaluation in Preliminary yield trials

1. Oval purple fruits in cluster with light green foliage.
2. Oval glossy purple fruits in cluster with purplish green foliage, heavy yielder and tolerant to shoot and fruit borer, little leaf.
3. Oval glossy purple fruits with green calyx, dark green foliage, clustering habit, tolerant to little leaf.
4. Oblong to oval glossy purple fruits and tolerant to little leaf.
5. Round glossy purple fruits with green calyx and fruits borne in cluster.
6. Elongated oval glossy purple fruits with green calyx, Fruits are in cluster and tolerant to shoot and fruit borer and little leaf.

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