Internat. J. agric. Sci. Vol.2 No.2 July 2006 : (411-413)

Diallel analysis for yield and yield components in summer brinjal (*Solanum melongena* L.)

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ABSTRACT
Combining ability analysis of a 10 x 10 diallel, excluding reciprocals was undertaken for fruit yield per plant and its component characters in round brinjal. Non-additive gene action was noticed to be pre-ponderant for fruit yield per plant and the yield component characters studied. A perusal of the *gca* effects revealed KS 224, PLR 1, Surati Ravaiya and JBPR 1 to be good general combiners for fruit yield per plant. These parents had also recorded high *per se* performance for the trait, indicating their suitability in breeding programmes for development of high yielding hybrids. Among the hybrids, 22 crosses had exhibited significant and desirable *sca* effects for fruit yield per plant. Of these, eight crosses had recorded desirable *sca* effects in addition to significantly high *per se* performance, compared to hybrid mean for the trait. An analysis of these crosses revealed the involvement of a good and a poor general combiner parent for majority (62.5%) of the crosses; and both good (25%) or both poor (12.5%) in few cases. The hybrid, PLR 1 x JBPR 1, involving both good combiner parents for fruit yield per plant, 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 off-season commercial exploitation.

Key words : Brinjal, Combining Ability, Fruit Yield, Yield Components, Summer

INTRODUCTION

Brinjal is an important vegetable crop being increasingly grown during summer season, as an off-season vegetable in Gujarat for its premium price during the season. The productivity of F_1 hybrids in brinjal has been reported to be high, compared to varieties (Varghese and Vahab, 1994). Further, the use of hybrid cultivars of brinjal has been predicted to increase in the country in the ensuing years (Singh, 2000), owing to low cost of hybrid seed due to higher rate of successful cross setting and large number of seeds per fruit. Information on combining ability is however, a pre-requisite for development of superior hybrids, since it helps in the identification of superior parents with better *gca* and crosses with high *sca* effects. Knowledge on the nature of gene action governing quantitative traits is also essential for planning systematic crop improvement programmes. In this context, the present investigation was undertaken to elucidate information on the nature of gene action and combining ability of round brinjal genotypes for fruit yield and yield component characters, in addition to identification of potential round brinjal hybrids for cultivation during summer season.

MATERIALS AND METHODS

The experimental material comprised of ten elite homozygous lines, namely, KS 224, JB 64-1-2, AB 98-10, AB 98-13, PLR 1, Gandhinagar Local, Bombay Gulabi, Morvi 4-2, Surati Ravaiya and JBPR 1 (Table 1) obtained from the germplasm collections maintained at the Main Vegetable Research Station, Gujarat Agricultural University, Anand and their 45 hybrids derived from the 10 x 10 diallel mating (excluding reciprocals) of these lines. The hybrids and parents were evaluated along with the check, GBH 1 in a randomized block design with three replications for fruit yield and yield component characters namely, days to first picking, plant height, primary branches per plant, fruit length, fruit diameter, fruit weight and number of fruits per plant at the Main Vegetable Research Farm, Anand.

The sowings were undertaken in the nursery during the first week of February and transplanting of the seedlings was effected 35-40 days after sowing, depending on the growth of seedlings. The normal, healthy and vigorous seedlings of each genotype were transplanted in a single row plot of 6 m length, with a spacing of 90 x 60 cm and 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. Observations for plant height and number of primary branches per plant were recorded at last picking. In contrast, data on number of fruits per plant and fruit yield per plant was obtained for each picking and the average was computed. However, for fruit yield per plant, the total of all pickings was obtained. The observations on fruit length, fruit diameter and fruit weight were recorded on five random fresh fruits taken from each genotype in each replication and the mean values were calculated. Observations on days to first picking were however, recorded on plot basis. The estimates of combining ability variances and effects were obtained using Diallel analysis, Method 2 of Model I, suggested by Griffing (1956).

RESULTS AND DISCUSSION

The analysis of variance for combining ability (Table 1) revealed significant mean squares due to *gca* and *sca* for fruit yield per plant and the yield component characters studied, namely, days to first picking, plant height, primary branches per plant, fruit length, fruit diameter, fruit weight and fruits per plant, indicating the importance of both additive and non-additive gene actions for these traits. Several workers had also reported similar results for fruit yield per plant, plant height and primary branches per plant (Baig and Patil, 2002); days to first picking (Vaghasiya *et al*., 2000); fruit length and fruit weight (Das and Barua, 2001); fruit diameter (Varshney *et al*., 1999) and fruits per plant (Baig and Patil, 2002).

Non-additive gene action was however, found to be pre-ponderant for fruit yield per plant and the yield components studied, indicating the need for heterozygosity in the population and heterosis exploitation for improvement of these traits. Similar results were reported earlier for fruit yield and fruits per plant (Vaghasiya *et al*., 2000); days to first picking (Kale *et al*., 1992); plant height (Vaghasiya *et al*., 2000); primary branches per plant, fruit length and fruit weight (Prasanth *et al*., 1999); and fruit diameter (Baig and Patil, 2002). The predominant role played by non-additive gene action in brinjal for fruit yield and yield component characters has also been reported by Patil and Shinde (1989).

A perusal of the general combining ability (*GCA)* effects for parents (Table 2) revealed that none of the parents was good general combiner for all the characters studied. However, KS 224 was observed to be good combiner for fruit yield per plant, days to first

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Table 1 : Combining ability ANOVA for fruit yield and component characters in summer brinjal

Source	d.f	Fruit yield/plant	Days to first picking	Plant height	Primary branches/ plant	Fruit length	Fruit diameter	Fruit weight	Fruits per plant
gca	9	0.15**	69.01**	323.25**	0.27**	2.13**	10.21**	759.51**	1269.57**
sca	45	0.11**	28.40**	51.50**	0.11*	0.52**	1.76**	89.84**	130.26**
Error	108	0.01	0.07	17.09	0.05	0.05	0.22	12.78	12.13
σ^2gca		0.01	5.75	25.51	0.02	0.17	0.83	62.23	104.79
σ^2sca		0.10	28.33	34.41	0.06	0.47	1.54	77.06	118.13
σ^2gca/σ^2sca		0.10	0.20	0.74	0.33	0.36	0.54	0.81	0.89

*,** Significant at 5 and 1 per cent levels, respectively

picking, fruit length and fruit diameter; JB 64-1-2 for fruits per plant; AB 98-10 for days to first picking and fruits per plant; AB 98-13 for fruit weight; PLR 1 for fruit yield per plant, days to first picking and fruits per plant; Gandhinagar Local for days to first picking; Bombay Gulabi for plant height, primary branches per plant and fruit weight; Morvi 4-2 for days to first picking, fruit length, fruit diameter and fruit weight; Surati Ravaiya for fruit yield per plant, plant height, primary branches per plant, fruit length, fruit diameter and fruit weight; and JBPR 1 for fruit yield per plant, fruit length and fruits per plant. These parents may therefore be used in crop breeding programs aimed at improvement of the respective traits. Further, consideration of *per se* performance in combination with combining ability estimates was reported to provide a better criteria for the choice of superior parents in hybridization programs (Rao,1972). Similarly, Prasad and Singh (1986) reported the importance of high *per se* performance in selection of superior parents. The parents, KS 224, PLR 1, Surati Ravaiya and JBPR 1 exhibiting significant and desirable *gca* effects for fruit yield per plant had also recorded high *per se* performance for the trait. Hence, these parents may be used in the hybridization programmes aimed at development of superior hybrids.

The study of specific combining ability effects (Table 3) revealed significant and desirable effects for several hybrids with regards to yield and yield components. 22 hybrids had exhibited significant and desirable *sca* effects for fruit yield per plant. Among these, only eight hybrids (KS 224 x AB 98-10, JB 64-1-2 x AB 98-13, JB 64-1-2 x PLR 1, PLR 1 x Bombay Gulabi, PLR 1 x JBPR 1, Morvi 4-2 x Surati Ravaiya, Morvi 4-2 x JBPR 1 and Surati Ravaiya x JBPR 1) had recorded significant and desirable *sca* effects, coupled with significantly high *per se* performance, compared to hybrid mean for fruit yield per plant. An analysis of the *gca* effects of the parents for these elite crosses with regards to fruit yield per plant revealed maximum number of elite hybrids (62.5%) to be of high x low type. The production of superior hybrids with the combination of high and low *gca* parents has also been reported by Chaudhary and Malhotra (2000). Das and Barua (2001) inferred that such crosses would throw up desirable transgressive segregants, if the additive genes present in the good combiner and complementary epistatic effects, present in the cross, act in the same direction so as to maximize the desirable plant attributes. In few cases (25%), crosses with both good general combiner parents (PLR 1 x JBPR 1 and Surati Ravaiya x JBPR 1) had also exhibited high *sca* effects, indicating the role of additive x additive type of gene action and hence, a good scope for fixation of the heterotic effects through the isolation of high yielding homozygous lines in advance generations. Chaudhary and Malhotra (2000) also reported the production of superior hybrids in crosses involving both parents with high *gca* effects for yield and its component characters. Similarly, Das and Barua (2001) inferred crosses involving two good combiners to be of particular merit, in practical brinjal breeding programs and suggested bi-parental mating among the F_2 progenies for evolving of better genotypes through the combination of desirable attributes. Further, superior hybrids (12.5%) were also noticed to result with both poor combiner parents (JB 64-1-2 x AB 98-13), indicating the presence of dominance x dominance type of gene action and hence its exploitation as hybrid only. The findings are in conformity with the

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

Parent	Fruit yield per plant	Days to first picking	Plant height	Primary branches per plant	Fruit length	Fruit diameter	Fruit weight	Fruits per plant
KS 224	0.07*	-1.01**	-2.68*	0.01	0.34**	0.53**	-0.49	-2.92**
JB 64-1-2	-0.00	0.73**	-1.19	-0.19**	-0.42**	-0.93**	-9.10**	8.18**
AB 98-10	0.02	-2.76**	-5.03**	-0.09	-0.30**	-1.12**	-8.99**	10.41**
AB 98-13	-0.10**	2.81**	0.23	-0.08	-0.05	-0.08	2.58**	-7.18**
PLR 1	0.13**	-2.76**	-5.16**	-0.20**	-0.16*	-0.45**	-6.16**	12.89**
Gandhinagar Local	-0.16**	-2.76**	-4.83**	0.07	-0.43**	-0.07	-2.68**	-2.14*
Bombay Gulabi	-0.15**	3.73**	11.58**	0.22**	-0.26**	0.26	8.50**	-11.80**
Morvi 4-2	-0.03	-0.51**	0.78	0.08	0.91**	1.75**	12.64**	-8.65**
Surati Ravaiya	0.09**	2.23**	4.51**	0.20**	0.17**	1.02**	9.42**	-12.25**
JBPR 1	0.13**	0.31**	1.78	-0.01	0.21**	-0.90**	-5.71**	13.47**
SE (g_i) $\pm$	0.03	0.08	1.17	0.07	0.07	0.14	1.01	0.99

*,** Significant at 5 and 1 per cent levels, respectively

Table 3 : Specific combining ability of the hybrids for fruit yield and component characters in summer brinjal

Characters	Range		Number of hybrids with significant and desirable *sca* effects
	Minimum	Maximum	
Fruit yield per plant	-0.60**	0.80**	22
Days to first picking	-6.09**	20.40**	26
Plant height	-9.76**	14.94**	15
Primary branches per plant	-0.46**	0.78**	15
Fruit length	-1.71**	1.90**	21
Fruit diameter	-2.76**	2.41**	22
Fruit weight	-19.99**	25.69**	16
Fruits per plant	-23.48**	37.62**	20

*,** Significant at 5 and 1 per cent levels, respectively

reports of Varshney *et al.* (1999). Among the above hybrids, PLR 1 x JBPR 1 hybrid had recorded maximum fruit yield per plant and hence, is identified as a potential round brinjal hybrid for off-season commercial cultivation. The hybrid is also relatively early, dwarf and compact with higher fruit number per plant, and therefore, highly suitable for brinjal based inter-cropping systems.

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Received : November, 2005; Accepted : March, 2006