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Combining ability and gene action for fruit yield and its attributes in brinjal (S*olanum Melongena* L.)

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ABSTRACT
Gentic studies for fruit yield per plant and its attributing traits in brinjal was conducted by following line x tester mating design comprising of seven lines and four testers at Instructional Farm, Junagadh Agricultural University, Junagadh, Gujarat. The analysis of combining ability revealed the predominant role of both additive and non-additive gene effects in the inheritance of fruit yield and its component traits. The genotypes NSR-1, JBG-10-208 and Pant Rituraj displayed high gca effect for fruit yield per plant and some desirable traits like days to 50 % flowering, days to first picking, fruit girth, fruit weight, numbers of primary branches per plant, plant spread and total soluble solids. The estimates of sca effect of the crosses indicated that five hybrids manifested significant and positive sca effect for fruit yield per plant. The crosses JBG-10-208 x GJB-2, ABR-2-23 x GBL-1 and AB-09-1 x GOB-1 were emerged as best specific combinations. The cross JBG-10-208 x GJB-2 was also found good specific combiner for plant height, fruit weight, fruit girth and number of primary branches per plant and also showed maximum *per se* performance. These hybrids may be exploited for obtaining transgressive segregants toward developing hybrid varieties in brinjal.

Key words: Brinjal, Combing ability, Fruit yield, Gene action.

INTRODUCTION

Brinjal (*Solanum melongena* L.), also known as eggplant, is an important solanaceous vegetable crop grown round the year in India. It is grown for its immature, unripe fruits which are used in the variety of ways as cooked vegetable in curries. It is grown extensively in all parts of India except at higher altitude. It is popular among the people of all social strata and hence, it is rightly called as vegetable of masses (Patel and Sarnaik, 2003). With increasing popularity of F_1 hybrids in brinjal, it is imperative to obtain hybrid having excellent quality coupled with high fruit yield. A knowledge of general combining ability (gca) and specific combining ability (sca) helps in choice of parents and hybrids respectively and the nature of gene action acts as a basis for choosing effective breeding strategies. The present investigation, therefore, was undertaken to identify potential parental combinations in order to identify superior hybrids of excellent qualities coupled with high fruit yield per plant in brinjal.

MATERIALS AND METHODS

The experimental material comprised of parents and their F_1s derived by crossing seven lines *viz.*, JBL-08-08 (Fruits are long and light purple in colour), AB-09-1 (Fruits are purple and medium round), JBG-10-208 (Fruits are big round and attractive due to shining of bright purple colour), JBL-10-04 (Fruits are purple, big and oblong shape), NSR-1 (Fruits are pink medium round), JB-12-06 (Fruits are green and round) and ABR-2-23 (Fruits are pink purple and oblong) and four testers *viz.*, GOB-1 (Fruits are black and medium oblong), GJB-2 (Fruits are pink purple and medium long), GBL-1(Fruits are purple long and born in cluster) and Pant Rituraj (Fruits are round purple and slightly tapering toward bottom) in a line x tester fashion. The genotypes were selected on the basis of morphological variability for growth, maturity, fruit size and shape, fruit yield and yield contributing characters. The experiment was laid out in a randomized block design with three replications during *kharif*-2014 at Instructional Farm, Junagadh Agricultural University, Junagadh, Gujarat. The observations were recorded on 11 characters *viz.,* days to 50 % flowering, days to first picking, fruit length (cm), fruit girth (cm), fruit weight (g), number of fruits per plant, number of primary branches per plant, plant height (cm), plant spread (cm), total soluble solids (^oB) and fruit yield per plant (kg). Combining ability analysis was carried out by the method suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance for combining ability indicated that the mean squares due to lines were significant for all the characters, whereas the mean squares due to testers were significant for all the characters except for days to 50 % flowering and days to first picking. The mean squares due

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Table-1 : Analysis of variance for combining ability and variance components for different characters in brinjal.

Source	d.f.	Days to 50 % flowering	Days to 1st picking	Fruit length (cm)	Fruit girth (cm)	Fruit weight(g)	Number of fruits per plant
Replications	2	20.76*	10.48	0.79	0.03	23.22	4.28
Lines	6	27.19**	27.10**	3.82**	3.04**++	3133.30**++	82.90**+
Testers	3	9.63	4.48	18.73**++	5.36**++	1342.93**	24.64**
Lines x Testers	18	30.81**	28.62**	1.91**	0.67**	519.33**	27.58**
Error	54	4.47	4.21	0.56	0.17	33.19	5.09
Variance components							
ó^{2}gca		0.84	0.70	0.64	0.24	133.63	2.95
ó^{2}sca		8.71	8.13	0.45	0.16	162.04	7.49
ó^{2}gca/ ó^{2}sca		0.09	0.08	1.44	1.46	0.82	0.39

Source	d.f.	Number of primary branches	Plant height(cm)	Plant spread (cm)	TSS	Fruit yield per plant (kg)
Replications	2	0.08	12.06	19.66	0.022	0.006
Lines	6	1.77**	583.31**++	558.88**	0.738**	0.3085**
Testers	3	2.77**	116.94**	140.48**	0.621**	0.1016*
Lines x Testers	18	1.44**	68.91**	169.51**	1.104**	0.1812**
Error	54	0.17	14.28	31.03	0.054	0.026
Variance components						
ó^{2}gca		0.12	20.35	19.31	0.037	0.010
ó^{2}sca		0.42	18.21	46.16	0.350	0.051
ó^{2}gca/ ó^{2}sca		0.30	1.11	0.41	0.108	0.209

*, ** Significant at 5 and 1 per cent levels, respectively
+,++ Significant at 5 and 1 per cent levels, respectively against lines x testers interaction.

to lines x testers were found significant for all the characters studied. This indicated predominant role of both additive and non-additive gene effects in the inheritance of all these traits (Table 1).

The ratio of σ^2gca/σ^2sca was less than unity for days to 50 % flowering, days to first picking, fruit weight, number of fruits per plant, number of primary branches per plant, fruit yield per plant, plant spread and total soluble solids which indicated the importance of non-additive gene action. For remaining characters *viz.,* fruit length, fruit girth and plant height, the ratio of σ^2gca/σ^2sca was more than unity indicating the importance of additive gene action for these three traits. These results are in accordance with those obtained by Vaddoria *et al.* (2004) and Shanmugapriya *et al.* (2009) for days to 50 % flowering, numbers of primary branches per plant and fruit yield per plant; Sao and Mehta (2010) and Pachiyappan *et al.* (2012) for days to first picking, numbers of fruits per plant and plant height; Patel *et al.* (2013) and Ansari and Singh (2014).for plant height.

The estimates of gca effect (Table 2) indicated that among the lines, NSR-1 ranked first as it was good general combiner for most of the characters *viz.,* days to 50 % flowering, days to first picking, fruit girth, fruit weight, number of primary branches per plant, plant spread and fruit yield per plant. Other good general combiners identified for different characters were JBG-10-208 for four character *viz.*, fruit girth, fruit weight, total soluble solids and fruit yield per plant; Pant Rituraj for fruit girth, fruit weight and fruit yield per plant; JB-12-06 for four characters *viz.,* number of fruits per plant, number of primary branches per plant, plant height and total soluble solids. Among the testers, GBL-1 was good general combiner for fruit length and number of primary branches per plant, whereas GJB-2 was good general combiner for three characters *viz.,* fruit length, number of fruits per plant and plant height. Good general combining ability effect was exerted for plant height and total soluble solids by GOB-1. For days to 50 % flowering, days to first picking, number of primary branches per plant and plant height, the line ABR-2-23 was exerted good general combining ability effect. In view of this, NSR-1, Pant Rituraj, JBG-10-208, ABR-2-23 and JB-12-06 offered the best possibilities of exploitation for development of improved varieties with enhanced fruit yielding ability in brinjal and these lines turned out to be good general combiners and can be used as donor parents in fruit yield improvement programme. Similar finding was also reported by Das and Barua (2001), Singh *et al.* (2003), Kamal *et al.* (2006) and Kumar *et al.* (2012) in brinjal.

The estimates of sca effect of the crosses indicated that five hybrids manifested significant and positive sca effect for fruit yield per plant. These best five specific combinations were JBG-10-208 x GJB-2 followed by ABR-2-23 x GBL-1, AB-09-1 x GOB-1, JBL-08-8 x GJB-2 and JB-12-06 x GOB-1 (Table 3). The cross JBG-10-208 x GJB-2 was also

Table-3 : Specific combining ability effects for different characters in brinjal.

Crosses	Days to 50% flowering	Days to first picking	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of fruits per plant	Number of primary branches per plant	Plantheight (cm)	Plant spread (cm)	Total Soluble Solids(°B)	Fruityield per plant (kg)
JBL-08-8 x GOB-1	-1.26	-2.26	-0.59	0.16	1.76	-1.61	0.12	1.52	2.12	-0.83 **	-0.14
JBL-08-8 x GJB-2	2.40	3.12 **	1.14 *	0.21	5.51	1.16	-0.36	0.80	4.47	-0.49 **	0.22 *
JBL-08-8 x GBL-1	-3.17 *	-1.31	-1.00 *	0.15	-2.13	2.91 *	0.48	-1.15	2.52	0.98 **	0.16
JBL-08-8 x Pant Rituraj	2.02	0.45	0.45	-0.52 *	-5.14	-2.46	-0.23	-1.17	-9.12 **	0.34 *	-0.23 *
AB-09-1 x GOB-1	2.40	2.40 *	0.97 *	-0.48	-8.09 *	3.09 *	-0.07	4.46 *	-1.03	-0.03	0.23 *
AB-09-1 x GJB-2	2.40	2.12	-0.62	-0.10	-9.91 **	2.29	0.61 *	3.33	6.40 *	0.47 **	-0.11
AB-09-1 x GBL-1	-5.17 **	-4.31 **	0.41	0.31	12.75 **	-4.69 **	-0.63 *	-4.56 *	-2.81	-0.13	-0.19 *
AB-09-1 x Pant Rituraj	0.36	-0.21	-0.75	0.27	5.25	-0.69	0.09	-3.23	-2.55	-0.31 *	0.08
JBG-10-208 x GOB-1	-3.60**	-1.68	-0.77	-0.02	-5.07	2.38	0.43	0.83	7.09 *	0.52 **	0.16
JBG-10-208 x GJB-2	1.40	0.04	-0.25	0.98 **	15.10 **	-0.78	0.82 **	4.70 *	-1.65	-0.45 **	0.37 **
JBG-10-208 x GBL-1	2.83 *	1.94	1.24 **	-0.77 **	-22.52 **	-0.31	-0.80 **	-4.44 *	-11.06**	0.35 **	-0.51 **
JBG-10-208 x Pant Rituraj	-0.64	-0.30	-0.21	-0.20	12.49 **	-1.29	-0.45	-1.09	5.62	-0.42 **	-0.02
JBL-10-04 x GOB-1	3.57 **	4.15 **	-0.35	-0.13	-9.87 **	-0.61	0.77 **	-7.20 **	-5.08	0.70 **	-0.22 *
JBL-10-04 x GJB-2	-2.10	-3.80 **	0.12	-0.71 **	-18.35 **	3.78 **	-0.06	-4.68 *	-0.37	-0.03	-0.01
JBL-10-04 x GBL-1	2.00	1.11	0.32	0.65 **	15.09 **	-1.54	-0.14	10.47 **	4.69	-0.80 **	0.15
JBL-10-04 x Pant Rituraj	-3.48 **	-1.46	-0.09	0.20	13.13 **	-1.63	-0.57 *	1.41	0.76	0.13	0.07
NSR-1 x GOB-1	-1.01	-1.68	0.73	0.01	3.49	-1.35	-0.60 *	0.92	-6.15	-0.05	-0.15
NSR-1 x GJB-2	-0.68	-1.63	-0.31	-0.25	8.10 *	-1.37	-0.53 *	2.00	6.34	-0.68 **	-0.05
NSR-1 x GBL-1	-1.58	-1.39	-1.00 *	0.26	0.70	0.78	0.96 **	0.49	3.63	0.69 **	0.14
NSR-1 x Pant Rituraj	3.27 **	4.70 **	0.57	-0.02	-12.29 **	1.94	0.17	-3.41	-3.81	0.04	0.07
JB-12-06 x GOB-1	1.32	0.24	-0.54	-0.03	0.46	1.35	-0.59 *	-2.07	-3.12	-0.08	0.19 *
JB-12-06 x GJB-2	-4.01 **	-3.38 **	-0.04	0.15	10.01 **	-4.34 **	0.21	-3.54	-11.63 **	0.42 **	-0.15
JB-12-06 x GBL-1	5.08 **	4.86 **	0.84	-0.19	2.30	-1.53	-0.71 **	-2.44	-0.63	-0.41 **	-0.11
JB-12-06 x Pant Rituraj	-2.39	-1.71	-0.27	0.07	-12.77 **	4.52 **	1.08 **	8.05 **	15.38 **	0.08	0.08
ABR-2-23 x GOB-1	-1.43	-1.18	0.55	0.49 *	17.32 **	-3.25 *	-0.04	1.54	6.18	-0.22	-0.06
ABR-2-23 x GJB-2	0.57	3.54 **	-0.04	-0.28	-10.46 **	-0.74	-0.69 **	-2.61	-3.56	0.75 **	-0.27 **
ABR-2-23 x GBL-1	-0.01	-0.89	-0.81	-0.41	-6.19	4.38 **	0.83 **	1.62	3.67	-0.68 **	0.36 **
ABR-2-23 x Pant Rituraj	0.86	-1.46	0.30	0.20	-0.67	-0.39	-0.09	-0.56	-6.28	0.14	-0.04
SE (S_{ij})	1.22	1.18	0.43	0.24	3.32	1.30	0.24	2.18	3.21	0.13	0.09

*,** Significant at 5 % and 1 % levels, respectively

Table-2 : General combining ability effects for different characters in brinjal.

Parents	Days to50 % flowering	Days to first picking	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Number of fruits per plant	Number of primary branches per plant	Plantheight (cm)	Plant spread (cm)	Total Soluble Solids(°B)	Fruityield per plant (kg)
Lines											
JBL-08-08	1.83 **	1.69 **	0.63 **	-0.62 **	-18.54**	3.09 **	-0.36 **	-0.58	-9.67 **	-0.26 **	-0.12 **
AB-09-1	-1.17	-1.31 *	0.58 **	-0.14	-4.90 **	-0.20	-0.27 *	0.64	-3.10	-0.36 **	-0.13 **
JBG-10-208	1.50 *	1.44 *	-0.28	0.66 **	13.67 **	-2.09 **	-0.39 **	-0.33	2.28	0.16 *	0.15 **
JBL-10-04	0.67	0.94	0.48 *	-0.40 **	3.08	-1.95 **	-0.17	-1.73	-3.14	0.11	-0.16 **
NSR-1	-1.75 **	-1.23 *	-0.59 **	0.69 **	25.92 **	-2.74 **	0.54 **	-12.88 **	12.68 **	-0.11	0.27 **
JB-12-06	0.58	0.52	-0.71 **	0.02	-18.16**	4.02 **	0.25 *	9.80 **	0.40	0.33 **	-0.01
ABR-2-23	-1.67 **	-2.06 **	-0.12	-0.21	-1.07	-0.12	0.39 **	5.08 **	0.55	0.13	-0.01
SE(g_i)	0.61	0.59	0.21	0.12	1.66	0.65	0.12	1.09	1.60	0.07	0.05
Testers											
GOB-1	-0.65	-0.15	-0.16	0.13	-3.49 **	-0.16	-0.30 **	3.53 **	1.16	0.21 **	-0.03
GJB-2	-0.32	-0.54	0.56 **	-0.44 **	-6.07 **	1.45 **	0.01	-1.10	1.13	0.07	-0.02
GBL-1	0.92	0.56	0.86 **	-0.35 **	-2.19	-0.12	0.51 **	-1.44	-3.87 **	-0.13 *	-0.05
Pant Rituraj	0.06	0.13	-1.26 **	0.66 **	11.75 **	-1.17 *	-0.22 *	-0.98	1.58	-0.15 **	0.10 **
SE(g_j)	0.47	0.44	0.16	0.09	1.25	0.50	0.09	0.82	1.21	0.05	0.03

*, ** Significant at 5 % and 1 % levels, respectively.

found good specific combiner for plant height, fruit weight, fruit girth and number of primary branches per plant. Likewise, the cross ABR-2-23 x GBL-1 also showed desirable sca effect for number of fruits per plant and number of primary branches per plant and AB-09-1 x GOB-1 showed desirable sca effect for fruit length and plant height. The high sca effect observed for fruit yield per plant was associated with its component characters like plant height, fruit girth, fruit length, fruit weight, number of fruits per plant and number of primary branches per plant. Hybrid, JBL-08-8 x GJB-2 recorded significant sca effects in desirable direction for fruit yield per plant and fruit length. Thus, this hybrid could be exploited in practical plant breeding for selection of better transgressive sergeants and they may also be exploited through heterosis breeding programme in brinjal.

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