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

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ABSTRACT

A set of 7 x 7 diallel crosses excluding reciprocals was studied for combining ability in brinjal. The analysis showed that general combining ability variances were significant for all the characters. The ratio of additive to nonadditive genetic variance indicated prepondarance of non additive type of gene action for all the characters. General combining ability of the parents revealed that the parents K-314, P.B.R.-5 and Pusa Purple Long were good general combiners for fruit yield per plant and some of the yield contributing characters. Hybrids K-316 x N.D.B.-25, K-316 x Pusa Purple Long, P.B.R.-5 x K-314 and Junagadh Selection-1 x Pusa Purple Long were good specific combinations for fruit yield per plant and most of its yield contributing characters.

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INTRODUCTION

Brinjal (*Solanum melongena* L.) also known as eggplant, is one of the important vegetable crops. It is cultivated throughout the tropics and also as a summer annual in warm subtropics. Brinjal having 2n=24 chromosomes belong to the family solanaceae and is classified as a self-pollinated crop. However, natural out crossing has also been reported which is known to vary with the variety and environment, the average being about 6 to 7 per cent (Choudhary, 1976). According to Vavilov (1928), brinjal had originated in India.

The average yield of existing varieties of brinjal has remained low, despite the fact that considerable scope exists for its improvement by adopting appropriate breeding programmes. In crop improvement programme, the breeder is often confronted with the difficulty of choosing the parental lines which when crossed, will result in a higher proportion of desirable segregants. Therefore, in order to develop high yielding varieties, firstly, it would be most appropriate to identify better combiners for different traits. The evaluation of potential parental lines for combining ability is not only helpful in selecting the parents for hybridization, but also for developing superior hybrids.

Amongst different approaches available for studying combining ability, Griffing's (1956) method of working out combining ability from the diallel crosses is one of the most widely used methods because of its precision and

versatility. The same has been followed in present investigation. The method in short provides a systematic approach for identification of superior parents and crosses, which is the basic requirement for successful breeding programme.

MATERIALS AND METHODS

The seven diverse genotypes used in generating the experimental material were, Junagadh Selection-1, K-316, Kat-4, Pusa Purple Long, N.D.B.-25, P.B.R.-5 and K-314. These were crossed during kharif 1988-89, in diallel fashion making all possible combinations, excluding reciprocals, to obtain seeds of 21 F_1 'S. The 28 entries comprising of seven parents and their 21 hybrids were transplanted in a randomized block design with three replications at Vegetable Research Farm, College of Agriculture, Sardar Krushinagar during *kharif*-1989. Each entry was grown in one row plot of six meters length keeping inter and intra row distance of 90 and 60 cm, respectively. Data were recorded on five randomly selected plants from each entry in each replication for various characters. Then the mean values were calculated and used for statistical analysis. The observations were recorded for eight characters viz., days to flowering, plant height, number of primary branches per plant, number of fruits per plant, average fruit weight, fruit length, fruit girth and fruit yield per plant.

Mean values of 28 entries comprising of seven parents and 21 hybrids were arranged in a diallel tabie for combining ability analysis according to the procedure described by Griffing (1956) for model-I (fixed model) and method-2 in which parents and one set of F_1S were included without reciprocals. Model-I assumes that the variety and block effects are constant (fixed) but environmental effect is variable.

TABLE 1

Analysis of variance for combining ability, estimation of components of genetic variance and their ratios for different characters.

Characters	*Mean squares*			*Genetic variance*		$\frac{1}{\text{d.f. g.c.a}} \Sigma g_i^2 \Big/ \frac{1}{\text{d.f. s.c.a.}} \Sigma\Sigma s_{ij}^2$
	g.c.a	*s.c.a.*	*Error*	Σg_i^2	$\Sigma\Sigma s_{ij}^2$	
Days to flowering	98.498**	13.819**	1.021	64.985	268.758	0.846
Plant height	180.264**	65.319**	7.539	115.150	1213.80	0.332
Number of primary branches per plant	0.412*	0.947**	0.156	0.171	16.611	0.036
Number of fruits per plant	50.088**	18.957**	3.008	31.387	334.929	0.328
Average fruit weight	224.194**	92.011**	2.961	147.489	1870.05	0.276
Fruit length	7.768**	3.320**	0.221	5.031	65.079	0.271
Fruit girth	4.778**	1.430**	0.091	3.131	28.119	0.389
Fruit yield per plant	213149.600**	189927.600**	14614.120	132356.986	3681583.08	0.126

*, ** = Significant at 5% and 1% level of significance, respectively.

RESULTS AND DISCUSSION

In a systamatic breeding programme, selection of parents with desirable characteristics, having good general combining ability effects for yield as well as its component characters and cross combinations having high estimates of specific combining ability effects are obviously the essential features.

In present study, the analysis of combining ability variance (Table-1) indicates that general combining ability and specific combining ability variances are significant for all the characters. This suggests that both additive and non additive gene effects are involved in the expression of fruit yield per plant and its components, but later is predominant. The ratio of additive to non additive genetic variance also shows that non additive genes are predominantly involved in the expression of fruit yield per plant and its components. The results are in general agreement with the findings of Gotoh (1954), Rajendran (1972), Lal *et al.* (1973), Peter and Singh (1973), Singh *et al.* (1974, 1981) and Parmar (1988). The results of present study suggest that, for exploitation of both additive and nonadditive genetic variances, population breeding approach in the form of biparental crosses followed by modified reccurent selection may result in greater genetic improvement in the early segregating generations. The similar view was held by Dixit *et al.*, 1984.

General combining ability effects of parents (Table-2) reveals that none of the parents has proved to be good combiner for all the characters. Parent K-314 was found to be good general combiner for days to flowering, plant height, number of fruits per plant, average fruit weight, fruit length and fruit yield per plant. The high yielding parent PBR-5 was found to be good general combiner for days to flowering, number of primary branches per plant, average fruit weight, fruit girth and fruit yield per plant. The dwarf parent Pusa Purple Long proved to be good general combiner for days to flowering, number of fruits per plant, fruit length and fruit yield per plant. Parent Junagadh Selection-1 was observed to be good general combiner for plant height, average fruit weight, fruit length and fruit girth. The late flowering parent N.D.B.-25 was found to be good general combiner for fruit girth.

As far as specifc combining ability effects are concerned, no cross-combination was consistently good for all the characters (Table-3). The third high yielding hybrid K-316 x N.D.B.-25 (average x poor) recorded highest significant positive SCA effects for fruit yield per plant. This hybrid also recorded significant SCA effects in desired direction for remaining all the characters except fruit length. The highest yielding hybrid PBR-5 x K-314 (good x good) manifested significant SCA effects in desired direction for fruit yield per plant, days to flowering, plant height, number of fruits per plant and average fruit weight. Second high yielding hybrid K-316 x Pusa Purple Long (average x good) had significant SCA effects in desired direction for all the characters except plant height. The fourth high yielding hybrid Junagadh Selection-1 x Pusa Purple Long (poor x good) exhibited significant SCA effects in desired direction for number of primary branches per plant, average fruit weight and fruit yield per plant. Certain hybrids showed SCA effects in negative direction as well. The crosses displaying high positive or negative SCA effects contained good x good, good x average, good x poor, average x average, average x poor and poor x poor combiners. The

TABLE 2

Estimates of general combining ability (gca) effects of parents for various characters.

Parents	*Days to flowering*	*Plant height*	*Number of primary branches per plant*	*Number of fruits per plant*	*Average fruit weight*	*Fruit length*	*Fruit girth*	*Fruit yield per plant*
J.S.-1	2.18**	4.41**	0.15	-3.14**	4.04**	0.93**	0.76**	-108.45**
K-316	1.59**	5.84**	0.02	-0.99	3.28**	-0.77**	0.20**	30.43
Kat-4	3.96**	-3.44**	0.07	-0.38	-9.54**	-0.95**	-1.37**	-257.58**
P.P.L.	-2.86**	-5.88**	-0.12	4.40**	-3.13**	1.12**	-0.47**	187.42**
N.DB.-25	2.59**	-3.87**	-0.41**	-1.13*	-0.59	-1.09**	0.34**	66.87
P.B.R.-5	-3.93**	0.81	0.25*	-0.05	4.30**	0.18	0.59**	95.79*
K-314	-3.52**	2.13*	0.05	1.30*	1.63**	0.59**	-0.04	119.35**
S.E. (g.) ±	0.31	0.85	0.12	0.53	0.53	0.14	0.09	37.31
S.E.(g_j-g_i) ±	0.48	1.29	0.19	0.82	0.81	0.22	0.14	56.99

*, ** = Significant at 5% and 1% level of significance, respectively.

J.S.-1 = Junagadh Selection-1 and P.P.L. = Pusa Purple Long.

TABLE 3

Estimates of specific combining ability (sca) effects of hybrids for various characters.

Hybrids	Days to flowering	Plant height	Number of primary branches per plant	Number of fruits/ plant	Average fruit weight	Fruit length	Fruit girth	Fruit yield/ plant
J.S.-1 x K-316	0.93	2.11	-0.36	-2.16	7.15**	-0.53	-0.60*	-48.04
J.S.-1 x Kat-4	0.23	2.79	0.32	1.39	7.98**	2.30**	0.68*	281.85*
J.S.-1 x P.P.L.	5.05**	4.77	0.97**	2.52	5.202**	0.01	0.31	351.89**
J.S.-1 x N.D.B.-25	-6.73**	10.28**	-1.13**	-0.19	-3.19*	-2.22**	1.59**	-115.81
J.S.-1 x P.B.R.-5	3.79**	2.80	0.21	-0.94	11.71**	1.91**	0.007	151.50
J.S.-1 x K-314	-3.29**	-1.91	1.14**	4.13**	-3.18*	2.98**	-0.54*	184.73
K-316 x Kat-4	1.16	-4.24	-0.55	-3.50*	9.70**	3.22**	0.28	-13.75
K-316 x P.P.L.	-5.69**	-11.20**	0.77*	5.04**	11.61**	2.66**	1.13**	666.11**
K-316 x N.D.B.-25	-2.47**	9.45**	0.80**	9.16**	9.19**	-0.08	2.66**	809.97**
K-316 x P.B.R.-5	1.38	5.30*	0.20	-2.00	-4.40**	-1.02*	0.11	-251.59*
K-316 x K-314	-3.03**	6.72**	1.34**	0.06	0.35	-0.50	0.13	-18.28
Kat-4 x P.P.L.	-1.06	6.22**	0.78*	3.93*	3.76**	0.41	-0.07	270.08*
Kat-4 x N.D.B.-25	-1.51	-1.26	-0.39	-1.36	-9.40**	-1.14**	-1.76**	-278.41*
Kat-4 x P.B.R.-5	1.68	10.12**	0.75*	1.72	-2.92	-1.37**	0.78**	29.12
Kat-4 x K-314	1.93*	1.48	-0.25	1.62	-5.31**	-0.56	0.07	-101.87
P.P.L. x N.D.B.-25	2.64**	8.17**	-0.07	4.77*	-1.23	-0.91*	-1.20**	198.26
P.P.L. x P.B.R.-5	4.82**	-4.71	0.01	-0.40	-0.31	-0.50	0.64*	-25.87
P.P.L x K-314	-3.25	8.91**	0.14	0.25	1.95	0.79	1.37**	67.11
N.D.B.-25 x P.B.R.-5	-4.95	1.14	1.83**	0.81	11.10**	1.76**	0.95**	286.63**
N.D.B.-25 x K-314	1.97*	-9.70**	0.63	0.87	7.15**	1.38**	0.37	205.89
P.B.R.-5 x K-314	-2.51**	6.13*	-0.42	4.70**	12.00**	0.28	0.16	673.66**
S.E. (S_{ij}) ±	0.89	2.42	0.35	1.53	1.52	0.41	0.27	106.61
S.E. (S_{ij} - S_{kl}) ±	1.26	3.42	0.49	2.16	2.15	0.59	0.38	150.77

*, ** = Significant at 5% and 1% level of significance, respectively.
J.S.-1 = Junagadh Selection-1 and P.P.L. = Pusa Purple Long.

marked undesirable SCA effects in hybrids between good x good combiners can be attributed to the lack of coadoptation between favourable alleles of the parents involved.

On the basis of combining ability analysis, the most promising parents were K-314, PBR-5 and Pusa Purple Long. The most promising hybrids were, K-316 x N.D.B.-25, K-316 x Pusa Purple Long, PBR-5 x K-314 and Junagadh Selection-1 x Pusa Purple Long. These parents and hybrids offer the best possibility of their future exploitation for developing high yielding varieties.

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