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Hetrosis for productivity traits in brinjal (*Solanum melongena* L.)

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Brinjal (*Solanum melongena* L.), also known as eggplant, is commercially important solanaceous vegetable crop of Indian subcontinent. Rich variability exist for both cultivated type and its wild species in the country. It is popular among 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 eggplant, it is imperative to obtain hybrids having excellent quality coupled with high yields. To obtain high yield per unit area, exploitation of hybrid vigour is one of the good options and particularly in crop like brinjal, where more seeds per fruit are obtained of hybrid brinjal. The common approach of selecting parents on the basis of *per se* performance does not necessarily lead to fruitful results but it provides the breeders an insight in nature and relative magnitude of fixable and non-fixable genetic variances. In this context, the present investigation was under taken to identify potential parental combination in order to have superior hybrids and extent of heterosis in F_1hybrid over better and mid parent in a diallel cross set of 7 parents.

The present experiment was conducted during *Kharif* 2011-12 at research farm of Indian Institute of Vegetable Research, Varanasi. Seven diverse genotypes of brinjal *viz*. PR, PR-5, CHBR-2, BR-14, PB, IVBL-9 and RCMBL-1 were used in diallel mating design to derive 21 F_1 hybrids. All the 21 F_{1S} and 7 parents were evaluated in a randomized block design with 60 x 45 cm spacing in three replications. Standard cultural practices were followed to raise the crop. Data were recorded on five randomly selected plants in each treatment over replication for various quantative traits *viz.*, days to 50% flowering, average fruit weight, plant height, number of branches/plant, fruit length, fruit diameter, fruit size, number of fruit per plant and yield per plant. Heterosis was calculated over the mid parent and over the better parent was estimated.

The superiority of the hybrids were estimated over the mid-parent (relative heterosis) and better parent (heterobeltiosis) to judge the potential of crosses to be exploited in hybrid breeding programs. Earliness is an important trait for realizing the potential economic yield in lesser as possible period, which is an important consideration for vegetable growers. Magnitude of heterosis as such does not assure its commercial exploitation unless it is significantly superior over the variety. Therefore in present investigation the performance of the F_1 hybrids (Table 1).

Earliness

Days to 50% flowering with negative values of heterosis was considered to be better and desirable, whereas for other remaining characters the higher and positive values of heterosis were considered better. Nineteen crosses showed negative heterosis, of which 14 were significant for relative heterosis, whereas five crosses showed significant negative heterosis for days to 50% flowering heterobeltiosis. Three best heterotic crosses were CHBR-2 x BR-14 (-12.86), PR-5 x PB (12.53) and PR x PB (-11.66) in mid heterosis, whereas the three best heterotic crosses were PR x PB (-11.00), CHBR-2 x BR-14 (-10.67) and BR-14 x PB (-9.55) in case of heterosis over parent for days to 50% flowering. Heterosis in positive as well negative direction for days to 50% harvesting has been reported by Kumar and Pathania (2003) and Dharwad *et al.* (2011).

Vegetative traits

The range of heterobeltiosis for plant height was between -20.51 (IVBL-9 x RCMBL-1) to 40.40 (BR-14 x RCMBL-1) and seven crosses showed highly significant and five crosses showed significant positive heterosis over better parent, whereas the range of heterosis over mid parent was between -11.75 (IVBL-9 x RCMBL-1)

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and 32.31(PR-5 x IVBL-9) and six crosses exhibited significant positive heterosis over mid parent. For plant height, highest heterosis over better parent was recorded in the cross BR-14 x RCMBL-1 followed by BR-14 x IVBL-9 and BR-14 x PB while maximum heterosis over mid parent was recorded in PR-5 x IVBL-9 followed by PR x PB and CHBR-2 x RCMBL-1.The per cent heterosis over better parent ranged from -24.179 (PB x IVBL-9) to 32.66 (PR x PB) and no any crosses showed positive significant heterosis, whereas the range for heterosis over mid parent was -15.77 (CHBR-2 x IVBL-9), 50.94(PR x PB) and two crosses exhibiting positive heterosis out of these for number of branches/plant. The crosses with high heterosis over mid parent were PR x PB findings is in conformity with that by Ramireddy and Reddy (2011) and Dharwad *et al.* (2011).

Yield traits

The range of heterosis over better parent for fruit weight was -26.20 (PR x BR-14) to 186.34 (PR-5 x RCMBL-1) and five crosses showed significant positive, whereas the range of heterosis percent over mid parental values was -85.50 (PR x BR-14) to 164.80 (BR-14 x IVBL-9) and seven crosses exhibited significant and positive heterosis per cent values and three crosses showed significant negative heterosis for average fruit weight. They are inagrcement with those finding of Ramireddy and Reddy (2011) and Dharwad *et al.* (2011).

The heterosis over mid parent for fruit length ranged between -20.76 (PR-5 x IVBL-9) and 76.93 (PB x IVBL-9) and seven crosses showed significant positive heterosis, whereas the heterosis over better parent ranged from -37.85 (PR -5 x IVBL-9) to 64.69 (PB x IVBL-9) and a total of five crosses emerged with significant positive heterosis. For average fruit length the cross PB x IVBL-9, PB x RCMBL-1 and IVBL-9 x RCMBL-1 showed better heterosis over better parent, whereas over mid parent significant heterosis was shown by the cross PB x IVBL-9 and PB x RCMBL-1 and PR-5 x PB.

For fruit diameter the range of heterosis over better parent was -54.84 (PR x RCMBL-1) to 43.68 (PR-5 x IVBL-9) and only two crosses emerged with significant positive heterosis, whereas for the heterosis over mid-parental value the range was -11.10 (PR x RCMBL-1) to 65.20 (PR-5 x IVBL-9) and seven crosses showed significant positive heterosis. The best cross showing highest heterotic effect over better parent for the character fruit diameter was PR-5 x IVBL-9.

Table 1: Estimates of per cent heterosis based on mid parent (average heterosis) and better parent (heterobeltosis) of 21 brinjal hybrids of ten characters

Crosses	DF	AFW	PH	NB	FL	FD	FS	NFPP	YPP
	Better	Better	Better	Better	Better	Better	Better	Better	Better
PRX PR-5	3.72	35.25*	-4.33	-17.13	-1.09	41.05*	7.33	19.23	45.38**
PRX CHBR-2	-1.87	-36.97**	1.46	-6.08	-18.73	21.34	-30.48	53.57	29.01*
PRX BR-14	5.80	-86.20**	-2.16	-17.13	-12.28	-4.67	-29.19	37.14	-21.59
PRX PB	-11.00*	-22.95	31.46*	32.60	27.54	-26.88	-3.92	27.03	-18.39
PRX IVBL-9	0.88	-39.07*	-1.19	-6.08	23.16	-6.45	-22.11	15.15	-21.69
PRX RCMBL-1	5.54	-20.77	-20.43*	16.02	2.99	-54.84	-21.65	80.56*	-12.07
PR-5XCHBR-2	-6.52	5.34	-3.19	19.21	2.83	26.84	1.31	14.29	29.08*
PR-5X BR-14	-2.81	36.09	-0.86	5.59	14.04	-0.93	19.37	-2.86	-33.09*
PR-5XPB	-8.59*	23.19	-9.58	19.21	47.21*	43.68*	29.44	51.35*	14.52
PR-5 X IVBL-9	-5.63	132.56*	20.47	9.00	-37.85*	13.16	-31.75	-21.21	38.89*
PR-5 x RCMBL-1	-6.70	186.34**	-5.46	11.80	-6.79	0.53	-5.59	-5.56	44.89**
CHBR-2XBR-14	-10.67**	-41.35**	6.94	5.59	-24.91	-5.61	-38.86*	22.86	16.31
CHBR-2XPB	-6.33	-77.03**	9.13	-13.91	-19.67	19.51	-27.73	0.00	-23.35
CHBR-2XIVBL-9	3.35	-30.98*	-4.57	-19.43	-7.63	21.95	22.07	-12.12	-14.50
CHBR-2X RCMBL-1	-6.72	-59.40**	29.50*	-6.83	5.98	-23.78	-27.30	-22.22	-50.77**
BR-14X PB	9.55*	24.26	32.44*	18.01	40.66*	-10.28	-27.43	-18.92	-27.86
BR-14X IVBL-9	-2.82	61.74*	37.22*	-0.47	-22.88	3.27	-16.11	-14.29	-5.91
BR-14X RCMBL-1	-3.29	34.12	40.40*	30.43	-32.34*	-7.94	-31.85	-25.00	6.12
PBX IVBL-9	-9.18*	158.14**	3.78	-24.17**	64.69**	18.33	43.75*	37.84	11.81
PBX RCMBL-1	-7.27*	11.89	8.99	-6.83	54.35**	-7.50	16.84	27.03	6.18
IVBL-9 X RCMBL-1	-8.82*	-0.88	-20.51*	-24.17	49.73**	-16.67	8.48	-13.89	0.85
S.E ±	1.37	111.45	7.91	0.82	1.05	0.62	8.33	2.00	0.39

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

DF, Days to 50% flowering; AFW, Average fruit weight (g); PH, Plant height (cm); NB, Number of branches; FL, Fruit length (cm); FD, Fruit diameter (cm); FS, Fruit size (cm^2); NFPP, Number of fruit per plant; YPP, Yield per plant (kg.)

The range of heterobeltiosis for fruit size was -38.86 (CHBR-2 x BR-14) to 43.75 (PB x IVBL-9) and the number of crosses showing significant positive heterosis was one, whereas the value of heterosis percent over mid parental value ranged from -36.70 (CHBR-2 x BR-14) to 72.31 (PB x IVBL-9) and five crosses exhibited significant and positive heterosis. The crosses PB x IVBL-9 over better and mid parent were found to be superior for fruit size per plant showing high heterosis effects.

The heterosis over better parent for fruit number value ranged between -25.00 (BR-14 x RCMBL-1) to 80.56 (PR x RCMBL-1) and two crosses showed significant heterosis in desirable positive direction, whereas heterosis over mid parent value ranged from -23.40 (BR-14 x RCMBL-1) to 77.78(PR-5 x PB) and five crosses showed significant positive heterosis percent value over mid parent. For number of fruits per plant the heterosis over better parent was maximum for the cross PR x RCMBL-1, while the heterosis over mid parent was maximum for PR-5 x PB. Ramireddy and Reddy (2011) and Dharwad *et al.* (2011) also reported similar trend of results.

At least 10-25% heterosis in yield is desirable for its commercial inploitation. Such heterosis for yield per plant might be due to additive heterosis effects. The range for heterosis over better parent was -50.77 (CHBR-2 x RCMBL-1) to 45.38 (PR x PR-5) and five crosses showed positive and highly significant heterosis, whereas the range for heterosis over mid parent was -56.00 (CHBR-2 x RCMBL-1) to 54.82 (PR x PR-5) and six crosses showed significantly positive heterosis over mid parent. For fruit yield per plant the cross PR-5 x RCMBL-1 showed highest heterosis over better parent followed by PR x PR -5 and PR -5 x IVBL-9, while cross PR x PR-5 showed maximum heterosis over mid parent followed by PR-5 x PB and PB x RCMBL-1. The findings are in accordance with Kumar and Pathania (2003).

A wide range of variations in the expression of heterosis for yield and its contributing trits was observed in the present investigation. These variations are attributed to the potential of parental lines as well as genetic mechanisms the hetrotic phenomena. We found that the F_1 hybrid PR × PR-5 with oblong traits and PR-5 × IVBL-9 with long fruits were potential hybrids and can be valdated for commercial impartation.

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