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Combining Ability Analysis for Yield and Yield Attributing Traits in Brinjal (*Solanum melongena* L.)

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Abstract

The combining ability analysis of a (7x3) L x T set of a crosses in brinjal was under taken for fruit yield and its attributing characters. Ten parents, twenty-one hybrids and one standard check variety were evaluated at Plant Breeding Farm, Faculty of agriculture, Annamalai University. Combining ability analysis in brinjal genotypes indicated significant genotypic and environmental variations for all the ten characters studied. Both general combining ability (GCA) and specific combining ability (SCA) variances showed significant interactions. Genotypes Sevanthipatti brinjal (L_4), Kulasai brinjal (L_7), Ark keshav (L_2), Arka harshita (T_3) were found to be good general combiners, and the crosses L_4 x T_3 (Sevanthipatti brinjal x Arka harshita), L_7 x T_3 (Kulasai brinjal x Arka harshita) were identified as good specific combiners for fruit yield and other related traits. These hybrid combinations can be used for commercial exploitation for fruit yield in brinjal.

***Key words*:** *Solanum melongena* L., Combining ability, Gca, Sca

Brinjal (*Solanum melongena* L.) is very popular vegetable crop belongs to the family of *Solanaceae* and has diploid chromosome number (2n = 2× = 24). Due to its versatile use in Indian food, brinjal is often described as the "king of vegetables". It is popular among the people of all the social strata and hence it is called as "Vegetable of masses" [1]. It is also cultivated in temperate regions of the globe mainly for its immature fruit as vegetables [2]. It is often referred as the poor man's crop [3] because of its low cost of production and availability throughout the year. A knowledge of combining ability studies helps to identify the best combiners which aids heterosis breeding or to accumulate fixable genes through selection process. This information forms the back bone of any breeding programme. Among the various methods of plant breeding, Line x Tester analysis provides information on the combining ability of genotypes. Heterosis and combining ability studies are prerequisite in any plant breeding programme, which provides the desired information regarding the varietal improvement or exploiting heterosis for commercial purposes. .The combining ability analysis is an important tool in preferring suitable parents for hybridization and superior cross combinations through general combining ability (GCA) and specific combining ability (SCA), respectively Dhillon [4] opined that combining ability of parents gave useful information on making the choice of parents in terms of expected performance of their hybrid and progenies. In the present investigation, a study was conducted to study on combining ability in various crosses in brinjal.

MATERIALS AND METHODS

The experiment study was carried out in Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalainagar, Chidambaram, Tamil Nadu in 2020-22. The genotype such as (Violet brinjal (L_1), Arka keshav (L_2), Bhavani brinjal (L_3), Sevanthipatti brinjal (L_4), Kollampatti brinjal (L_5), Manaparai brinjal (L_6), Kulasai brinjal (L_7) and three testers (White brinjal (T_1), Large bhavani brinjal (T_2), Arka harshita (T_3) collected from Namakkal, Tamil Nadu and IIHR, Bangalore were used for these studies. These Seven lines and three testers were crossed in line × tester mating design to obtain 21 F_1S. These crosses, parents were grown in *kharif* and summer season of 2020-22 in randomized block design with three replications. The data was recorded on ten selected plants and was recorded for ten characters viz., days to 50% flowering, plant height, number of branches per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, fruit length, fruit weight, fruit breadth and fruit yield per plant. The above characters data was used for estimating combining ability. The combining ability analysis was computed as per Kempthorne [5]. Parents/ hybrids that showed negative and significant gca effect were considered for days to 50% flowering.

RESULTS AND DISCUSSION

Analysis of variance revealed highly significant differences among all the ten parents and hybrids for all the ten characters which indicting the presence of considerable amount of genetic variability (Table 1). The analysis of variances for

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combining ability showed significant difference between lines was observed for all the ten characters. Hybrids versus parents' comparison was significant for all the traits, revealing occurrence of heterotic effects. Knowledge of additive and non-additive gene action is essential for the plant breeder to develop an efficient hybridization programme (Table 2).

Table 1 Analysis of variance for ten characters

Source	Df	Days to 50% flowering	Plant height	No. of branches per plant	No. of flower per cluster	No. of fruit per cluster	No. of fruits per plant	Fruit length	Fruit weight	Fruit breadth	Fruit yield per plant
Replication	2	0.9227	0.0609	0.1202	0.0864	0.0452**	1.9429	0.6146	0.6468	0.5486	0.5323
Genotype	9	126.26**	184.86**	1.9269**	2.1077**	1.9499**	90.8450**	22.0538**	1213.053**	7.2695**	43107.503**
Hybrid	20	97.130**	161.33**	1.4784**	1.6743**	1.21298**	68.2904**	19.6099**	993.3068**	5.0044**	31934.145**
Lines	6	220.79**	138.18**	4.2147**	4.8666**	5.2272**	158.89**	25.6825**	1870.3704**	13.0490**	78658.989**
Testers	2	22.518**	115.07**	1.2162**	0.2155**	0.8031**	110.7859**	53.6149**	2482.6189**	4.7971**	71719.466**
L × T	12	62.28**	130.78**	0.6001**	0.4819**	0.2389**	16.9682**	1.2292**	221.0879**	0.7419**	8285.2147**
Error	60	0.3027	0.2464	0.0997	0.0493	0.00646	0.3633	0.2000	0.4285	0.2331	430.2695

Table 2 Analysis of variance for combining ability for ten characters

Source	Days to 50% flowering	Plant height	No. of branches per plant	No. of flower per cluster	No. of fruits per cluster	No. of fruits per plant	Fruit length	Fruit weight	Fruit breadth	Fruit yield per plant
GCA	0.9075	0.7955	0.0229	0.0311	0.0254	1.3365	0.4787	20.1099	0.1110	615.8576
SCA	20.6629	43.4973	0.1664	0.1422	0.0526	5.5221	0.3369	73.5263	0.1641	2623.1813
GCA/SCA	0.04391	0.01828	0.1376	0.21870	0.4828	0.2420	1.4208	0.2735	0.6764	0.2347

Among the parents Sevanthipatti brinjal was good general combiner for days to 50% flowering, plant height, number of branches per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, fruit weight and fruit yield per plant. Kulasai brinjal was good general combiner for almost all the yield contributing characters such as plant height, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, fruit length and fruit yield per plant. The other good general combiner was Arka keshav which showed high *gca* for yield contributing characters such as performed well for days to 50% flowering, number of flowers per cluster number of fruits per plant and fruit length. Arka harshita was recorded desirable *gca* effect for all the yield contributing character except number of branches per plant, number fruits per cluster and fruit breadth. Large bhavani brinjal possessed desirable *gca* effect for days to 50% flowering, plant height, number of flowers per cluster, number of fruits per cluster and fruit breadth. Therefore, these parents were noted as good source of favourable genes for increasing fruit yield per plant through various yield contributing characters and use of these parental lines would be more rewarding for boosting fruit yield in brinjal.

Table 3 Estimates of general combining ability effects of parents

Parents	Days to 50 % flowering	Plant height	No. of branches per plant	No. of flowers per cluster	No. of fruits per cluster	No. of fruits per plant	Fruit length	Fruit weight	Fruit breath	Fruit yield per plant
Violet brinjal	-6.73**	1.54**	0.38**	0.27**	0.74**	5.48**	-0.52**	-3.47**	1.05**	-35.25**
Arka keshav	-0.96**	3.98**	-0.44**	0.60**	-0.55**	3.34**	2.27**	-10.80**	-1.56**	-65.54**
Bhavani brinjal	3.20**	1.80**	-0.46**	-0.46**	-0.72**	-3.73**	-0.37*	0.38	1.13**	11.21
Sevanthipatti brinjal	-2.58**	0.80**	0.86**	0.28**	0.21*	0.55**	-0.13	17.35**	-0.22	110.05**
Kollampatti brinjal	6.11**	-4.68**	-0.25*	-0.51**	0.66**	-5.94**	-0.96**	10.84**	-0.70**	53.83**
Manaparai brinjal	4.30**	-3.83**	0.18	-0.54**	0.10	-0.34	-0.06	-9.55**	1.10**	-59.95**
Kulasai brinjal	-3.70**	0.38*	-0.27**	0.36**	-0.43**	0.66**	-0.23	-4.74**	0.80**	54.88**
White brinjal	1.18**	5.97**	0.53**	-0.69**	0.15*	2.51**	-2.21**	-0.80**	0.14	-1.05
Large bhavani brinjal	-0.68**	-3.31**	-0.33**	0.33**	0.17*	-3.10**	-0.99**	-15.96**	0.71**	-86.62**
Arka Harshita	-0.50**	-2.67**	0.20**	0.36**	-0.31**	0.60**	3.11**	16.76**	-0.85**	87.67**

Based on the *sca* effect three F_1 hybrid $L_4 \times T_3$, $L_7 \times T_3$, $L_2 \times T_3$ were identified as promising specific combiners for fruit yield per plant and other characters. Sevanthipatti brinjal × Arka harshita was good specific combiner for days to 50% flowering, plant height, number of flowers per cluster, number of fruits per cluster, fruit length, fruit weight and fruit yield per plant. Kulasai brinjal × Arka harshita was good specific combiner for days to 50% flowering, plant height, number of flowers per cluster, number of fruits per plant, fruit weight and fruit yield per plant. Arka keshav × Arka harshita was good specific combiner for number of flowers per cluster, number of fruits per cluster, fruit weight and fruit yield per plant.

Good general combining parents do not always produce F_1 hybrids with high *sca* effects, similarly, poor general combining parents do not always produce low *sca* effects in F_1's. So, any parental combination either good × good, average x good, average × average or poor x poor may result into high *sca* effects. Similar results have been reported by Barbind [6],

Patil and Ajri [7], Prakash *et al.* [8], Padmanabhamn and Jagdish [9], Ingale *et al*. [10], Venkatesan [11] and Pachiyappan *et al.* [12] in brinjal. 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 F_1 hybrids were constantly superior for all the traits. This indicated that the specific combining ability of the F_1 hybrids was not always dependent on the *gca* of the parents involved. These results were supported by the findings of Patel *et al.* [13], Aswani and Kandelwal [14] and Sao and Mehta [15] in brinjal.

Table 4 Estimates of specific combining ability effects of hybrids

F_1 hybrids	Days to 50% flowering	Plant height	No. of branches per plant	No. of flowers per cluster	No. of fruits per cluster	No. of fruits per plant	Fruit length	Fruit weight	Fruit breath	Fruit yield per plant
Violet brinjal × White brinjal	0.04	-6.07**	-0.29	0.07	0.44*	0.09	-0.17	6.13**	0.39	38.38 **
Violet brinjal × large bhavani brinjal	-0.43	5.18**	-0.38*	-0.19	-0.01	0.04	0.00	-1.46**	-0.07	20.94
Violet brinjal × Arka harshita	0.39	0.89**	0.66**	0.12	-0.42*	-0.13	0.17	-4.67**	-0.32	-59.32 **
Arka keshav × White brinjal	-0.68**	0.84**	0.59**	-0.25	-0.19	0.91*	0.48	-7.49**	-0.57	-82.31 **
Arka keshav × Large bhavani brinjal	-0.94**	2.72**	-0.28	-0.31*	-0.12	-1.36**	0.83**	0.44	0.41	10.32
Arka keshav × Arka harshita	1.63**	-3.57**	-0.30	0.56**	0.51**	0.45	-1.31**	7.05**	0.16	71.98 **
Bhavani brinjal × White brinjal	5.14**	5.60**	0.14	-0.32*	-0.03	-3.34**	0.61*	5.13**	-0.54	38.24**
Bhavani brinjal × Large bhavani brinjal	-1.10**	-4.22**	-0.20	0.56**	0.48**	0.10	-0.56*	0.46	0.16	8.03
Bhavani brinjal × Arka harshita	-4.04**	1.38*	0.05	-0.24	0.08	3.24**	-0.05	-5.59**	0.38	-46.27**
Sevanthipatti brinjal × White brinjal	-0.11	-8.80**	-0.46*	0.04	-0.17	0.88*	-0.53	6.88**	-0.03	9.60
Sevanthipatti brinjal × Large bhavani brinjal	-0.94**	6.70**	0.78**	-0.10	0.05	-0.06	-0.35	-10.69**	-0.57	-40.45**
Sevanthipatti brinjal × Arka harshita	-1.05**	2.10**	-0.32	0.60**	0.46**	-0.81*	0.88**	3.81**	0.59*	30.85**
Kollampatti brinjal × White brinjal	1.38**	12.13**	0.14	0.70**	0.47**	-0.97*	-0.10	-3.08**	0.22	40.73**
Kollampatti brinjal × Large bhavani brinjal	6.22**	-7.03**	-0.09	-0.30*	-0.24	4.33**	0.12	2.94**	-0.15	-25.23**
Kollampatti brinjal × Arka harshita	-7.59**	-5.09**	-0.04	-0.40**	0.08	-3.36**	-0.02	0.14	-0.08	-15.50**
Manaparai brinjal × White brinjal	-5.78**	-1.66**	-0.28	-0.24	0.16	2.14**	-0.31	2.90**	0.56	-11.00**
Manaparai brinjal × Large bhavani brinjal	-2.07**	-1.58**	0.31	0.32*	0.07	-1.62**	-0.13	9.00**	0.22	42.43**
Manaparai brinjal × Arka harshita	7.87**	3.24**	-0.03	-0.09	-0.23	-0.52	0.44	-11.90**	-0.78**	-31.43**
Kulasai brinjal × White brinjal	0.02	-2.04**	0.16	-0.01	-0.36*	0.29	0.02	-10.45**	-0.04	-33.64**
Kulasai brinjal × Large bhavani brinjal	-0.70*	-1.77**	-0.14	0.01	0.29	-1.43**	0.08	-0.69	-0.01	-16.04
Kulasai brinjal × Arka harshita	-0.71**	3.81**	-0.02	0.12**	0.07	1.14**	-0.10	11.15**	0.05	49.68**

CONCLUSION

From the afore mentioned investigation it could be concluded that among the parents, sevanthipatti brinjal, kulasai brinjal were promising general combiners for fruit yield and other yield contributing traits viz., plant height, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, fruit yield per plant. Based on the *sca* effects, three hybrids viz., $L_4 \times T_3$, $L_7 \times T_3$, $L_2 \times T_3$ were identified as promising specific combiners for major traits.

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