Plant Archives Vol. 18 No. 2, 2018 pp. 1263-1267 ***ISSN 0972-5210***

GENERAL AND SPECIFIC COMBINING ABILITY FOR YIELD AND SHOOT AND FRUIT BORER INCIDENCE IN BRINJAL (*SOLANUM MELONGENA* L.)

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Abstract

A field study was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram, Tamilnadu, India, during January 2015, with a view to estimate, general and specific combining ability in brinjal for fifteen characters through diallel analysis involving 6 parents. The combining ability analysis revealed highly significant differences among the treatments for all the parameters studied except number of primary branches per plant and number of short styled flowers per plant. The genotype P_1 was found to be the best combiner for shoot and fruit borer incidence, fruit weight and fruit yield per plant. The genotype P_3 was found the best combiner for number of fruits per plant and fruit yield per plant. The top two crosses ($P_1 \times P_3$ and $P_1 \times P_6$) with high *per se* performance have exhibited high SCA effects for yield. Both additive and non-additive gene actions were operating for all the characters except number of primary branches per plant and number of short styled flowers per plant. Therefore, the general combiner can be exploited for the creation of varieties lines, and the presence of specific combining in the hybrids.

Key words: General combining ability, specific combining ability, brinjal.

Introduction

Brinjal or eggplant (*Solanum melongena* L.) belongs to the family Solanaceae is one of the important and popular vegetable crops grown in India and other parts of the world and is probably a native of India and has been cultivated since prehistoric times. It is widely cultivated in both tropical and subtropical regions of the globe mainly for its immature fruits as vegetables. It is popular among people of all social strata and hence, it is referred as "vegetable of masses" (Patel and Sarnaik, 2003). With increasing popularity of F_1 hybrids in brinjal, it is imperative to obtain hybrids having excellent and marketable fruit quality coupled with high yield. A knowledge of general combining ability (GCA) and specific combining ability (SCA) helps in choice of parents or hybrids and the nature of gene action provides a basis for choosing an effective breeding methodology. Information on combining ability and the types of gene action that governs the inheritance of economically important quantitative characters can help breeders to select suitable parents and device efficient breeding strategy. While selecting parents on the basis of *per se* performance does not necessarily fetch good combinations. It provides the breeders an insight in to nature and relative magnitude of fixable and non-fixable genetic variances. In this context, the present investigation was undertaken with six diverse parents to elucidate information on the basis of nature of gene action and combining ability of brinjal genotypes for superior hybrids of excellent qualities coupled with high yields in addition to identification of hybrid for commercial exploitation.

Materials and method

The experiment was conducted at the Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram, during the period January 2015. Six diverse genotypes *viz.*, Thovalai local (Kanyakumari District, Tamil Nadu)-(P_1), Pechiparai local (Kanyakumari District, Tamil Nadu)-(P_2), Mothiramalai local (Kanyakumari District, Tamil Nadu)-(P_3), IC 127063

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(NBPGR, New Delhi)-(P_4), IC 316291 (NBPGR, New Delhi)-(P_5) and Annamalai-1 (Annamalai University, Tamil Nadu)-(P_6) were crossed in all possible combinations excluding reciprocals to get 15 F_1s. The experimental material comprised of 21 genotypes including 15 F_1s and 6 parents with one parent as commercial check variety (Annamalai-1) were evaluated using Randomized Block Design, with three replications. Plants were grown at a spacing of 60 cm × 45 cm adopting the package of practices recommended by Tamil Nadu Agriculture University (TNAU). Observations were recorded on five randomly selected plants of each genotype in each replication for sixteen characters *viz.*, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per plant, number of flowers per plant, number of days to 1st flowering, fruit set percentage, number of fruits per plant, shoot and fruit borer incidence (%), fruit length (cm), fruit girth (cm), fruit weight (g) and fruit yield per plant (g). The combining ability was calculated according to the Model-I and Method-II of Griffing (1956). In this approach, using a suitable statistical model the component of variances due to general and specific combining ability was estimated.

Results and discussion

The variances due to general combining ability (GCA) and specific combining ability (SCA) are presented in table 1. General combining ability (GCA) largely involves additive gene action. The additive genetic effects are mainly due to polygenes, which act inadditive manner, producing fixable effects. It is evident from the analysis that mean squares due to GCA were significant for almost all the characters except number of primary branches per plant and number of short styled flowers per plant and the SCA were significant for eleven characters except number of primary branches per plant, number of short styled flowers per plant, number of flowers per plant and fruit length. This indicated the importance of both additive and non additive gene action. Further, mean square values for GCA were higher than SCA for all traits except number of short styled flowers per plant, indicating prevalence of wide variability and high degree of additive variance for the former traits while dominance for the later. The similar results were also reported by Rai and Asati (2011), Choudhary and Didel (2014) and Ravi Kumar *et al.* (2017).

The character-wise estimates of general combining ability effects for each parent are presented in table 2. Among six parents, none of parent was good general combiner for all the traits studied. The parent P_4 had negative GCA effects in desirable direction for plant height, positive GCA effects in desirable direction for number of primary branches per plant, number of long styled flowers per plant and fruit set percentage. It had significant positive GCA effects for days to first flower, number of fruits per plant, fruit girth, fruit weight and fruit yield which consider it as average general combiner for this traits.

Parent P_1 and P_3 had significant negative GCA effects in desirable direction for plant height, days to first flower, shoot and fruit borer incidence. It had significant positive GCA effects in desirable direction for number of primary branches per plant, number of secondary branches per plant, number of long styled flowers per plant, number of medium styled flowers per plant, number of flowers per plant, number of fruits per plant, fruit set percentage, fruit girth, fruit weight and fruit yield per plant which consider it as a good general combiner. Parent P_6 had also significant negative GCA effects for plant height and shoot and fruit borer incidence.

P_1-Thovalai local, P_2-Pechiparai local, P_3-

Table 1: ANOVA for combining ability effects for different characters in brinjal.

Sources of variation	GCA	SCA	Error
df	5	5	70
Plant height	64.65**	19.25**	3.96
No. of primary branches per plant	0.18	0.15	0.13
No. of secondary branches per plant	1.32**	0.69**	0.04
No. of long styled flowers per plant	7.87**	5.97**	1.41
No. of medium styled flowers per plant	8.15**	3.05**	1.50
No. of short styled flowers per plant	2.56	3.75	1.66
No. of flowers per plant	18.56*	8.13	6.39
Days to Ist flower	27.92**	5.84**	1.12
No. of fruits per plant	36.02**	24.62**	2.38
Fruit set percentage	34.01**	28.69**	6.88
Shoot and fruit borer incidence	98.66**	76.03**	1.49
Fruit length	7.25**	1.24	0.68
Fruit girth	21.49**	2.41**	0.07
Fruit weight	152.95**	119.61**	6.67
Fruit yield per plant	561760.00**	503686.40**	14880.30

*- significant at 5 per cent probability level,
**- significant at 1 per cent probability level

Table 2: Estimates of GCA effects of parents for fifteen yield characters studied in brinjal.

Parents	Plant height	No. of primary branches per plant	No. of secondary branches per plant	No. of long styled flowers per plant	No. of medium styled flowers per plant	No. of short styled flowers per plant	No. of flowers per plant	Days to I[st] flower
P_1	-4.42**	0.20*	0.62**	1.10*	0.85	-0.20	2.08**	-1.38**
P_2	4.35*	-0.21	-0.45**	-2.70	-1.43**	0.64	-2.28*	2.44**
P_3	-1.98**	0.17	0.09	0.33	0.85*	-0.44	0.27*	-1.22**
P_4	-0.53	0.02	-0.10	0.24	-0.29	-0.41	-0.89	-0.79**
P_5	3.85	-0.20	-0.16	0.23	-0.03	0.12	0.23	1.25**
P_6	-1.27*	0.05	0.02	0.80*	0.05	0.30	0.60*	-0.32

Table 2 cont….

Parents	No. of fruits per plant	Fruit set percentage	Shoot and fruit borer incidence	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
P_1	1.72**	2.72**	-3.44**	0.13	0.72**	6.77**	250.48**
P_2	-5.67**	-3.21**	2.77**	-1.04**	-4.32**	-16.86*	-919.03**
P_3	2.13**	2.64**	-2.72**	0.08	0.27**	2.38**	176.86**
P_4	0.91*	0.03	4.42**	-0.40	1.00**	2.43**	170.66**
P_5	0.90*	-2.33	-0.30	-0.09	1.25**	2.45**	173.67**
P_6	0.36	0.14	-0.73*	1.32**	2.16**	2.83**	147.37**

*- significant at 5 per cent probability level, **- significant at 1 per cent probability level

Mothiramalai local, P_4-IC 127063, P_5-IC 316291 and P_6-Annamalai-1. It showed positive GCA effects for number of primary branches per plant, number of secondary branches per plant, number of medium styled flowers per plant, fruit set percentage, number of fruits per plant. It also showed significant positive GCA effect for number of long styled flowers per plant, number of flowers per plant, fruit length, fruit weight per plant and fruit yield per plant which consider it as a good general combiner. The parent P_5 had also showed significant positive GCA for number of fruits per plant, fruit girth, fruit weight, and fruit yield per plant which consider it as good general combiner. None of the parent showed significant for number of short styled flowers per plant.

In the present study, both GCA and SCA variances were highly significant for plant height, number of secondary branches per plant, number of long styled flowers per plant, number of medium styled flowers per plant, number of flowers per plant, days to first flower, number of fruits per plant, fruit set percentage, shoot and fruit borer incidence, fruit length, fruit girth, fruit weight and fruit yield per plant. This suggested that both additive and non-additive variances were important in the expression of these traits. It was observed that none of the parent was showing significant favorable GCA effects for all the characters. For exploitation of heterosis, the information on GCA should be supplemented with SCA and hybrid performance. The estimates of SCA effects revealed that none of the crosses was constantly superior for all the traits. These findings are supported by Kamalakkannan *et al.* (2007), Sao and Mehta (2010) and Desai *et al.* (2017).

The specific combining ability (SCA) effects of all 15 crosses for different traits are presented in table 3. Number of long styled flowers per plant, number of medium styled flowers per plant, number of fruits per plant, fruit set percentage, fruit girth, fruit yield per plant are important growth parameters which act as a source traits to support yield. Among 15 hybrids, hybrids *viz.*, $P_1 \times P_3$, $P_1 \times P_6$ and $P_4 \times P_5$ have significant SCA effects in desirable direction for long styled flowers per plant. Two Crosses *viz.*, $P_1 \times P_3$ and $P_4 \times P_5$ exposed significant SCA effects in desirable direction for medium styled flowers per plant. Hybrids $P_1 \times P_3$ and $P_4 \times P_5$ showed significant SCA effects in desirable direction for number of flowers per plant. Hybrids *viz.*, $P_1 \times P_3$, $P_1 \times P_6$, $P_2 \times P_4$ and $P_3 \times P_5$ exposed significant SCA effects in desirable direction for number of fruits per plant. For fruit set percentage hybrids *viz.*, $P_1 \times P_3$, $P_1 \times P_6$ and $P_4 \times P_5$ exposed significant SCA effects in desirable direction. Hybrids *viz.*, $P_1 \times P_2$, $P_1 \times P_3$, $P_1 \times P_6$, $P_2 \times P_4$, $P_2 \times P_5$ and $P_3 \times P_4$ exposed significant SCA effects in desirable direction for fruit girth. Hybrids *viz.*, $P_1 \times P_3$, $P_1 \times P_6$, $P_2 \times P_4$, $P_2 \times P_5$, $P_2 \times P_6$, $P_3 \times P_5$ and $P_4 \times P_6$ recorded significant SCA effects in

Table 3: Magnitude of specific combining ability (SCA) effects of hybrids for fifteen characters in brinjal

Crosses	Plant height	No. of primary branches per plant	No. of secondary branches per plant	No. of long styled flowers per plant	No. of medium styled flowers per plant	No. of short styled flowers per plant	No. of flowers per plant	Days to I[st] flower
$P_1 \times P_2$	-0.46	0.05	-.003	-0.60	-0.26	0.39	-0.63	-0.35
$P_1 \times P_3$	-0.19	-0.27	-0.06	1.72*	1.46*	-2.24**	1.83*	-3.93**
$P_1 \times P_4$	0.89	0.04	-0.25*	-0.76	-0.84	0.07	-1.20	-0.09
$P_1 \times P_5$	-0.68	0.01	-0.07	-0.21	-0.01	-0.02	-0.15	0.39
$P_1 \times P_6$	1.14	0.10	0.33**	1.50*	0.74	-1.77*	0.51	-1.67**
$P_2 \times P_3$	-2.72*	0.15	-0.31*	0.94	-0.23	-0.10	0.52	0.27
$P_2 \times P_4$	-0.93	0.27	0.67**	1.01	1.42	-1.00	1.82	0.03
$P_2 \times P_5$	0.47	0.01	1.06**	0.15	-0.09	0.22	0.33	1.66*
$P_2 \times P_6$	1.18	0.16	0.55**	0.91	0.88	0.03	0.79	1.58*
$P_3 \times P_4$	2.85*	-0.21	-0.22	0.75	0.90	-0.59	1.16	0..31
$P_3 \times P_5$	2.53*	-0.11	-0.08	0.58	0.80	-0.72	0.08	-0.77
$P_3 \times P_6$	4.08**	-0.34	-0.69**	-1.36	-0.82	0.22	-2.09	1.14
$P_4 \times P_5$	0.71	0.29	0.09	3.00**	1.88*	-0.70	4.09**	-1.19
$P_4 \times P_6$	-0.30	0.06	-0.09	0.36	-1.16	-0.05	-1.24	-0.46
$P_5 \times P_6$	2.73*	0.03	-0.14	-0.11	-0.62	-0.14	-0.62	-0.17
S.E	1.19	0.21	0.11	0.71	0.73	0.77	1.51	0.63
S.ED	2.29	0.41	0.22	1.37	1.41	1.48	2.91	1.22

Table 3 cont….

Crosses	No. of fruits per plant	Fruit set percentage	Shoot and fruit borer incidence	Fruit length	Fruit girth	Fruit weight	Fruit yield per plant
$P_1 \times P_2$	-1.31	-1.21	5.11**	-0.82	0.52**	-2.86	-241.03**
$P_1 \times P_3$	4.98**	4.77**	-6.46**	0.62	2.20**	9.84**	686.22**
$P_1 \times P_4$	-1.66	-1.23	-0.02	-0.44	-2.04**	-1.50	-197.09**
$P_1 \times P_5$	-1.00	-0.99	2.82**	0.01	-0.11	-1.87	-172.72*
$P_1 \times P_6$	4.15**	3.57**	-3.99**	0.89	0.79**	7.98**	658.63**
$P_2 \times P_3$	1.23	1.32	0.85	0.33	-0.00	3.01	151.83*
$P_2 \times P_4$	3.17**	2.87	-2.40**	1.33*	-0.35*	4.14**	356.07**
$P_2 \times P_5$	0.33	0.46	4.23**	0.17	0.47**	6.64**	262.94**
$P_2 \times P_6$	1.40	0.80	0.36	0.40	0.31	4.28**	225.64**
$P_3 \times P_4$	1.53	1.21	4.24**	-0.33	1.86**	-0.92	33.15
$P_3 \times P_5$	3.20**	1.92	1.46*	0.36	-0.33*	8.05**	205.73**
$P_3 \times P_6$	0.05	1.81	10.44**	0.03	-0.23	-7.77**	-388.87**
$P_4 \times P_5$	1.47	3.25*	-6.13**	0.85	0.04	2.43	124.05
$P_4 \times P_6$	0.08	1.21	2.43**	0.08	-0.27	3.73*	632.53**
$P_5 \times P_6$	-0.18	0.09	4.19**	-0.18	-0.28	0.68	-4.34
S.E	0.92	1.57	0.73	0.49	0.16	1.55	73.30
S.ED	1.77	3.02	1.40	0.95	0.31	2.98	140.85

*,** significant at 5 and 1 per cent level

desirable direction for fruit weight and hybrids *viz.*, $P_1 \times P_3$, $P_1 \times P_6$, $P_2 \times P_3$, $P_2 \times P_4$, $P_2 \times P_5$, $P_2 \times P_6$, $P_3 \times P_5$ and $P_4 \times P_6$ recorded significant SCA effect in desired direction for fruit yield per plant. Similar results have been reported by Rai and Asati (2011), Ramireddy *et al.* (2011), Shinde *et al.* (2011), Bhusan *et al.* (2012), Patel *et al.* (2013), Singh *et al.* (2013), Tiwari *et al.* (2013), Choudhary and Didel (2014), Venkata Naresh *et al.* (2014) and Desai *et al.* (2017).

The parents P_1, P_3 and P_6 involved in these crosses were found to be good general combiners for majority of the characters. The cross, $P_1 \times P_3$ and $P_1 \times P_6$ identified have SCA effects for at least one major yield components like number of fruits per plant, fruit weight and fruit yield per plant. The crosses showing high SCA effects were not always the results of good × good GCA combiners. Similar results were also reported by Kamalakkannan *et al.* (2007), Rai and Asati (2011), Hubaity and Teli (2013), Raghvendra *et al.*, (2014) and Sharif Uddin *et al.*, (2015).

The superior crosses (Hybrids *viz.*, $P_1 \times P_3$ and $P_1 \times P_6$) attempted through Diallel mating design by utilization of local germplasm of brinjal on the basis of GCA and SCA effects can be further exploited for commercial cultivation after multilocation testing. It is also necessary to assess genetic potentialities of the parent in hybrid combination through systematic studies in relation to general and specific combining abilities.

References

Bhushan, B., A.S. Sidhu, A.S.Dhatt and A. Kumar (2012). Studies on combining ability for yield quality traits in brinjal (*Solanum melongena* L.). *J. Hort. Sci.,* **7(2):** 145-151.

Choudhary, S. and R.P. Didel (2014). Combining ability analysis for growth and yield components in brinjal (*Solanum melongena* L.). *Asian J. Bio. Sci.,* **9(1):** 88-92.

Desai, K.M., S.N. Saravaiya, V. Maheta and D.A. Patel (2017). Combining ability for yield and yield attributing characters in brinjal (*Solanum melongena* L.). *Electron. J. Plant Breed.,* **8(2):** 480-484.

Giffing, B. (1956). Cocept of general and specific combining ability in relation to diallel crossing system. *Australian. J. Biol. Sci*., **9(1):** 88-92

Hubaity, A.I. and J.A. Teli (2013). Combining ability and heterosis in eggplant (*Solanum melongena* L.). *Mesopotamia J. Agri.,* **41(1):** 23-34.

Kamalakkannan. T., P. Karuppaiah, K. Sekar and P. Senthilkumar (2007). Line and Tester analysis in brinjal for yield and shoot and fruit borer tolerance. *Indian. J. Hort.*, **64(4):** 420-424.

Patel, J.P., U. Singh, S.P. Kashyap, D.K. Singh, A. Goswami, S.K. Tiwari and M. Singh (2013). Combining ability for yield and other quantitative traits in eggplant (*Solanum melongena* L.). *Veg. Sci.,* **40(1):** 61-64.

Raghvendra, D., D. Arpita, M.D. Oijha, S. Bholanath, R. Ashish and K. Singh (2014). Heterosis and combining ability studies for yield and yield attributing traits in brinjal (*Solanum melongena* L.). *The Bio* SCA*n,* **9(2):** 889-894.

Rai, N. and B.S. Asati (2011). Combining ability and gene action studies for fruit yield and yield contributing traits in brinjal. *Indian J. Hort.*, **68(2):** 212-215.

Ramreddy, S.R.K.M., H.B. Lingaiah, P. Naresh, P.V.K. Reddy and V.S. Kuchi (2011). Heterosis study for yield and yield attributing characters in brinjal (*Solanum melongena* L.). *Plant Archives,* **11(2):** 649-653.

Ravi Kumar., Randhir Kumar, Amit Kumar, Saksham Kumar Sinha and Preeti Kumari (2017). General and specific combining ability for nine morphologic characters in round brinjal (*Solanum melongena* L.). *BJAST*., **21(2):** 1-6.

Sao, A. and N. Mehta (2010). Heterosis in relation to combining ability for yield and quality attributes in brinjal (*Solanum melongena* L.). *Electron. J. Plant Breed.,* **1(4):** 783-788.

Sharuf Uddin, M., M.M. Rahman, M.M Hossian and M.A. Khaleque Main (2015). Combining ability of yield components in eggplant (*Solanum melongena* L.). during summer. *Universal J. Plant Sci.,* **3(4):** 59-66.

Shinde, K.G., M.N. Bhalekar and B.T. Patil (2011). Combining ability of quantitative characters in brinjal. *Veg. Sci.,* **38(2):** 231-234.

Singh, O., B. Singh, K.V. Singh, Pooran Chand and Vaishalli (2013). Combining ability studies for yield and its components in brinjal (*Solanum melongena* L.). *Annals Hort.,* **6(2):** 279-283.

Tiwari, P.K., M. Ahmad, I.N. Shukla, V. Pandey and P.K. Singh (2013). Combining ability for fruit yield and its contributing traits in brinjal (*Solanum melongena* L.). *Curr. Adv. Agric. Sci.,* **5(2):** 189-192.

Venkata Naresh, B., A.K. Dubey, P.K. Tiwari and M.R. Dabbas (2014). Line × Tester analysis for yield components and cercospora leafspot resistance in brinjal (*Solanum melongena* L.). *Electron. J. Plant Breed.,* **5(2):** 230-235.