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Combining Ability Studies in Brinjal (*Solanum melongena* L.)

C.P. Gharge[1], S.A. Ranpise[1], M.N. Bhalekar[1], K.G. Shinde[1] and C.A. Nimbalkar[1]

Abstract: *Combining ability analysis of 8 × 8 diallel, excluding reciprocals was undertaken for yield and its component characters in brinjal. Non-additive gene action was noticed to be pre-ponderant for all the characters except days to 50% flowering in which additive gene action was predominant. A perusal of the GCA effects revealed JBR-2, RHRB-74, RHRB-77 and Kudachi to be good general combiners for yield and its contributing characters. These parents had also recorded high per se performance for the trait. Majority of their hybrids had also recorded significant and desirable SCA effects, in addition to high per se performance, for the trait, indicating their suitability in breeding programmes for development of high yielding hybrids. All the hybrids exhibited significant and desirable SCA effects for yield. Of these, nine crosses had recorded desirable SCA effects in addition to high per se performance for the trait. An analysis of these crosses revealed the involvement of a good and good general combiner parent for majority of the crosses; and both poor in few cases. The hybrid, 5×8 i.e. RHRB-74 x DBSR-195, involving good and poor combiner parents for yield, had recorded maximum fruit yield, in addition to desirable SCA effects for fruit yield and several other component characters. Hence, it is identified as a potential hybrid for commercial exploitation. Fixation of the heterotic effects may also be attempted through the isolation of desirable and high yielding homozygous lines for the cross.*

Keywords: *Combining ability, GCA, SCA, Brinjal.*

INTRODUCTION

The brinjal (*Solanum melongena* L.) is a third most important vegetable crop in India, possesses a lot of genetic variability with respect to yield and its components which may be exploited through breeding. Combining ability analysis is one of the efficient tools, which helps in selecting the parents and crosses for improvement of particular (quantitative) characters. Information regarding the general and the types of gene effects influencing various traits enables the plant breeder to evaluate parental material and to decide a suitable breeding procedure for maximum character improvement.

The general combining ability (gca) is the average performance of a genotype in a series of cross combinations. Specific combining ability (sca) is the relative performance of a specific cross combination. Among the several mating design adopted for the study of genetic architecture inn brinjal, Diallel analysis has been widely used for evaluating more number of genotype at a time for combining ability effect. Diallel analysis is a good approach for screening the germplasm line at a time as compared other mating designs. Keeping in view, the present investigation was undertaken to study combing ability in respect of yield and its component traits in brinjal during *kharif* 2011.

MATERIALS AND METHODS

The present investigation entitled, "Genetic studies in brinjal (*Solanum melongena* L.) was conducted at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during *kharif* 2011. The experimental field has an altitude of 532 m above mean sea level, latitude of 190 47′ to 190 57′ N and longitude of 740 82′ to 740 91′ E.

[1] Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri-412 722 Maharashtra.

Table 1
Combing ability variance for the 12 character in 8 × 8 diallel cross in brinjal (Mean of square)

Character	*Sources of variation*		
	GCA	*SCA*	*Error*
DF	7	27	34
Plant height (cm)	1415.85**	245.001**	14.34
Number of primary branches	0.64*	0.49**	0.20
Days to 50% flowering	31.30**	7.12**	4.90
Fruit length (cm)	0.64**	0.24**	0.03
Fruit breadth (cm)	0.339**	0.11**	0.01
Fruit girth (cm)	3.04**	1.01**	0.13
Pedicel length (cm)	1.06**	0.34**	0.01
Number of fruits per plant	1100.48**	213.58**	2.99
Average fruit weight (g)	564.79**	149.56**	10.14
Fruit infestation number basis (%)	11.61**	9.86**	1.81
Yield per plant (kg)	0.31**	0.22**	0.003
Yield per ha. (q)	11056.48**	7700.74**	103.28

*,** - significant at 5 and 1 per cent level, respectively.

The experimental material comprised of eight elite homozygous lines of brinjal, namely, Ruchira, Manjari Gota, Krishna Kathi-1, JBR-2, RHRB-74, RHRB-77, Kudachi and DBSR-195 obtained from the germplasm collections maintained at the All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Agriculture University, Rahuri and their 28 hybrids derived from the 8 × 8 diallel mating (excluding reciprocals) of these lines.

The hybrids and parents were evaluated along with the standard checks (SC1 and SC2) *viz.*, Krishna and Phule Arjun in a randomized block design with two replications for fruit yield and yield component characters namely, plant height, number of primary branches per plant, days to 50% flowering, fruit length, fruit breadth, fruit girth, pedicel length, fruit weight, number number of fruits per plant, fruit infestation on number basis, yield per plant and per hectare. The crop was raised following recommended package of practices. Data was recorded on five random, competitive plants tagged for each entry, in each replication and the average values were computed.

RESULTS AND DISCUSSION

The analysis of variance for combing ability revealed highly significant differences among the parents for all the characters during *kharif* season. Specific combining ability effects among hybrids were significant for all the characters (Table 1) which indicated the importance of both additive and non-additive gene action.

Beside, the ration of σ^2 GCA/σ^2 SCA was also less than one for all the characters, thereby indicating preponderance of non-additive variance for fruit yield and its contributing characters. These results are in close conformity with Aswani and Khandelwal (2005), Suneetha *et al.* (2008), Dubey *et al.* (2014) and Uddin *et al.* (2015) in brinjal.

The estimates of gca of the parent for different characters are presented in Table 2. Among the ten diveres parents, P_8 was found to be the most desirable general combiner that possesses dominant genes for most of the traits *viz.,* plant height, number of primary branches per plant, fruit length, fruit breadth, fruit girth, pedicel length, fruit weight, number of fruits per plant, and yield per hectare followed by P_4, P_5 and P_6 which were good general combiners for varying sets of characters. The high gca effects were observed primarily due to additive and additive x additive gene effects (Griffing, 1956). However overall best general combiner on the basis of per se performance and gca effect was P_8 followed by P_4 and P_5.

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 association between these two parameters was also observed by Sane *et al.* (2011) and Suneetha *et al.* (2008) in brinjal.

The estimates of sca of the crosses are presented in Table 3. The performance of lines per se together with the nature of combining ability provides the criteria for choice of parent for hybridization programme. None of the cross combination have showed simultaneous significant sca effects favorably for all the characters.

On the basis of per se performance and desirable sca effects, the cross combination(s)

Table 2
General combining ability effect of parent

Sources	*Plant height (cm)*	*Number of primary branches*	*Days to 50% flowering*	*Fruit length (cm)*	*Fruit breadth (cm)*	*Fruit girth (cm)*	*Pedicel length (cm)*	*Number of fruits per plant*	*Average fruit weight (g)*	*Fruit infestation number basis (%)*	*Yield per plant (kg)*	*Yield per ha. (q)*
P_1	17.84**	–0.31*	2.65*	0.18 **	0.24**	0.73**	0.11**	–9.35**	–0.16**	–0.95*	–31.93**	0.24**
P_2	–23.39**	–0.02	1.70*	–0.09	0.13**	0.39**	0.14**	–9.40**	–0.21**	0.13	–41.94**	0.13**
P_3	2.61*	0.30*	–0.90	0.08	–0.11**	–0.34**	0.53**	–4.81**	–0.15**	1.97**	–29.89**	–0.11**
P_4	6.99**	0.13	–2.55*	0.08	0.13**	0.39**	–0.16**	–3.36**	0.10**	–1.76**	18.03**	0.13**
P_5	–0.89	0.38**	0.90	0.22**	–0.17**	–0.50**	0.09*	10.06**	0.27**	0.12	52.61**	–0.17**
P_6	5.51**	–0.05	–1.70*	0.25**	0.06	0.18	–0.53**	–1.18*	0.16**	–0.02	31.18**	0.06
P_7	–5.15**	–0.21	0.65	–0.22**	0.03	0.09	0.15**	–3.12**	0.01	0.49	1.80	0.03
P_8	–3.52**	–0.22	–0.75	–0.49**	–0.31**	–0.94**	–0.32**	21.16**	–0.001	0.01	0.14	–0.31**
S.E. (±)	1.12	0.14	0.66	0.06	0.04	0.11	0.04	0.51	0.01	0.40	3.01	0.04
CD at 5%	2.27	0.27	1.33	0.11	0.07	0.22	0.07	1.03	0.03	0.81	6.10	0.07
CD at 1%	3.05	0.38	1.80	0.16	0.11	0.30	0.11	1.39	0.03	1.09	8.19	0.11

*,** – significant at 5 and 1 per cent level, respectively.

Table 3
Specific combining ability effect of the crosses for different characters in a 8 × 8 diallel cross in brinjal

Crosses	*Plant height (cm)*	*Number of primary branches*	*Days to 50% flowering*	*Fruit length (cm)*	*Fruit breadth (cm)*	*Fruit girth (cm)*	*Pedicel length (cm)*	*Number of fruits per plant*	*Average fruit weight (g)*	*Fruit infestation number basis (%)*	*Yield per plant (kg)*	*Yield per ha. (q)*
1 × 2	0.45	0.44	–4.52*	0.25	0.11	0.33	0.31	1.75**	–9.01**	5.26**	–0.37	–66.88**
1 × 3	13.05**	–0.39	–0.42	–0.52**	0.42**	1.26	0.13	5.29**	4.68**	–4.84**	0.36	67.00**
1 × 4	18.07**	0.29	–2.27	–0.13	0.36**	1.08	–0.14	2.72**	0.84**	1.79**	0.04	6.14**
1 × 5	7.95*	1.04*	–2.72	0.38*	0.04	0.12	0.01	–6.94**	13.56**	–1.41**	0.13	22.74**
1 × 6	15.95**	0.22	2.88	0.98**	0.10	0.29	–0.10	1.62**	13.38**	–1.73**	0.33	60.58**
1 × 7	10.11**	–0.90*	1.53	–0.24	0.39**	1.18	–1.24**	–0.83**	0.08	–0.96**	–0.27	–50.42**
1 × 8	–5.62	–0.66	0.43	0.1	–0.18	–0.54	–0.17	–13.09**	–3.99**	–3.45**	0.08	13.77**
2 × 3	–15.82**	–0.63	1.03	–0.19	–0.32**	–0.95	–0.46**	–0.36*	3.29**	–1.63**	–0.14	–25.36**
2 × 4	0.50	–0.51	0.18	0.02	–0.01	–0.03	–1.12**	9.40**	8.09**	–2.32**	0.78	143.67**
2 × 5	–12.32**	–0.66	0.73	0.07	0.04	0.11	0.81**	–5.35**	6.35**	–0.78**	0.01	0.12
2 × 6	24.98**	–0.08	–1.17	0.15	0.25*	0.73	0.02	6.39**	–0.85**	–3.69**	0.27	51.36**
2 × 7	–6.06	1.33**	2.48	0.35*	–0.10	–0.28	0.66**	9.88**	–3.64**	1.04**	0.40	72.31**
2 × 8	–7.09*	0.35	2.38	0.06	0.02	0.06	0.80**	–23.76**	7.36**	–2.81**	–0.28	–53.48**
3 × 4	4.00	–0.33	5.28*	0.8**	0.02	0.06	0.45*	–6.84**	8.44**	–2.29**	–0.43	–80.37**
3 × 5	–2.32	0.17	–2.17	–0.7**	–0.02	–0.05	–0.56**	–6.42**	15.52**	3.86**	0.25	44.44**
3 × 6	–20.72**	0.60	–3.57*	–0.31	–0.13	–0.38	0.19	2.49**	–2.05**	4.74**	–0.02	–3.19**
3 × 7	16.44**	–0.51	–2.48	–0.07	–0.45**	–1.35	0.35*	5.83**	2.98**	3.47**	0.34	62.93**
3 × 8	11.81**	1.10*	–0.02	0.84**	0.41**	1.23	–0.11	–8.49**	–1.36**	–3.14**	0.31	58.12**
4 × 5	6.40	1.59**	–2.52*	0.88**	0.45**	1.37	–0.11	4.18**	3.43**	–0.75**	0.52	94.61**
4 × 6	–29.3**	–0.73	0.08	–0.6**	–0.25*	–0.76	–0.18	0.32	5.92**	–0.40*	0.07	12.42**
4 × 7	4.66	–0.31	–2.77*	–0.21	–0.16	–0.48	–0.55**	2.26**	7.04**	–1.48**	0.21	39.01**
4 × 8	–3.57	–0.05	1.13	0.07	0.53**	1.60	0.02	–21.7**	11.29**	1.96**	–0.01	–2.39**

Cont. table 3

Crosses	*Plant height (cm)*	*Number of primary branches*	*Days to 50% flowering*	*Fruit length (cm)*	*Fruit breadth (cm)*	*Fruit girth (cm)*	*Pedicel length (cm)*	*Number of fruits per plant*	*Average fruit weight (g)*	*Fruit infestation number basis (%)*	*Yield per plant (kg)*	*Yield per ha. (q)*
5 × 6	0.58	–0.23	5.13*	–0.11	–0.06	–0.17	–0.13	1.06**	–3.99**	–2.37**	–0.07	–14.78**
5 × 7	13.84**	0.18	2.78	0.55**	–0.06	–0.19	0.53**	1.99**	4.38**	–5.03**	0.36	72.10**
5 × 8	12.51**	–0.06	2.63	0.31	–0.10	–0.31	0.31	1.46**	0.62**	–2.23**	0.75	146.59**
6 × 7	8.24*	–0.64	–2.11	–0.4*	–0.09	–0.27	–0.84**	8.26**	2.16**	1.24**	0.48	88.08**
6 × 8	12.91**	0.13	–0.72	–0.05	0.49**	1.46	0.57**	–19.68**	20.27**	–0.14	0.44	81.70**
7 × 8	11.17**	0.79	1.43	–0.56**	0.25*	0.75	–0.11	–24.87**	13.62**	4.27**	–0.18	–33.99**
S.E. (sij)	3.43	0.41	2.01	0.17	0.11	0.33	0.11	1.55	2.89	1.22	0.05	9.22
C.D. 5 %	6.97	0.84	4.08	0.35	0.22	0.67	0.22	3.16	5.86	2.48	0.09	18.71
C.D. 1 %	9.33	1.12	5.47	0.46	0.30	0.90	0.30	4.22	7.86	3.32	0.14	25.08

*,** – significant at 5 and 1 per cent level, respectively.

$P_5 \times P_8$, $P_4 \times P_5$, $P_5 \times P_7$, $P_6 \times P_7$, $P_2 \times P_4$, $P_6 \times P_8$, $P_5 \times P_6$, $P_3 \times P_5$ and $P_1 \times P_6$ were found to be promising for all the characters under study.

The crosses having high sca effect and also involved at least the one good general combiner parent may be considered useful because such croses provide transgressive type of segregants in the advanced generation more frequently than crosses with the poor combiner parents. It is clear from the present study that the cross combination $P_1 \times P_6$ for plant height, fruit length, $P_2 \times P_4$ for yield per hectare, $P_3 \times P_5$ for minimum fruit infestation on number basis, $P_4 \times P_5$ for number of primary branches, days to 50% flowering yield per hectare, $P_5 \times P_8$ for yield per hectare and $P_6 \times P_8$ for fruit weight may give rise to the transgressive segregants in the advance generations.

The results derived from combing ability studies are more or less, in consonance with the earlier findings of Khapte *et al.* (2013) Mishra *et al.* (2013), Dubey *et al.* (2014) and Uddin *et al.* (2015) in brinjal, they reported that the crosses having sca effect will be useful, if the parents involve are also good general combiner specially in self-pollinated crops.

The hybrids with significant positive or negative cross effect involved either high × high combing parents suggesting the role of cumulative effects of favorable genes, or poor × poor, suggesting the involvement of complementation of gene present in the parent, or avarge × average combing parents indication the involvement of dominance effect.

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