*Plant Archives* Vol. 18 No. 1, 2018 pp. 770-774 ***ISSN 0972-5210***

# COMBINING ABILITY ANALYSIS FOR FRUIT YIELD AND ITS CONTRIBUTING TRAITS IN BRINJAL (*SOLANUM MELONGENA* L.)

**V. Chaitanya[1]*, K. Ravinder Reddy[1] and R. V. S. K. Reddy[2]**

[1]College of Horticulture, Rajendranagar, Hyderabad – 500 030 (A.P.), India.
[2]Dr. Y.S.R.H.U., Venkatramannagudem, Tadepallygudem, West Godavari (A.P.), India.

## Abstract

A 7×7 diallel set of crosses was attempted to study the extent of heterosis in brinjal for yield and its component characters. Estimates of *gca* effects indicated that parents $P_7$ followed by $P_2$, $P_1$ and $P_4$ were good general combiners as they showed desirable *gca* effects for many characters including marketable yield per plant. The cross combination $C_3$ ($P_1 \times P_4$) have recorded significantly high *sca* effects for days to 50% flowering, number of marketable fruits per plant, marketable yield per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits, $C_{11}$ ($P_2 \times P_7$) for fruit length, average fruit weight, number of marketable fruits per plant, marketable fruit yield per plant, ascorbic acid content, $C_{13}$ ($P_3 \times P_5$) for average fruit weight, number of marketable fruits per plant, marketable yield per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits, $C_{16}$ ($P_4 \times P_5$) for fruit length, average fruit weight, number of marketable fruits per plant and marketable fruit yield per plant and $C_{21}$ ($P_6 \times P_7$) for fruit width, number of marketable fruits per plant, marketable fruit yield per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits indicating the importance of both additive and non-additive effects for these characters. This suggests that the crosses having high *sca* effects and also involved at least one good general combiner parent may be considered useful because such crosses provide transgressive type of segregants in the advanced generation more frequently than crosses with the poor combiner parents.

***Key words :*** Brinjal, diallel crosses, combining ability.

## Introduction

Brinjal (*Solanum melongena* L.) is one of the major and principle vegetable crops widely grown in both temperate and tropical regions of the globe. In Telangana state only few cultivars of brinjal are available for commercial cultivation, which are either poor yielders or susceptible to various biotic and abiotic stresses. In the face of increasing population, there is a need for increasing its production and productivity levels. Its diversification, off-season production, availability of diverse types and development of potential hybrids has resulted in change of local preferences. In view of changing local preference for colour, shape, taste *etc*., it is not possible to have one common cultivar to suit different localities of a region and local preferences. It is therefore, necessary to improve the locally preferred cultivars or develop new hybrid combinations for high yield, quality, consumer acceptability and meet diverse taste of locals. This necessitates the development of varieties/ hybrids superior in yield and quality. However, due to continued selection, much of the variability has exhausted. In order to create variability and identify the desirable segregants, emphasis needs to be laid on hybridization between the parents. Before any such improvement programme is initiated through hybridization, there is a need to have knowledge on combining ability of different genotypes and the nature and magnitude of various genetic parameters operative in different characters. Several biometrical procedures are available for evaluation of parents and their crosses for their general and specific combining ability and to know the nature and magnitude of gene effects for expression of various metric traits. Half- diallel analysis as suggested (Griffing, 1956) helps to generate basic information on nature of inheritance of traits and to assess the combining ability of parents. The information generated on general and specific combining ability can be effectively

****Author for correspondence :*** E-mail: chaitanya.hortico@gmail.com

used to identify superior varieties to be used as parents for hybridization and also indicate cross combinations likely to yield desirable segregates.

## Materials and Methods

The present investigation was conducted during *kharif* season, 2012-13 at Vegetable Research Station, S.K.L.T.S. Horticulture University, Hyderabad. The experimental material comprised of seven elite homozygous lines of purple brinjal namely, IC-281104, IC-02162, IC-127024, IC-090084-2, IC-090084-4, IC-090783-3 and IC-23771 obtained from germplasm collections maintained at the Vegetable Research Station, SKLTS Horticulture University, Hyderabad and their 21 hybrids derived from the 7×7 diallel mating (excluding reciprocals) of these lines. The seeds were sown in the nursery during the last week of June and the seedlings were transplanted on first week of August, 2013 in a randomized block design at 50×50 cm spacing with two replications. Standard cultural practices were followed to raise the normal crop. The data were recorded on five randomly selected plants in each treatments over replications for nine characters *viz.,* days to fifty percent flowering, fruit length (cm), fruit width (cm), average fruit weight (g), number of marketable fruits per plant, marketable yield per plant (g), ascorbic acid content (mg/100g), fruit and shoot borer infestation on shoots (%) and fruit and shoot borer infestation on fruits (%). The estimates of general and specific combining ability effects were calculated according to diallel analysis, Method 2 of Model1 suggested by Griffing (1956).

## Results and Discussion

The analysis of variance for combining ability was presented in table 1. It appears that in *kharif*, the mean sum of squares due to parents and hybrids were highly significant for all the characters. The mean sum of squares due to parents *vs* hybrids were highly significant for majority of the characters except days to 50% flowering, fruit width, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits. The mean sum of squares due to *GCA* and *SCA* variances were highly significant for all the characters studied.

The estimates of general combing ability (*gca*) effects of the parents for various characters are presented in the table 2. The parents $P_1$ (IC-281104) for number of marketable fruits per plant, ascorbic acid content, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits, $P_2$ (IC-021621) for fruit width, average fruit weight, marketable yield per plant, $P_4$ (IC-090084-2) for days to 50% flowering, fruit length, number of marketable fruits per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits, $P_6$ (IC-090783-3) was a good general combiner for days to 50% flowering, fruit and shoot borer infestation on shoots and $P_7$ (IC-23771) for fruit length, fruit width, average fruit weight, marketable yield per plant, ascorbic acid content, are found to have high magnitude of significant *gca* effects in desirable direction for the respective traits. Hence, these can be recommended for use in breeding programmes to develop prolific varieties of brinjal. The results obtained suggested that selection of parents to be included in hybridization programme could also be judged on *per se* performance, besides, *gca* effects. Similar kind of associations between these two parameters was also observed by Suneetha *et al*. (2008), Sao and Mehta (2010), Nalini *et al.* (2011), Sane *et al.* (2011) and Thangavel (2011).

The estimates of specific combining ability (*sca*) effects of 21 crosses with their corresponding standard errors for each character are presented in Table 3. Specific combining ability helps in the identification of superior cross combinations for commercial exploitation of heterosis. In the present investigation, the cross $C_2$ ($P_1$× $P_3$) for number of marketable fruits per plant, marketable yield per plant and ascorbic acid content, $C_3$ ($P_1$× $P_4$) for days to 50% flowering, number of marketable fruits per plant, marketable yield per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits, $C_4$ ($P_1$× $P_5$) for days to 50% flowering and ascorbic acid content, $C_5$ ($P_1$× $P_6$) for number of marketable fruits per plant and marketable fruit yield per plant, $C_6$ ($P_1$× $P_7$) for ascorbic acid content, $C_{10}$ ($P_2$× $P_6$) for ascorbic acid content and fruit and shoot borer infestation on shoots, $C_{11}$ ($P_2$× $P_7$) for fruit length, average fruit weight, number of marketable fruits per plant, marketable yield per plant and ascorbic acid content, $C_{13}$ ($P_3$× $P_5$) for average fruit weight, number of marketable fruits per plant, marketable yield per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits.

$C_{16}$ ($P_4$× $P_5$) for fruit length, average fruit weight, number of marketable fruits per plant and marketable yield per plant, $C_17$ ($P_4$× $P_6$) and $C_{18}$ ($P_4$× $P_7$) for ascorbic acid content, $C_{19}$ ($P_5$× $P_6$) for fruit length and fruit and shoot borer infestation on fruits, $C_{20}$ ($P_5$× $P_7$) for days to 50% flowering, fruit length, number of marketable fruits per plant and ascorbic acid content and $C_{21}$ ($P_6$× $P_7$) for fruit width, number of marketable fruits per plant, marketable yield per plant, fruit and shoot borer infestation on shoots and fruit and shoot borer infestation on fruits were the best specific combiners. These superior specific

**Table 1 :** Analysis of variance for combining ability in *kharif* season of brinjal.

| Source of variation | d.f. | Days to 50% flowering | Fruit length (cm) | Fruit width (cm) | Avg. fruit weight (g) | Number of marketable fruits/plant | Marketable yield per plant (g) | Ascorbic acid content (mg/100g) | Fruit and shoot borer infestation on shoots (%) (ASN) | Fruit and shoot borer infestation on fruits (%) (ASN) |
|---|---|---|---|---|---|---|---|---|---|---|
| Replicates | 2.00 | 3.46 | 0.13 | 0.14 | 6.65 | 1.82 | 3957.07 | 0.01 | 0.41 | 1.34 |
| Treatments | 27.00 | 20.14** | 2.40** | 0.76** | 85.60** | 34.84** | 150877.30** | 9.25** | 4.16** | 18.02** |
| Parents | 6.00 | 32.82** | 2.91** | 1.46** | 174.96** | 46.34** | 62512.57** | 2.08** | 3.68** | 13.63* |
| Hybrids | 20.00 | 16.29** | 2.27** | 0.57** | 60.23** | 27.03** | 145031.38** | 10.48** | 4.43** | 19.78** |
| Parents *vs* Hybrids | 1.00 | 21.22 | 1.91* | 0.35 | 57.04* | 121.88** | 797984.00** | 27.62** | 1.69 | 9.29 |
| Error | 54.00 | 6.40 | 0.30 | 0.12 | 9.13 | 2.44 | 8706.03 | 0.10 | 0.88 | 5.31 |
| Total | 83.00 | 10.80 | 0.98 | 0.33 | 33.94 | 12.96 | 54840.08 | 3.07 | 1.93 | 9.35 |
| GCA | 6.00 | 10.57** | 2.40** | 0.93** | 95.23** | 14.22** | 27509.06** | 0.51** | 1.26** | 5.11** |
| SCA | 21.00 | 5.61** | 0.34** | 0.06 | 9.48** | 10.87** | 56801.97** | 3.82** | 1.42** | 6.84** |
| Error | 54.00 | 2.13 | 0.10 | 0.04 | 3.04 | 0.81 | 2902.01 | 0.03 | 0.29 | 1.77 |

*, ** significant at 5 and 1% levels, respectively.

**Table 2 :** General combining ability effects of parents for fruit yield and yield component characters in brinjal.

| | | Days to 50% flowering | Fruit length (cm) | Fruit width (cm) | Avg. fruit weight (g) | Number of marketable fruits/plant | Marketable yield per plant (g) | Ascorbic acid content (mg/100g) | Fruit and shoot borer infestation on shoots (%) (ASN) | Fruit and shoot borer infestation on fruits (%) (ASN) |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Parents** | | | | | | | | | |
| $P_1$ | IC-281104 | 2.05** | -0.45** | -0.02 | -2.10** | 1.19** | -1.13 | 0.29** | -0.62** | -0.30 |
| $P_2$ | IC-021621 | 0.34 | -0.08 | 0.47** | 2.03** | -0.49 | 39.31* | -0.28** | 0.44* | 0.49 |
| $P_3$ | IC-127024 | 0.12 | -0.06 | -0.03 | -0.66 | -1.12** | -78.88** | 0.04 | -0.36* | 0.84* |
| $P_4$ | IC-090084-2 | -1.12* | 0.10 | -0.47** | -3.60** | 1.91** | -15.04 | -0.19** | 0.19 | -0.89* |
| $P_5$ | IC-090084-4 | 0.07 | -0.41** | -0.31** | -1.59** | -0.25 | -50.80** | -0.15** | 0.11 | 0.14 |
| $P_6$ | IC-090783-3 | -1.18* | -0.19 | 0.08 | -0.30 | 0.39 | 20.96 | -0.06 | 0.30 | 0.16 |
| $P_7$ | IC-23771 | -0.28 | 1.08** | 0.28** | 6.24** | -1.64** | 85.59** | 0.34** | -0.06 | -0.45 |
| S.Egi | | 0.45 | 0.10 | 0.06 | 0.54 | 0.28 | 16.62 | 0.06 | 0.17 | 0.41 |
| S.E gi-gj | | 0.69 | 0.15 | 0.10 | 0.82 | 0.43 | 25.39 | 0.09 | 0.26 | 0.63 |

*, ** significant at 5 and 1 % levels, respectively

**Table 3 :** Specific combining ability effects of the hybrids for fruit yield and yield component characters in purple brinjal.

| S.no | | Days to 50% flowering | Fruit length (cm) | Fruit width (cm) | Avg. fruit weight (g) | Number of marketable fruits per plant | Marketable yield per plant (g) | Ascorbic acid content (mg/100g) | Fruit and shoot borer infestation on shoots (%) (ASN) | Fruit and shoot borer infestation on fruits (%) (ASN) |
|---|---|---|---|---|---|---|---|---|---|---|
| $C_1$ ($P_1$×$P_2$) | IC-281104×IC-021621 | -0.69 | -0.05 | -0.01 | -0.53 | -1.99* | -115.14* | 0.28 | -0.63 | 3.26* |
| $C_2$ ($P_1$×$P_3$) | IC-281104×IC-127024 | 2.62 | 0.43 | -0.09 | -0.80 | 2.98** | 115.07* | 1.08** | 0.26 | -0.65 |
| $C_3$ ($P_1$×$P_4$) | IC-281104×IC-090084-2 | -4.69** | 0.33 | 0.00 | 2.45 | 4.78** | 360.09** | -0.56** | -1.04* | -5.44** |
| $C_4$ ($P_1$×$P_5$) | IC-281104×IC-090084-4 | -3.12* | -0.45 | 0.00 | -1.68 | -4.24** | -268.41** | 3.56** | 0.37 | 3.13* |
| $C_5$ ($P_1$×$P_6$) | IC-281104×IC-090783-3 | 2.22 | -0.08 | -0.21 | 0.85 | 3.18** | 188.41** | -2.69** | 1.94** | -0.41 |
| $C_6$ ($P_1$×$P_7$) | IC-281104×IC-23771 | -0.76 | -0.20 | -0.08 | 1.17 | -2.80** | -104.29* | 0.36* | 0.13 | 2.17 |
| $C_7$ ($P_2$×$P_3$) | IC-021621×IC-127024 | 0.14 | 0.00 | -0.10 | 2.92 | -1.58 | -10.72 | -0.91** | 0.98 | 0.06 |
| $C_8$ ($P_2$×$P_4$) | IC-021621×IC-090084-2 | -0.04 | -0.28 | 0.05 | -3.90* | -1.50 | -201.54** | 0.12 | 1.60** | 0.52 |
| $C_9$ ($P_2$×$P_5$) | IC-021621×IC-090084-4 | 1.40 | -0.77* | 0.10 | -1.52 | -0.83 | -108.27* | 0.24 | -0.06 | 0.99 |
| $C_{10}$ ($P_2$×$P_6$) | IC-021621×IC-090783-3 | 0.75 | 0.17 | 0.20 | -0.72 | 1.15 | 34.51 | 0.72** | -1.14* | -0.23 |
| $C_{11}$ ($P_2$×$P_7$) | IC-021621×IC-23771 | 0.41 | 1.01** | 0.02 | 5.98** | 4.63** | 486.11** | 3.03** | 0.04 | -2.11 |
| $C_{12}$ ($P_3$×$P_4$) | IC-127024×IC-090084-2 | -0.25 | -0.18 | 0.11 | 2.39 | -2.70** | -65.63 | -1.40** | -0.65 | 0.55 |
| $C_{13}$ ($P_3$×$P_5$) | IC-127024×IC-090084-4 | 0.42 | -0.29 | 0.29 | 6.54** | 5.02** | 466.91** | 0.51** | -2.40** | -3.89** |
| $C_{14}$ ($P_3$×$P_6$) | IC-127024×IC-090783-3 | 3.35* | 0.57 | -0.11 | -2.01 | -1.24 | -139.07** | 3.03** | 2.04** | 0.94 |
| $C_{15}$ ($P_3$×$P_7$) | IC-127024×IC-23771 | -2.65 | -0.02 | -0.06 | -2.27 | 1.91* | 40.98 | -1.48** | -0.62 | 1.39 |
| $C_{16}$ ($P_4$×$P_5$) | IC-090084-2×IC-090084-4 | 1.30 | 1.06** | 0.04 | 3.40* | 2.96** | 260.79** | -2.30** | 0.30 | -2.05 |
| $C_{17}$ ($P_4$×$P_6$) | IC-090084-2×IC-090783-3 | -0.82 | -0.18 | 0.12 | 2.99 | -2.17* | -23.04 | 1.25** | 0.32 | 2.88* |
| $C_{18}$ ($P_4$×$P_7$) | IC-090084-2×IC-23771 | 0.66 | 0.23 | -0.47* | -2.29 | -1.03 | -100.02 | 3.30** | -0.62 | 2.94* |
| $C_{19}$ ($P_5$×$P_6$) | IC-090084-4×IC-090783-3 | -1.10 | 0.71* | 0.35 | 1.50 | 1.08 | 77.31 | -0.13 | -0.57 | -3.64** |
| $C_{20}$ ($P_5$×$P_7$) | IC-090084-4×IC-23771 | -3.26* | 0.88** | 0.22 | -3.23 | 3.21** | 86.79 | 1.10** | -0.08 | -1.24 |
| $C_{21}$ ($P_6$×$P_7$) | IC-090783-3×IC-23771 | -1.98 | -1.08** | 0.43* | -1.25 | 3.77** | 200.86** | -2.17** | -1.89** | -3.20* |
| | SE ($S_{ij}$) | 1.31 | 0.28 | 0.18 | 1.57 | 0.81 | 48.35 | 0.16 | 0.49 | 1.19 |
| | SE($S_{ij}$-$S_{ik}$) | 1.95 | 0.42 | 0.27 | 2.33 | 1.20 | 71.83 | 0.24 | 0.72 | 1.77 |
| | SE($S_{ij}$-$S_{kl}$) | 1.82 | 0.40 | 0.25 | 2.18 | 1.12 | 67.19 | 0.23 | 0.67 | 1.66 |

*, ** significant at 5 and 1 % levels, respectively

**Table 4 :** Components of heritable variation and their ratios for nine yield and yield contributing characters of brinjal in *kharif*.

| Character | $\sigma^2 gca$ | $\sigma^2 sca$ | $\sigma^2 gca/\sigma^2 sca$ |
|---|---|---|---|
| Days to 50% flowering | 0.94 | 3.48 | 0.27 |
| Fruit length (cm) | 0.26 | 0.24 | 1.08 |
| Fruit width (cm) | 0.09 | 0.02 | 4.51 |
| Average fruit weight (g) | 10.24 | 6.43 | 1.59 |
| Number of marketable fruits per plant | 1.49 | 10.05 | 0.15 |
| Marketable yield per plant(g) | 2734.11 | 53899.95 | 0.05 |
| Ascorbic acid content (mg/100g) | 0.05 | 3.78 | 0.01 |
| Fruit and shoot borer infestation on shoots (%) | 0.107 | 1.128 | 0.09 |
| Fruit and shoot borer infestation on fruits (%) | 0.148 | 5.063 | 0.03 |

$\sigma^2 gca$ , $\sigma^2 sca$ = Additive and non-additive components of heritable variation, respectively.

combiners have highest magnitude of significant *sca* effects in favourable direction are recommended for heterosis breeding.

The results obtained from combining ability studies are more or less, in consonance with the earlier findings of Das and Baura (2001) and Thangavel (2011). High general combining ability of the parents therefore seems to be reliable criterion for the prediction of specific combining ability. Heterosis in the cross involving high × low *gca* effects of combiners might be due to additive × dominance type of interaction which is partially fixable and the crosses involving both the poor combining parents showing high *sca* must be due to intra and inter allelic interactions. Generally the crosses $C_3$ ($P_1 \times P_4$), $C_5$ ($P_1 \times P_6$), $C_{11}$ ($P_2 \times P_7$), $C_{13}$ ($P_3 \times P_5$), $C_{16}$ ($P_4 \times P_5$) and $C_{21}$ ($P_6 \times P_7$) could be exploited for hybrid vigour and yield and other economic traits in brinjal. However, it needs further testing before recommending these combinations for exploitation on large scale.

In the present investigation, the ratio of $\sigma^2$gca /$\sigma^2$sca was lower than unity (<1) for most of the characters except fruit length, fruit width and average fruit weight indicating the preponderance of non-additive gene action involved in the inheritance of these traits. Hence, heterosis breeding and recombination breeding with postponement of selection at later generations are ideal to improve these traits. These results are results are in close conformity with Sane *et al*. (2011) and Thangavel (2011).

## References

Arunachalam, V. (1976). Evaluation of diallel crosses by graphical and combining ability methods. *Indian J. Genet*., **36** : 358-366.

Das, G. and S. N. Baura (2001). Heterosis and combining ability for yield and its components in brinjal. *Ann. Agric. Res.* New Series. **22** : 399-403.

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.,* **9** : 463-493.

Nalini, D., S. A. Patil and P. M. Salimath (2011). Heterosis and combining ability analysis for productivity traits in brinjal (*Solanum melongena* L.). *Karnataka Journal of Agricultural Sciences*, **24(5)** : 622-625.

Sane, S. C., M. N. Bhalekar, B. T. Patil, S. S. Dhumal, A. N. Gaikwad and D. B. Kshirsagar (2011). Combining ability for yield and yield contributing characters in brinjal (*Solanum melogena* L.). *Asian Journal of Horticulture*, **6(1)** : 215-217.

Sao, A. and N. Mehta (2011). Heterosis and Inbreeding Depression for fruit yield and its components in brinjal (*Solanum melongena* L.). *Vegetable Science*, **38(1)** : 88-91.

Suneetha, Y., K. B. Kathiria, J. S. Patel and T. Srinivas (2008). Studies on heterosis and combining ability in late summer brinjal. *Indian Journal of Agricultural Research*, **42(3)** : 171-176.

Thangavel, P. (2011). Studies on gene action and combining ability for yield and other quantitative traits in brinjal (*Solanum melongena* L.). *International Journal of Current Agricultural Sciences*, **2(1)** : 23-25.