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Manifestation of heterosis for certain economic characters in round-fruited brinjal (*Solanum melongena L.*) under *Tarai* conditions of Uttaranchal, India

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Abstract

Hybrid advantages as a consequences of fruit yield and its component characters of round-fruited brinjal were studied with ten hybrids along with their five genetically diverse parents in half-diallel manner during 2002-2003. Appreciable heterosis was recorded over mid parent, better parent and also standard parent for all the characters. Heterosis to the extent of 8.8, 18.6, 28.0, 41.1and 59.5 per cent over standard parent (Pant Rituraj) was recorded for fruit length, fruit diameter, total number of fruits per plant, total weight of fruits per plant and early yield, respectively. Heterosis for yield was the cumulative effect of heterosis for most yield attributing characters. The highest yielding hybrid was PB-62 ×T-3 (4.5 kg per plant) followed by PR × PB-61 (4.2 kg per plant) with 41.1 and 32 per cent standard heterosis, respectively. The hybrid PR × PB-61 combination was also earliest in maturity with 59.5 per cent followed by PR × PB-60 showing 41.3 per cent standard heterosis. These two crosses could be exploited as commercial hybrids in the *tara*i of Uttaranchal.

Key words: Hybrid, half-diallel, heterosis, standard heterosis, heterobeltiosis, mid parent heterosis

Introduction

Brinjal (*Solanum melongena* L.) is one of the most common, popular and principal vegetable crops grown in India and other parts of the world. With ever increasing demand of brinjal, it has become very much important to breed high yielding and suitable varieties / F_1 hybrids with proper quality under cultivation in different agro climatic conditions to boost up the production per unit area and per unit time. Heterosis, the improvement of the heterozygote in relation to the better parent, mid parent and top or check variety (Tysdal *et al.,* 1962; Fonseca and Patterson, 1968) will be more realistic parameter for assessing the superiority of F_1 hybrids. Heterosis for yield and yield attributing characters has been reported by several workers (Patil *et al.,* 2001; Gupta and Singh, 2000; Prasath *et al.,* 2000; Sousa *et al.,* 1998; Joshi and Singh 1997; Mandal *et al.,* 1994 and Sawant *et al.,* 1992.) in brinjal. The present study was undertaken to generate some information on brinjal hybrids under *Tarai* conditions of Uttaranchal .

Materials and methods

The present investigation was initiated during autumn-winter season, 2001-02 and the field trial was conducted during autumn-winter season, 2002-2003 at Vegetable Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttaranchal), India. The material for the present investigation comprised of a diallel set of five genotypes excluding reciprocals of eggplant. These five genotypes were agronomically and morphologically diverse. The genotypes were Pant Rituraj (PR), PB-60, PB-61, PB-62 and T-3. Hybrids along with the parents were evaluated in Randomized Block Design with three replications. The data was subjected to appropriate statistical analysis.

Results and discussion

Mean values of parents and F_1s and heterosis percentage for five traits are presented in Table 1&2. The fruit weight per plant ranged from 2.7 to 4.5 kg, number of fruits per plant varied from12.8 to 20.1 while the fruit length and fruit diameter ranged form 8.4 to 12.0 cm and 6.2 to 10.4 cm, respectively. Most of the crosses manifested significant heterosis over better, mid and standard parent for almost all the characters.

The relative heterosis for fruit length ranged from –8.2 (PB-62×T-3) to 13.9 % (PR×PB-60). Seven crosses showed significant relative heterosis but one in negative direction (PB-62×T-3). Significant heterobeltiosis was found in four crosses ranging from –19.4 (PB-62×T-3) to 8.8% (PR×PB-60). The best cross for heterobeltiosis was found in PR×PB-60 (8.8 %) followed by PR×PB-61 (8.2 %). Heterosis over standard parent (PR) was found significant for five crosses and ranging from –18.2 for the cross PB-62×T-3 to 8.8% for the cross PR×PB-60. Two crosses were in significant positive direction *viz.* PR×PB-60 (8.8 %) and PR×PB-61 (8.2 %) and three crosses were significant in negative direction like PB-62×T-3 (-18.2 %), PR×T-3 (-17.3 %) and PB-61xT-3 (-8.2 %). In case of fruit diameter, relative heterosis was found significant in seven crosses, of these six were in desired direction *i.e.* positive relative heterosis. Relative heterosis ranged from -14.1 (PB-60×PB-61) to 21.0 (PR×PB-61). Heterobeltiosis ranged from –21.7 (PR×T-3) percent to 18.6 (PR×PB-61). Seven crosses showed significant heterobeltiosis, of these four crosses showed positive heterobeltiosis and rest three were in negative direction. Economic heterosis was found significant for eight crosses.

Table 1. Mean values of economic characters for parents used and F_1s

Cross	Fruit length (cm)			Fruit diameter (cm)			Total weight of fruits plant^{-1} (kg)			Early yield plant^{-1} (g)			Total number of fruits plant^{-1}		
	F	M	F_1	F	M	F_1	F	M	F_1	F	M	F_1	F	M	F_1
PR×PB-60	11.0	10.0	12.0	8.8	8.9	10.2	3.2	3.0	3.5	0.422	0.322	0.593	15.7	14.5	14.7
PR×PB-61	11.0	10.0	11.9	8.8	8.6	10.4	3.2	2.7	4.2	0.422	0.407	0.670	15.7	13.5	15.7
PR×PB-62	11.0	11.2	11.7	8.8	8.9	10.0	3.2	3.1	3.5	0.422	0.371	0.564	15.7	12.8	14.1
PR×T-31	11.0	8.4	9.1	8.8	6.2	6.9	3.2	2.9	2.9	0.422	0.274	0.503	15.7	19.5	15.9
PB-60×PB-61	10.0	10.0	10.9	8.9	8.6	7.5	3.0	2.7	2.7	0.322	0.407	0.280	14.5	13.5	15.3
PB-60×PB-62	10.0	11.2	11.2	8.9	8.9	9.9	3.0	3.1	3.3	0.322	0.371	0.260	14.5	12.8	13.9
PB-60×T-3	10.0	8.4	10.4	8.9	6.2	7.5	3.0	2.9	3.9	0.322	0.274	0.408	14.5	19.5	18.5
PB-61×PB-62	10.0	11.2	11.8	8.6	8.9	9.7	2.7	3.1	3.7	0.407	0.371	0.270	13.5	12.8	13.5
PB-61×T-3	10.0	8.4	10.1	8.6	6.2	8.2	2.7	2.9	3.5	0.407	0.274	0.524	13.5	19.5	17.9
PB-62×T-3	11.2	8.4	9.0	8.9	6.2	8.2	3.1	2.9	4.5	0.371	0.274	0.493	12.8	19.5	20.1
LSD (*P*=0.05)		0.9			0.8			0.4			0.2			2.3	
LSD (*P*=0.01)		0.2			1.1			0.5			0.2			3.1	
CV (%)		4.90			5.5			7.3			22.6			8.9	

F-female parent, M-male parent, F_1- hybrid

Table 2. Percent increase or decrease of the F_1s over mid parental value (relative heterosis,MP), better parent (heterobeltiosis, BP) and standard parent (economic heterosis, SP)

Cross	Fruit length (cm)			Fruit diameter (cm)			Total weight of fruits plant^{-1} (kg)			Early yield plant^{-1} (g)			Total number of fruits plant^{-1}		
	BP	MP	SP	BP	MP	SP	BP	MP	SP	BP	MP	SP	BP	MP	SP
PR×PB-60	8.8*	13.9**	8.8*	14.2**	15.1**	16.0**	10.6	13.8*	10.6	-6.8	-2.9	-6.8	-6.8	-2.9	-6.8
PR×PB-61	8.2*	13.3**	8.2*	18.6**	21.0**	18.6**	32.0**	43.5**	32.0**	-0.4	7.3	-0.4	-0.4	7.3	-0.4
PR×PB-62	4.7	5.5	6.4	13.2**	13.8**	14.4**	8.9	9.8	8.9	-10.2	-0.9	-10.2	-10.2	-0.9	-10.2
PR×T-3	-17.3**	-6.3	-17.3**	-21.7**	-8.4	-21.7**	-10.9	-6.1	-10.9	-18.4**	-9.6	1.3	-18.4**	-9.6	1.3
PB-60×PB-61	8.5	8.5*	-1.2	-15.7**	-14.1**	-14.5*	-11.9	-6.8	-16.8*	6.0	9.8	-25.0	6.0	9.8	-25.0
PB-60×PB-62	0.6	6.0	2.1	11.6*	11.8**	13.3**	5.7	7.9	4.0	-3.7	2.2	-11.4	-3.7	2.2	-11.4
PB-60×T-3	3.5	12.4**	-5.8	-15.7**	-08	-14.5**	29.9**	33.2**	22.6**	-5.5	8.6	17.4*	-5.5	8.6	17.4*
PB-61×PB-62	5.6	11.4**	7.3	9.0	10.9**	10.2*	16.2**	25.3**	14.3*	0.5	3.0	-14.0	0.5	3.0	-14.0
PB-61×T-3	0.9	9.5**	-8.2*	-4.7	10.4*	-6.9	21.7**	25.7**	9.2	-8.5	8.3	13.6	-8.5	8.3	13.6
PB-62×T-3	-19.4**	-8.2*	-18.2**	-7.9	8.2	-6.9	43.5**	50.1**	41.1**	3.1	24.5**	28.0**	3.1	24.5**	28.0**
LSD (*P*=0.05)	0.87	0.75	0.87	0.79	0.69	0.79	0.41	0.35	0.41	2.3	2.0	2.3	2.3	2.0	2.3
LSD (*P*=0.01)	1.17	1.01	1.17	1.07	0.93	1.07	0.55	0.48	0.5	3.1	2.7	3.1	3.1	2.7	3.1

Economic heterosis ranged from –21.7 (PR×T-3) to 18.6 % (PR× PB-61). Five crosses showed significant positive economic or standard heterosis. The best heterotic cross was PR×PB-61 (18.6 %) followed by PR×PB-60 (16 %), PR×PB-62 (14.4 %) and PB-60×PB-62 (13.3 %). Three crosses, PR×T-3 (-21.7 %), PB-60×PB-61 (-14.5%) and PB-60×T-3 (-14.5 %) showed negative standard heterosis *i.e.* less fruit diameter. Patil *et al.* (2001), Prasath *et al.* (2000), Dubey *et al.* (1998), Mandal *et al.* (1994) Singh and Gautam (1991), Singh *et al.* (1978) reported heterosis for fruit length and diameter.

Total number of fruits per plant is one of the important yield contributing characters. Only one cross PB-62 × T-3 showed significant relative heterosis (24.5 %) in positive direction for this character. Range of relative heterosis was –9.6 (PR× T-3) to 24.5 (PB-62×T-3) percent. Heterobeltiosis ranged from –18.43 (PR×T-3) to 6.0 (PB-60× PB-61) per cent. One cross (PR×T-3) showed significant heterobeltiosis but in negative direction. Standard heterosis was found significant in two crosses, PB-62×T-3 (28.0 %) and PB-60×T-3 (17.4 %). The range of standard heterosis was –14 (PB-61×PB-62) to 28 % (PB-62×T-3). Same trend for this character was reported by other workers like Dubey *et al.* (1998), Mandal *et al.* (1994), Singh and Gautam (1991) and Verma *et al.* (1986).

The range of relative heterosis percent for fruit yield was –6.8 (PB-60×PB-61) to 50.1 % (PB-62×T-3). The highest significant relative heterosis was found in the cross PB-62×T-3 (50.1%) followed by PR×PB-61 (43.5 %), PB-60×T-3 (33.2 %) and PB-61×T-3 (25.7 %). Heterobeltiosis ranged from –11.9 (PB-60× PB-61) to 43.5 % (PB-62×T-3). Standard heterosis varied from –16.8 % in PB-60×PB-61 to 41.1 % in PB-62×T-3. The highest standard heterosis was found in the cross PB-62×T-3 followed by PR×PB-61 (32.0 %) and PB-60×T-3 (22.6 %). In brinjal, heterosis for fruit yield per plant has been also reported by Patil *et al.* (2001), Gupta and Singh (2000), Prasath *et al.* (2000), Sousa *et al.* (1998), Joshi and Singh (1997), Mandal *et al.* (1994) and Sawant *et al.* (1992).

Early maturing variety is generally considered better because it provides more income as it catches early market. In the present study relative heterosis for early yield per plant ranged from –30.6 (PB-61×PB-62) to 61.7 % (PR×PB-61). The best combinations

Table 3. Three best heterotic cross combinations with respect to each character in desired direction

Character	Heterotic cross combinations and their values in percentage		
	MP	BP	SP
Fruit length	PR×PB-60 (13.9)PR×PB-61 (13.3)	PR×PB-60 (8.8)PR×PB-61 (8.2)	PR×PB-60 (8.8)PR×PB-61 (8.2)
Fruit diameter	PR×PB-61 (21.0)PR×PB-60 (15.1)	PR×PB-61 (18.6)PR×PB-60 (14.2)	PR×PB-61 (18.6)PR×PB-60 (16.0)
Total number of fruits plant^{-1}	PB-62×T-3 (24.5)PB-60×PB-61 (9.8)	PB-60×PB-61 (6.0)PB-62×T-3 (3.1)	PB-62×T-3 (28.0)PB-60×T-3 (17.4)
Total weight of fruits plant^{-1}	PB-62×T-3 (50.1)PR×PB-61 (43.5)	PB-62×T-3 (433.5)PR×PB-61 (32.0)	PB-62×T-3 (41.1PR×PB-61 (32.0)
Early yield plant^{-1}	PR×PB-61 (61.7)PR×PB-60 (59.5)	PR×PB-61 (58.8)PR×PB-60 (40.6)	PR×PB-61 (59.5)PR×PB-60 (41.3)

Heterosis values are given in parenthesis

for relative heterosis were found in PR× PB-61 (61.7%), PR× PB-60 (59.5%), PB–61×T-3 (54 %), PB-62×T-3 (52.9 %) and PR×T-3 (44.6 %). Heterobeltiosis ranged from –33.6 (PB-61×PB-62) to 58.8 % (PR×PB-61). Standard heterosis ranged from –38.1 (PB-60×PB-62) to 59.5 % (PR×PB-61). In the present study, maximum standard heterosis was expressed by PR×PB-60 for fruit length (8.8 %), PR×PB-61 for fruit diameter (18.6 %) and PB-62×T-3 for total numbers of fruits (28.0 %). Heterosis for these characters has been reported by Prasath *et al*. (2000).

On the basis of estimates of standard heterosis it can be concluded that heterosis breeding would be advantageous for the improvement in yield and its component characters. The lines PB-62, T-3 and PR can be used in hybridization programme to get the desirable recombinants in segregating generations. Further the crosses PB-62×T-3, PR×PB-61 and PB-60×T-3 could be exploited as commercial hybrids after testing their performance for one or two season in multi locational trial.

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