Vegetable Science (2015) 42 (2) : 25-29

# Genetic combining ability for yield and other economic traits in brinjal (*Solanum melongena* L.)

**V Prasad[1], V K Dwivedi[2], A A Deshpande[3] and B K Singh[4*]**

Received: May, 2014 / Accepted: August, 2015


## Abstract

An 8 × 8 half diallel set of crosses were made to identify promising genotypes and crosses and to suggest suitable breeding approaches for increasing simultaneous yield and consumers' preference traits in brinjal. The estimates of GCA effects indicated that the parents, namely Black beauty, Pusa Purple Long, Pusa Purple Round and Surati Ravaiya excelled for eleven, nine, nine and eight economic traits, respectively. Desirable SCA effects for yield of marketable fruits per plant were observed in eleven crosses (Pusa Purple Long × Black Beauty, Manjarigota × Surati Ravaiya, BB-44 × Surati Ravaiya, Green Long × Black Beauty, Black Beauty × Surati Ravaiya, Pusa Purple Long × Green Long, Gulabi Long × Pusa Purple Round, Gulabi Long × Black Beauty, Pusa Purple Long × Gulabi Long, Pusa Purple Long × Pusa Purple Round, Gulabi Long × Surati Ravaiya). However, six cross combinations (Black Beauty × Surati Ravaiya, Pusa Purple Long × Black Beauty, Gulabi Long × Surati Ravaiya, Pusa Purple Long × Green Long, BB-44 × Black Beauty and Pusa Purple Long × Gulabi Long) were found to be best for fruit yield. These crosses have at least one of the parents as good general combiner and could be exploited through heterosis breeding and hybridization followed by selection breeding approaches.


**Keywords:** GCA, SCA, diallel analysis, eggplant (*Solanum melongena* L.), quantitative traits.

Department of Genetics and Plant Breeding, C. C. S. University, Meerut, Uttar Pradesh

[1]Vegetable Research and Development, J. K. Agri Genetics Ltd., Sonepat, Haryana;

[2]J. V. College Barout, Bagpat, Uttar Pradesh;

[3]Vegetable Research and Development, J. K. Agri Genetics Ltd., Bangalore, Karnataka;

[4]ICAR-Indian Institute of Vegetable Research (IIVR), Shahanshahpur-221305, Varanasi, Uttar Pradesh; E-mail: bksinghkushinagar@yahoo.co.in.

## Introduction

Brinjal (*Solanum melongena* L.), known as eggplant, is a tropical vegetable, indigenous to India, grown over an area of 0.68 m ha in India, 0.73 m ha in China and 1.73 m ha in world along with respective productivity of 17.5 t/ ha, 33.5 t/ ha and 25.0 t/ ha (NHB 2011). In India, it is one of the most important and widely consumed vegetables with distinct preferences for their types and commercially cultivated in almost all states across the country (Prasad et al. 2010). This crop exhibits rich genetic diversity for various economic traits and has potential for improvement quantitatively and qualitatively. A number of brinjal hybrids and cultivars are under cultivation throughout India and globe, which differ for their yield potential, fruit quality (taste, seed to pulp ratio, shelf life, moisture content and blossom end scar size), and consumers' preference (colour, shape, size and shining of fruit, spineness and calyx colour). Now, fruit quality and consumers' preference are imparting a major role in determining its market demand and price.

Combining ability is a genetic tool to predict the potentiality of genotypes for its use in improvement activities of the crop. Keeping this in view, an experiment on combining ability was undertaken to determine relative magnitude of additive and non-additive effects for economic traits, which would be very useful while selecting superior parents and determining the breeding strategies for developing the potential, preferable and productive cultivars and hybrids. The general combining ability (GCA) refers to average performance of a line in a set of cross combinations, while specific combining ability (SCA) refers to cases in which certain cross combinations perform relatively better that would be expected on the basis of average performance of lines involved. Thus, the objectives of this study was to identify promising genotypes and crosses on the basis of GCA and SCA performance and to suggest suitable breeding approaches for increasing yield as well as traits of consumers' preference simultaneously.

## Materials and Methods

The experimental materials (Table 1) for the present study comprised of eight diverse parents, *viz* Pusa Purple Long, Green Long, BB-44, Gulabi Long, Manjarigota, Black Beauty, Pusa Purple Round and Surati Ravaiya; were transplanted and crossed in diallel fashion excluding reciprocals to get appropriate amounts of cross seeds. Subsequently, the seedlings of eight parents along with their 28 crosses were raised in nursery and transplanted in field following randomized block design (RBD) with three replications. Twenty-one plants in each replication were accommodated at the inter- and intra-row spacing of 90 and 60 cm, respectively.

The data were recorded for morphological and economic traits, namely plant height at first flowering (cm), plant height at last picking (cm), number of primary branches per plant, number of secondary branches per plant, days to 50 % flowering, days to first fruit picking, fruit setting flowers (%), non-setting flowers (%), volume of fruit (ml), moisture content in fruit (%), length of fruit (cm), breadth of fruit (cm), seed to pulp ratio (%), number of marketable fruits per plant, number of unmarketable fruits per plant, yield of marketable fruits per plant (kg), yield of unmarketable fruits per plant (kg), and average fruit weight (g). The data were analysed statistically for combining ability using the method 2 and model-I of Griffing (1956).

## Results and Discussion

The partitioning of mean squares into GCA and SCA (Table 2) revealed that mean squares due to parents were significant for all economic traits except number of primary branches per plant and moisture content in the fruit. Significant mean squares for lines indicate existence of additive variance. The mean squares due to SCA also showed significant difference for all the traits under study except plant height at first flowering stage, which indicates the prevalence of non-additive variance. The mean square due to GCA was higher than the SCA for all the characters other than number of primary branches, fruit setting flowers, non-setting flowers and moisture content in fruit. The finding was in corroboration for all the characters except marketable fruit yield per plant with Das and Barua (2001) and Quamruzzaman *et al.* (2006).

The estimates of variance components for various parameters (Table 3) indicated a lower ratio of $ó^2_{gca}/ó^2_{sca}$ for all the characters except fruit length, fruit breadth, and number of marketable fruits per plant. The characters such as plant height at first flowering, plant height at last picking, number of primary branches per plant, number of secondary branches per plant, days to 50 % flowering, fruit setting flowers, non-setting flowers, moisture content in fruit, seed to pulp ratio, number of unmarketable fruits per plant, yield of marketable fruits per plant, yield of unmarketable fruits plant and average fruit weight indicated predominance of non-additive gene action which can be exploited through heterosis breeding. Nevertheless, additive gene action predominated for fruit length and breadth that indicates the prospect of hybridization followed by

**Table 1:** Details of basic experimental materials

| Parent | Code (used hereafter) | Plant height | Leaf colour | Spine on calyx & plant | Calyx colour | Fruit colour | Fruit shape | Fruit weight (g) |
|---|---|---|---|---|---|---|---|---|
| Pusa Purple Long | P 1 | Short | Green | Few spine | Green | Purple | Long | 70 |
| Green Long | P 2 | Medium | Dark green | Non spiny | Green | Green | Oblong | 60 |
| BB-44 | P 3 | Short | Green | Non spiny | Green | Green + White | Oval | 45 |
| Gulabi Long | P 4 | Medium | Green purple | Non Spiny | Greenish purple | Pink | Long | 60 |
| Manjary Gota | P 5 | Short | Light green | Spiny | Green | Purple + White | Oval | 150 |
| Black Beauty | P 6 | Tall | Dark green | Non spiny | Green | Black | Oval | 160 |
| Pusa Purple Round | P 7 | Medium | Purple | Non spiny | Purplish green | Dark purple | Round | 120 |
| Surati Ravaiya | P 8 | Medium | Green | Non spiny | Green | Purple | oval | 130 |

**Table 2:** Analysis of variance of combining ability (8 × 8 half diallel) for 18 morphological traits in brinjal

| S.V. | d.f. | Mean square | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| GCA | 7 | 60.37** | 126.04** | 0.15 | 6.21* | 16.66** | 17.93** | 141.53** | 138.94** | 685.05** | 4.33 | 38.60** | 9.31** | 14.11** | 436.81** | 40.57** | 2.02** | 0.23** | 4270.47** |
| SCA | 28 | 29.37 | 60.47** | 0.27* | 5.41** | 9.43** | 2.94** | 151.98** | 159.90** | 99.73** | 5.36* | 1.53** | 0.21** | 4.89** | 35.49** | 20.75** | 0.39** | 0.11** | 672.13** |
| Error | 70 | 18.84 | 19.59 | 0.15 | 2.24 | 0.79 | 0.86 | 4.43 | 4.41 | 13.11 | 2.71 | 0.51 | 0.076 | 0.49 | 3.15 | 1.56 | 0.026 | 0.0080 | 19.82 |

S.V.: source of variation, d.f.: degree of freedom

*, **: significant at 5% and 1% level, respectively

1. Plant height at first flowering (cm) 2.Plant height at last picking (cm) 3. No. of primary branches/ plant 4. No. of secondary branches/ plant
5. Days to 50% flowering 6. Days to first fruit picking 7. Fruit setting flowers (%) 8. Non setting flowers (%)
9. Volume of fruits (ml) 10.Moisture content in fruit (%) 11. Length of fruit (cm) 12. Breadth of fruit (cm)
13. Seed to pulp ratio (%) 14. No. of marketable fruits/ plant 15. No. of unmarketable fruits/ plant 16. Yield of marketable fruits/ plant (kg)
17. Yield of unmarketable fruits/ plant (kg) 18. Average fruit weight (g)

**Table 3:** Estimates of variance components for eighteen characters in brinjal

| S. No. | Trait | $\sigma^2_{gca}$ | $\sigma^2_{sca}$ | $\sigma^2_{gca}/\sigma^2_{sca}$ | Predictability ratio | Predominant gene action |
|---|---|---|---|---|---|---|
| 1. | Plant height at first flowering (cm) | 4.15 | 10.53 | 0.39 | 0.28 | NA |
| 2. | Plant height at last picking (cm) | 10.65 | 40.88 | 0.26 | 0.21 | NA |
| 3. | No. of primary branches/ plant | 0.001 | 0.130 | 0.01 | 0.01 | NA |
| 4. | No. of secondary branches/ plant | 0.40 | 3.17 | 0.13 | 0.11 | NA |
| 5. | Days to 50% flowering | 1.59 | 8.64 | 0.18 | 0.16 | NA |
| 6. | Days to first fruit picking | 1.71 | 2.08 | 0.82 | 0.45 | A + NA |
| 7. | Fruit setting flowers (%) | 13.71 | 147.55 | 0.09 | 0.09 | NA |
| 8. | Non setting flowers (%) | 13.45 | 155.49 | 0.09 | 0.08 | NA |
| 9. | Volume of fruits (ml) | 67.19 | 86.62 | 0.78 | 0.44 | A + NA |
| 10. | Moisture content in fruit (%) | 0.16 | 2.65 | 0.06 | 0.06 | NA |
| 11. | Length of fruit (cm) | 3.81 | 1.02 | 3.73 | 0.79 | A |
| 12. | Breadth of fruit (cm) | 0.92 | 0.13 | 6.89 | 0.87 | A |
| 13. | Seed to pulp ratio (%) | 1.36 | 4.40 | 0.31 | 0.24 | NA |
| 14. | No. of marketable fruits/ plant | 43.37 | 32.34 | 1.34 | 0.57 | A + NA |
| 15. | No. of unmarketable fruits/ plant | 3.90 | 19.19 | 0.20 | 0.17 | NA |
| 16. | Yield of marketable fruits/ plant (kg) | 0.20 | 0.36 | 0.55 | 0.35 | NA |
| 17. | Yield of unmarketable fruits/ plant (kg) | 0.02 | 0.10 | 0.22 | 0.18 | NA |
| 18. | Average fruit weight (g) | 425.07 | 652.31 | 0.65 | 0.39 | NA |

$\sigma^2_{gca}$: variance general combining ability; $\sigma^2_{sca}$: variance specific combining ability
NA: non-additive gene action; A: additive gene action

selection for fruit size. Days to first fruit picking, volume of fruit and number of marketable fruits per plant showed predominance of both additive and non-additive gene action simultaneously, which that can be improved by reciprocal recurrent selection. The importance of both additive as well as non-additive components for fruits per plant, branches per plant, days to flowering, plant height and yield per plant in brinjal have also reported by Das and Barua (2001), Singh *et al.* (2003), Prasad *et al.* (2010) and Prasad *et al.* (2013).

The GCA effects of parents (Table 4 and Table 6) revealed that none of parent possessed outstanding performance in desired direction for all the traits. This suggests the need of multiple crossing in suitable mating system for substantial improvement in the yield and quality parameters. However, a variety Black Beauty (P 6) showed the best general combiners for 11 traits such as yield of marketable fruits per plant, plant height at last picking, number of primary branches per plant, fruit setting flowers, non-setting flowers, volume of fruits, moisture content, breadth of fruit, seed to pulp ratio, number of unmarketable fruits per plant and average fruit weight. This result is in agreement with finding of Biradar *et al.* (2005). The cultivars Pusa Purple Long (P 1) and Pusa Purple Round (P 7) were the next best combiners for nine traits, *viz.* yield of marketable fruits per plant, plant height at first flowering, number of primary branches per plant, days to 50 % flowering, days to first fruit picking, volume of fruit, breadth of fruit, number of unmarketable fruits per plant and average weight of the fruit in desired direction. Sao and Mehta (2010) have also reported Pusa Purple Long as good combiner. However, with respect to commercial point of view, Surati Ravaiya (P 8) was the second best general combiner for eight characters, namely yield of marketable fruits per plant, number of secondary branches per plant, volume of fruit, breadth of fruit, seed to pulp ratio, number of marketable fruits per plant, number of unmarketable fruits per plant and average weight of the fruit. The high GCA effects were observed primarily due to additive and additive × additive gene effects which could be exploited through hybridization followed by selection.

In the present investigation, the desirable SCA effects (Table 5 and Table 6) for yield of marketable fruits per plant were observed in 11 crosses (P 1 × P 6, P 5 × P 8,

**Table 4:** Estimates for general combining ability (GCA) effects for 18 morphological traits in brinjal

| Parent | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P 1 | 20.26** | -0.27 | 0.00 | 0.93** | -2.29** | -2.80** | -1.31** | 1.23** | -6.64** | 1.01** | 3.93** | -1.13** | -0.93** | 13.92** | 4.00** | 0.27** | -0.07** | -14.19** |
| P 2 | -4.60 | 0.90 | 0.15** | 0.33 | 0.88** | 0.23** | 1.73** | -1.81** | -2.87* | 0.18 | 0.54** | -0.66** | 0.02* | 0.00 | 1.00** | -0.17** | 0.03** | -10.82** |
| P 3 | -5.27 | -3.80* | -0.20** | -0.22 | -1.05** | -0.53** | 2.63** | -2.71** | -10.27** | 0.04 | -1.60** | -0.59** | 1.51** | -3.02** | 0.23 | -0.60** | -0.03** | -30.12** |
| P 4 | -5.74 | 1.54 | 0.00 | -1.23** | -0.21** | 0.43** | 1.99** | -2.07** | -8.61** | -0.52* | 1.46** | -0.96** | 0.46** | 2.17** | -1.53** | -0.29** | -0.22** | -15.09** |
| P 5 | -10.47* | -3.45* | -0.15** | -0.45** | 0.95** | 1.43** | 0.06 | -0.14 | 7.49** | -0.92** | -1.58** | 0.47** | 0.87** | -7.24** | -2.52** | -0.48** | -0.12** | 10.08** |
| P 6 | -6.40 | 7.38** | 0.13** | -0.13 | 0.59** | 1.33** | 4.12** | -3.87** | 12.03** | -0.66** | -0.19 | 1.57** | -2.28** | -6.13** | -1.48** | 0.21** | 0.13** | 31.74** |
| P 7 | 17.66** | -0.05 | 0.06** | -0.42* | -0.22** | -0.47** | -1.14** | 1.39** | 6.46** | 0.34 | -1.89** | 0.77** | 0.68** | -1.58** | -0.29* | 0.42** | 0.01** | 10.84** |
| P 8 | -5.77 | -2.67 | -0.03** | 1.18** | 1.35** | 0.37** | -8.08** | 7.99** | 2.39* | 0.54* | -067** | 0.52** | -0.34** | 2.15** | 0.58** | 0.64** | 0.27** | 17.58** |
| S.E. | 5.06 | 1.71 | 0.013 | 0.20 | 0.064 | 0.074 | 0.39 | 0.39 | 1.15 | 0.24 | 0.027 | 0.0067 | 0.043 | 0.28 | 0.14 | 0.0022 | 0.00069 | 1.73 |

*, **: significant at 5% and 1% level, respectively

**Table 5:** Estimates for specific combining ability (SCA) effects for 18 morphological traits in brinjal

| Cross | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P 1 × P 2 | -14.89 | 6.78 | -0.23 | 2.81 | -1.25 | -0.40 | 14.13** | -14.06** | -10.27 | 0.22 | 0.78* | -0.11 | -3.08** | 8.76* | 1.89 | 0.45** | 0.08** | -14.23 |
| P 1 × P 3 | -21.55 | 12.73 | 0.12 | -4.64 | 0.02 | -0.30 | 7.23 | -7.16 | 5.43 | 0.31 | 0.92* | 0.32** | 2.11** | 0.78 | 4.95** | -0.15** | 0.15** | -0.60 |
| P 1 × P 4 | -21.75 | 4.97 | -0.08 | 0.04 | -0.49 | -0.60 | 10.53 | -10.46 | 12.13 | -0.36 | -0.82* | -0.14 | -1.61** | 1.59 | 3.56 | 0.16** | 0.16** | -8.97 |
| P 1 × P 5 | -19.02 | 2.12 | 0.41* | 0.59 | -1.65 | -2.26* | 0.80 | -0.72 | 1.03 | 0.89 | 0.40 | -0.27** | 0.51 | 2.67 | 2.42 | -0.28** | 0.12** | -0.80 |
| P 1 × P 6 | -22.42 | -3.88 | 0.13 | 1.94 | -0.96 | -2.16* | -7.60 | 7.34 | -3.17 | 1.12 | -1.66** | -0.84** | 0.00 | 11.89** | 5.80** | 0.93** | 0.35** | 9.20 |
| P 1 × P 7 | 21.51 | 1.23 | 0.17 | -2.44 | 1.52 | 1.64** | -16.67** | 16.41** | -1.27 | -0.60 | -1.80** | 0.16 | 3.06** | -1.06 | 4.91** | 0.11* | 0.14** | 11.77 |
| P 1 × P 8 | -18.39 | 1.84 | -0.38* | -0.04 | -2.38* | 0.14 | -16.07** | 16.14** | 12.46 | 0.00 | -1.92** | 0.71** | -0.07 | 0.95 | -4.43* | -0.60** | -0.30** | 23.37 |
| P 2 × P 3 | -5.02 | -9.39 | -0.88* | 0.41 | -1.41 | 0.90 | 5.43 | -5.36 | -1.70 | -3.38 | 0.01 | 0.57** | 0.17 | -4.98 | -7.96** | 0.04 | -0.58** | -11.60 |
| P 2 × P 4 | 8.65 | 2.39 | 0.47** | -0.04 | -2.15* | -1.33 | 6.20 | -6.12 | 8.00 | -0.11 | 0.65 | 0.45** | -1.02 | -2.62 | -4.05* | -0.18** | -0.26** | -3.63 |
| P 2 × P 5 | 7.78 | -1.70 | -0.23 | -1.69 | -1.66 | -0.96* | 3.50 | -3.42 | 9.03 | 0.36 | -0.52 | -0.11 | 3.40** | 0.19 | 3.22 | -0.23** | 0.04** | 12.67 |
| P 2 × P 6 | 11.51 | 9.96 | 0.76** | -0.81 | -2.15* | -0.30 | -19.57** | 19.64** | 5.60 | 2.37 | -0.64 | -0.23** | 1.66** | 3.93 | 2.11 | 0.67** | 0.10** | 20.83 |
| P 2 × P 7 | 9.78 | 8.29 | 0.65** | -1.13 | -1.12 | -0.53 | -9.30 | 9.04 | 1.06 | 2.06 | -0.10 | -0.73** | -2.04** | 1.81 | 9.87** | -0.13* | 0.74** | 2.50 |
| P 2 × P 8 | -21.95 | -4.27 | -0.48** | 1.49 | -1.65 | -0.06 | 9.30 | -9.56 | 0.96 | 0.74 | 0.60 | -0.31** | 0.78 | 4.20 | 2.21 | -0.43** | 0.16** | 45.07 |
| P 3 × P 4 | 9.15 | -2.66 | 0.81** | -1.44 | 12.79** | 1.77 | -15.10** | 15.18** | -10.97 | 1.11 | -0.79* | -0.09 | -0.04 | -6.33 | 0.67 | -0.22** | 0.31** | -40.00 |
| P 3 × P 5 | -1.52 | -12.82 | -0.01 | 0.34 | 0.79 | 0.10 | 8.96 | -8.89 | -15.97 | -3.08 | -0.21 | -0.29** | 3.62** | -2.13 | -0.26 | -0.06* | -0.04** | 10.33 |
| P 3 × P 6 | 8.11 | -1.58 | 0.29 | 2.69 | 1.94* | 1.80 | -19.40** | 19.48** | 7.73 | 1.90 | -0.28 | 0.35** | 2.15** | 3.95 | 2.06 | -0.13** | 0.12** | 6.97s |
| P 3 × P 7 | 4.51 | 2.57 | -0.23 | 1.41 | -0.55 | 0.14 | -1.80 | 1.88 | 0.96 | 2.71 | -0.23 | -0.01 | -1.57** | 1.27 | -0.96 | -0.03 | -0.12** | 0.13 |
| P 3 × P 8 | 8.78 | 3.24 | -0.50** | 0.42 | -0.19 | -1.10 | -22.20** | 21.94** | 2.43 | 2.26 | -0.12 | -0.24** | -1.91** | 4.50 | 0.69 | 0.84** | 0.00 | -19.87 |
| P 4 × P 5 | -19.95 | -0.66 | 0.21 | 1.21 | 1.29 | 1.70 | -2.94 | 2.68 | 11.00 | 1.23 | 0.90* | -0.62** | -4.09** | -3.68 | -2.90 | -0.53** | -0.04** | 13.70 |
| P 4 × P 6 | 14.48 | 6.96 | -0.34 | -1.73 | -1.95* | -1.13 | 15.00** | -14.92** | -3.60 | -2.14 | -1.42* | 0.33** | -2.91** | 0.06 | 0.71 | 0.30** | 0.24** | -17.37 |
| P 4 × P 7 | 5.58 | -6.97 | -0.74** | -2.63 | -1.90* | -2.16* | 0.23 | -0.16 | 10.76 | -1.47 | 0.65 | -0.01 | 0.67 | 3.48 | 0.55 | 0.32** | 0.31** | -13.07 |
| P 4 × P 8 | 5.31 | 7.82 | 0.41* | -0.08 | 0.61 | -0.16 | 12.83* | -12.76* | -12.00 | 0.23 | -2.13** | 0.23** | -0.56 | -1.11 | -1.42 | 0.07* | 0.06** | -28.23 |
| P 5 × P 6 | 12.58 | 9.98 | -0.03 | 0.94 | 1.07 | 0.27 | 0.10 | -0.36 | -13.20 | 2.16 | 1.64** | -0.07 | -1.30* | -9.36* | -6.93** | -0.51** | -0.49** | -14.90 |
| P 5 × P 7 | -17.82 | 3.42 | 0.34 | -1.11 | 2.11* | 1.74 | -8.64 | 8.38 | -18.30 | -0.73 | -0.66 | -0.28** | -0.23 | -5.83 | -2.69 | -0.87** | -0.43** | 21.00 |
| P 5 × P 8 | -5.39 | -8.96 | 0.79** | 4.46 | 0.21 | 2.24* | 0.63 | -0.56 | -6.90 | -0.62 | 1.45** | 0.04 | -3.19** | 3.60 | 1.10 | 0.86** | -0.07** | 37.60 |
| P 6 × P 7 | 3.38 | -16.53 | 0.39* | -1.69 | 0.12 | -0.16 | 14.10** | -14.02** | -0.10 | -0.03 | -0.12 | 0.04 | -2.08** | -3.26 | -3.54 | -0.59** | -0.19** | 21.60 |
| P 6 × P 8 | 6.31 | 0.15 | -0.88** | -0.84 | 0.81 | -0.40 | -3.64 | 3.38 | -2.97 | -8.64** | 2.02** | 0.57** | 0.62 | -2.91 | -0.81 | 0.47** | -0.26** | 9.93 |
| P 7 × P 8 | -15.42 | 4.24 | -0.51** | 1.77 | -0.05 | -0.60 | -10.37 | 10.11 | 3.93 | 1.17 | 0.72 | 0.03 | 0.90 | -1.82 | 1.87 | -0.02 | 0.12** | -19.17 |
| S.E. | 20.45 | 23.52 | 0.18 | 4.03 | 0.95 | 1.03 | 5.31 | 5.30 | 15.72 | 3.25 | 0.38 | 0.092 | 0.58 | 3.78 | 1.88 | 0.031 | 0.0096 | 23.78 |

*, **: significant at 5% and 1% level, respectively

P 3 × P 8, P 2 × P 6, P 6 × P 8, P 1 × P 2, P 4 × P 7, P 4 × P 6, P 1 × P 4, P 1 × P 7 and P 4 × P 8); two crosses (P 1 × P 6 and P 1 × P 2) for number of marketable fruits per plant; eight crosses (P 1 × P 8, P 2 × P 3, P 6 × P 8, P 2 × P 4, P 3 × P 6, P 4 × P 6, P 1 × P 3 and P 4 × P 8) for fruit breadth; six crosses (P 6 × P 8, P 5 × P 6, P 5 × P 8, P 1 × P 3, P 4 × P 5 and P 1 × P 2) for length of fruit; three crosses (P 1 × P 5, P 1 × P 6 and P 4 × P 7) for days to first fruit picking; four crosses (P 4 × P 6, P 1 × P 2, P 6 × P 7 and P 4 × P 8) for fruit setting flowers and non-setting flowers; and five crosses (P 1 × P 8, P 2 × P 4, P 2 × P 6, P 4 × P 6 and P 4 × P 7) for days to 50 % flowering.

Among quality traits, desirable SCA effects were found for moisture content in one cross (P 6 x P 8) and seed to pulp rationin ten crosses (P 4 × P 5, P 5 × P 8, P 1 × P 2, P 4 × P 6, P 6 × P 7, P 2 × P 7, P 3 × P 8, P 1 × P 4, P 3 × P 7 and P 5 × P 6). The SCA effects represent dominant and epistatic effects, and can be used as an index to determine the usefulness of a particular cross combination in the expression of heterosis. None of the cross combinations was found to be significant for plant height at first flowering, plant height at last picking, number of secondary branches per plant, volume of

**Table 6:** Best performing parents and crosses based on GCA and SCA effects with respect to each trait in desirable direction

| S. No. | Trait | Desired direction | Parent | Cross |
|---|---|---|---|---|
| 1. | Plant height at first flowering (cm) | Positive | P 1, P 7 | - |
| 2. | Plant height at last picking (cm) | Positive | P 6 | - |
| 3. | No. of primary branches/ plant | Positive | P 2, P 6, P 7 | P 3 × P 4, P 5 × P 8, P 2 × P 6, P 2 × P 7, P 2 × P 4, P 1 × P 5, P 4 × P 8, P 6 × P 7 |
| 4. | No. of secondary branches/ plant | Positive | P 8, P 1 | - |
| 5. | Days to 50% flowering | Negative | P 1, P 3, P 7, P 4 | P 1 × P 8, P 2 × P 4, P 2 × P 6, P 4 × P 6, P 4 × P 7, |
| 6. | Days to first fruit picking | Negative | P 1, P 3, P 7 | P 1 × P 5, P 1 × P 6, P 4 × P 7 |
| 7. | Fruit setting flowers (%) | Positive | P 6, P 3, P 4, P 2 | P 4 × P 6, P 1 × P 2, P 6 × P 7, P 4 × P 8 |
| 8. | Non setting flowers (%) | Negative | P 6, P 3, P 4, P 1 | P 4 × P 6, P 1 × P 2, P 6 × P 7, P 4 × P 8 |
| 9. | Volume of fruits (ml) | Positive | P 6, P 5, P 7, P 8 | - |
| 10. | Moisture content in fruit (%) | Negative | P 5, P 6, P 4 | P 6 × P 8 |
| 11. | Length of fruit (cm) | Positive | P 1, P 4, P 2 | P 6 × P 8, P 5 × P 6, P 5 × P 8, P 1 × P 3, P 4 × P 5, P 1 × P 2 |
| 12. | Breadth of fruit (cm) | Positive | P 6, P 7, P 8, P 5 | P 1 × P 8, P 2 × P 3, P 6 × P 8, P 2 × P 4, P 3 × P 6, P 4 × P 6, P 1 × P 3, P 4 × P 8 |
| 13. | Seed to pulp ratio (%) | Negative | P 6, P 1, P 8 | P 4 × P 5, P 5 × P 8, P 1 × P 2, P 4 × P 6, P 6 × P 7, P 2 × P 7, P 3 × P 8, P 1 × P 4, P 3 × P 7, P 5 × P 6 |
| 14. | No. of marketable fruits/ plant | Positive | P 1, P 4, P 8 | P 1 × P 6, P 1 × P 2 |
| 15. | No. of unmarketable fruits/ plant | Negative | P 5, P 6, P 8, P 7 | P 2 × P 3, P 5 × P 6, P 1 × P 8, P 2 × P 4 |
| 16. | Yield of marketable fruits/ plant (kg) | Positive | P 8, P 7, P 1, P 6 | P 1 × P 6, P 5 × P 8, P 3 × P 8, P 2 × P 6, P 6 × P 8, P 1 × P 2, P 4 × P 7, P 4 × P 6, P 1 × P 4, P 1 × P 7, P 4 × P 8 |
| 17. | Yield of unmarketable fruits/ plant (kg) | Negative | P 4, P 5, P 1, P 3 | P 2 × P 3, P 5 × P 6, P 5 × P 7, P 1 × P 8, P 2 × P 4, P 6 × P 8, P 6 × P 7, P 3 × P 7, P 5 × P 8, P 4 × P 5, P 3 × P 5 |
| 18. | Average fruit weight (g) | Positive | P 6, P 8, P 7, P 5 | - |

**Table 7:** Best cross combination on the basis of high *per se* performance (mean), GCA effects and SCA effects for yield of marketable fruits per plant

| S. No. | Cross | Cross and parent value | | | | | GCA effect | | | SCA effect |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Cross | Female | Male | Mid parent | *Per se* performance | Female | Male | GCA combination | |
| 1. | P 6 × P 8 | 4.90 | 1.90 | 3.10 | 2.50 | P × G | 0.21** | 0.64** | G × G | 0.47** |
| 2. | P 1 × P 6 | 4.30 | 3.10 | 1.90 | 2.50 | G × P | 0.27** | 0.21** | G × G | 0.93** |
| 3. | P 4 × P 8 | 4.10 | 2.60 | 3.10 | 2.85 | G × G | -0.29** | 0.64** | P × G | 0.07* |
| 4. | P 1 × P 2 | 3.42 | 3.10 | 2.50 | 2.80 | G × G | 0.27** | -0.17** | G × P | 0.45** |
| 5. | P 3 × P 6 | 3.33 | 2.50 | 1.90 | 2.20 | G × P | -0.60** | 0.21** | P × G | -0.13** |
| 6. | P 1 × P 4 | 3.03 | 3.12 | 2.63 | 2.87 | G × G | 0.27** | 0.29** | G × G | 0.16** |

*, **: significant at 5% and 1% level, respectively, G: good, P: poor

fruit and average fruit weight but few parents were possessed with high GCA effects. This is possible only in the absence of any allelic interactions. Thus, it is evident that two parents with high GCA effects for a trait may not always result in a combination showing high SCA effects and these traits can't be improved through heterosis breeding. The cross P 2 × P 6 (Poor × Poor general combiner) had significant positive SCA effects for days to 50 % flowering in desirable direction. It might be due to presence of high magnitude of non-additive especially complementary epistatic effects which could be utilised for commercial exploitation of heterosis. The crosses P 4 × P 8 and P 1 × P 2 for yield of marketable fruits per plant and P 6 × P 8 for moisture content had significant SCA effects resulted from one good and one poor general combiner. Heterosis breeding and recurrent selection may be utilized for exploitation of both additive as well as non-additive gene effects.

Six best cross combinations (P 1 × P 6, P 4 × P 8, P 1 × P 4, P 1 × P 2, P 6 × P 8 and P 3 × P 6) for yield of marketable fruits per plant along with their parental values, GCA estimates and SCA estimates in Table 7 revealed that majority of cross combinations exhibiting higher fruit yield had at least one of the parents as good general combiner. The similar findings have also been reported by Randhawa *et al.* (1991), Aswani and Khandelwal (2005), and Suneetha *et al.* (2008). This study further emphasizes the significance of assessing the genetic combining ability for economic traits, identifying superior parents and appropriate breeding techniques for developing the potential cultivars and hybrids.


## सारांश

बैंगन में उत्कष्ट प्रभेदों तथा संकरणों को प्राप्त करने तथा उपयुक्त प्रजनन विधि से उपज तथा उपभोक्ता की रूचि बनाने के लिए 8 ग 8 अर्द्ध डाय एलिल समूह में संकरण कराया गया। सामान्य संयोजन क्षमता का आंकलन प्रभाव से संकेत मिलता है कि पितृ मुख्यतः ब्लैक ब्यूटी, पूसा पर्पल लांग, पूसा पर्पल राउण्ड तथा सुराती रावैया क्रमशः 11, 9, 9 तथा 8 आर्थिक गुणों के लिए उत्तम पाये गये। वांछित विशिष्ट संयोजन क्षमता बाजार योग्य फलों की संख्या/पौध व उपज 11 संकरण मेल (पूसा पर्पल लांग ग ब्लैक ब्यूटी, मंजरीगोटा ग सुराती रावैया, पूसा पर्पल लांग ग ग्रीन लांग, गुलाबी लांग ग सुराती रावैया, पूसा पर्पल लांग ग ग्रीन लांग, बी.बी.–44 ग ब्लैक ब्यूटी एवं पूसा पर्पल लांग ग गुलाबी लांग उपज के लिए उत्तम पाये गये। 27 संकरणों में कम से कम एक पितृ में सामान्य संयोजन क्षमता अधिक है जिसका संकरण कर अधिक संकर ओज प्राप्त किया जा सकता है और इसके बाद चयन प्रजनन तरीके को अपनाना चाहिए।


## References


Aswani RC, Khandelwal RC (2005) Combining ability studies in brinjal. Indian Journal of Horticulture 62: 37-40.

Biradar AB, Dumber AD Navale PA (2005) Combining ability studies in brinjal (*Solanum melongena* L.). Journal of Maharashtra Agriculture University 30: 342-345.

Das G and Barua NS (2001) Heterosis and combining ability for yield and its components in brinjal. Annals of Agricultural Research 22: 399-403.

Griffing B (1956) The concept of general and specific combining ability in relation to diallel crossing system. Australian Journal of Biological Science 9: 463-493.

NHB (2011) Indian Horticulture Database 2011. National Horticulture Board, Gurgaon, Haryana.

Prasad V, Dwivedi VK, Deshpande AA, Singh BK (2010) Gene action of economic traits in brinjal (*Solanum melongena* L.). Vegetable Science 37 (1): 97-99.

Prasad V, Dwivedi VK, Deshpande AA, Singh BK (2013) Heterosis for yield and other yield contributing economic traits in eggplant (*Solanum melongena* L.). In: Proceedings of the XV EUCARPIA meeting on genetics and breeding of capsicum and eggplant, 2-4 September 2013, Torino, Italy, pp 697-700.

Quamruzzaman AKM, Uddin MN, Rahman MM, Salam MA, Jamil MK (2006) Genetics architecture of yield in eggplant (*Solanum melongena* L.). Pakistan Journal of Science and Industrial Research 49: 134-139.

Randhawa JS, Kumar JC and Chadha ML (1991). Line x Tester analysis for the study of some economic characters in brinjal. Research Journal of Punjab Agriculture University 28: 192-198.

Sao A, Mehta N (2010) Heterosis in relation to combining ability for yield and quality attributes in Brinjal (*Solanum melongena* L.). Electronic Journal of Plant Breeding 1: 783-788.

Singh HV, Singh SP, Singh S, Rajput CBS (2003) Heterosis in relation to combining ability in brinjal (*Solanum melongena* L.). Vegetable Science 30: 38-41.