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Expression of Heterosis for Productive Traits in F_1 Brinjal (*Solanum melongena* L.) Hybrids

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Abstract

The study was carried out to estimate magnitude of heterosis over better parent and standard check for some important characters in 15 crosses resulting from a half diallel mating design of 6 inbred lines of brinjal. Hybrid variety 'Tarapuri' was used as standard check. The parents and the hybrids were evaluated at the farm of Olericulture Division, HRC, BARI, during the winter season of 2008-2009. A randomized complete block design with three replications was used. Significant levels of heterosis were detected for all the traits studied. Promising hybrids exhibited significant positive heterosis for fruit yield, magnitude of which ranged from 9.63% to 74.89% and 8.52% to 72.60% over better parent and standard check, respectively. Some of the promising hybrids showed desirable heterosis for earliness, increased fruit number and yield.

Keywords: Heterosis, productive traits, brinjal, hybrid.

1. Introduction

Brinjal (*Solanum melongena* L.) is one of the most important vegetables of Bangladesh grown throughout the year. Based upon its year round production potential and availability, it is also termed as poorman's vegetable. It is widely cultivated in both temperate and tropical regions of the globe mainly for its immature fruits as vegetable. In Bangladesh, productivity of brinjal is low as compared to the other brinjal growing countries, owing to use of low yielding cultivars grown for local preference and their susceptibility to pests and diseases. The present production, however, is not proportionate to the country's demand. Therefore, the crop deserves a deep deliberation for improvement. Being a centre of origin, brinjal has a huge genetic divergence in our country which offers much scope for improvement through heterosis breeding. The effort could enhance its quality and productivity without sacrificing the consumers' choice. The required goals of increasing productivity in the quickest possible time can be achieved only through heterosis breeding, which is feasible in this crop (Kakikazi, 1931). The estimation of heterosis for yield and its component characters would therefore, be useful to judge the best hybrid combination for exploitation of superior hybrids.

2. Materials and Methods

The investigation was conducted at the farm of Olericulture Division, HRC, BARI, during the winter season of 2008-2009. Six open pollinated cultivars (P-1= BARI Begun-8, P-20= Volanath, P-14= Kazla, P-5= Nayantara, P-19= Khatkhatia and P-18= Islampuri), 15 experimental hybrids obtained from the cultivars and one commercial

hybrid 'Tarapuri' were used as experimental materials. The seeds of all the 22 lines were sown on the seedbed on October 05, 2008. Thirty days old seedlings were transplanted in the main field on 05 November 2008. The experiment was laid out in a RCB design with three replications. The unit plot size was 10.5 x 0.70 m^2 and 15 plants were accommodated in a plot with a spacing of 70 cm from plant to plant and 1 m between rows. Data on days to 50% flowering, days to first harvest, single fruit weight (g), plant height (cm), fruit length (cm), fruit diameter (cm), fruit number per plant and fruit yield (t/ha) were recorded from eight randomly selected plants per entry per replication. Heterosis over better parent and standard check variety were estimated as per Hayes *et al.* (1955).

3. Results and Discussion

The *per se* performance and magnitude of heterosis over better parent and standard check variety are depicted in Table 1 and Table 2. Earliness, one of the most desirable characters for brinjal is indicated by days required for 50% flowering and days to 1st harvest and the crosses with negative significant heterosis were considered as desirable for these two traits. All except one cross (P-14 x P-5), exhibited expected negative heterosis over better parent for the character with respect to days to 50% flowering and the best results were obtained from the crosses P-20 x P-5(-27.59%) and P-5 x P-19 (-27.37%). Again, significant negative heterosis over standard check variety for this trait was observed in two crosses, P-20 x P-5(-4.57%) and P-5x P-19(-7.83%). Heterosis for days to 1st harvest in expected negative direction was also observed among the hybrids and significant negative heterosis was observed in ten and six hybrids over better parent and standard cheek, respectively. Earliness in brinjal hybrids due to negative heterotic effect to a considerable amount have been reported earlier by several researchers (Bavage, 2005 and Chadha *el al.* 1990.). The magnitude of heterosis for plant height ranged from 2.12 to 22.36% and -16.96 to 1.91% over better parent and standard cheek variety, respectively. Out of 15 hybrids, 12 showed significant positive heterosis over better parent but none of them was found in the same direction when estimated over standard cheek.

3.1. Magnitude of heterobeltiosis for Days to 50% flowering, days to 1st harvest, plant height, and fruit length in 15 brinjal hybrids

A wide range of heterosis was observed for fruit length (-34.04 to 32.35% and -7.89 to 93.17%) over better parent and standard check, respectively (Table 1). Better parent heterosis for fruit breadth was found to be reduced in all the crosses except in P-1 x P-20 and P-20 x P-14. Similar trend was also observed for single fruit weight. Ten cross combinations out of 15 exhibited significant negative heterosis over both better parent and standard check. The present findings agree with those of Prakash *et al*. 2008 and Shafeeq *et al*. 2007 who reported heterosis in brinjal hybrids both in positive and negative directions for fruit length, breadth and weight.

3.2. Magnitude of heterobeltiosis for fruit breadth, single fruit weight, fruit number and yield in 15 brinjal hybrids

Wide range of heterosis was observed among the hybrids for number of fruits per plant. Significant positive heterosis over both better parent and standard cheek was observed in nine crosses and the rest showed significant negative heterosis. A maximum of 105.0% (P-5x P-19) and 253.65% (P-14x P-19) heterosis was estimated over better parent and standard cheek, respectively for the trait (Table 2). The results obtained are in agreement with those of Bavage *et al*. (2005), Singh *et al*. (2004) and Shafeeq *et al.* (2007).

Table 1. Magnitude of heterobeltiosis for Days to 50% flowering, days to 1st harvest, plant height, and fruit length in 15 brinjal hybrids

Parents /hybrids	Days to 50% flowering			Days to 1st harvest			Plant height			Fruit length		
	Means	Heterosis (%)		Means	Heterosis (%)		Means	Heterosis (%)		Means	Heterosis (%)	
	(DAP)	BP	SC	(DAP)	BP	SC	(cm)	BP	SC	(cm)	BP	SC
P-1	67.3	-		101.6	-		65.9	-		26.23	-	
P-5	49.6	-		69.6	-		62.3	-		9.83	-	
P-14	46.7	-		78.0	-		62.7	-		16.03	-	
P-18	71.0	-		96.3	-		59.5	-		10.23	-	
P-19	64.3	-		83.3	-		65.2	-		24.87	-	
P-20	66.6	-		92.0	-		62.7	-		23.50	-	
Tarapuri	50.7	-		85.7	-		78.4	-		14.65	-	
P-1X P-14	62.3	-7.43 **	22.96**	80.7	-20.65**	-5.80	73.7	11.84**	-5.99*	20.63	-21.37**	40.61**
P-1X P-18	67.0	-5.63 **	32.24**	104.0	2.26	21.40**	69.3	5.16	-11.60**	17.27	-33.97**	18.09**
P-1X P-19	56.0	-16.79**	10.53**	88.3	-13.18**	3.07	76.9	16.69**	-1.91	26.90	2.67**	83.62**
P-1X P-20	66.7	-0.89	31.64**	103.0	1.28	20.23**	67.2	2.12	-14.15**	28.33	8.02**	93.17**
P-1X P-5	61.7	-8.32**	21.78**	76.0	-25.27**	-11.28**	77.8	18.06**	-0.76	18.20	-30.53**	24.23**
P-20X P-14	58.3	-12.59**	15.07**	70.0	-23.91**	-18.29**	74.6	19.14**	-4.71	24.23	2.98**	65.19**
P-20X P-18	66.0	-7.04**	30.26**	88.7	-7.89*	3.54	67.3	7.34*	-14.15**	15.53	-34.04**	5.80**
P-20X P-19	62.3	-6.60**	22.96**	81.7	-11.20**	-4.63	79.8	22.36**	1.91	26.47	6.43**	80.89**
P-20X P-5	48.3	-27.59**	-4.67*	75.0	-18.48**	-12.45**	70.6	13.32**	-9.94**	17.60	-25.11**	20.14**
P-14X P-18	66.6	-6.06**	31.64**	74.0	-23.16**	-13.62**	65.1	3.83	-16.96**	13.90	-13.13**	-5.12**
P-14X P-19	54.0	-16.02**	6.58**	77.6	-6.72	-9.30**	79.2	21.29**	1.02	17.63	-29.32**	20.14**
P-14X P-5	50.3	1.21	-0.72	79.3	1.67	-7.43*	70.5	13.16**	-10.07**	14.51	-9.38**	-1.02**
P-5X P-18	65.3	-8.03**	28.88**	83.3	-13.50**	-2.76	69.3	11.24**	-11.60**	13.53	32.35**	-7.85**
P-5X P-19	46.7	-27.37**	-7.83**	83.3	0.00	-2.76	75.1	15.01**	-4.20	18.10	-27.31**	23.55**
P-19X P-18	61.0	-14.08**	20.39**	82.0	-14.85**	-4.28	77.8	19.14**	-0.76	17.26	-30.52**	18.09**
CD value (5%)		3.95	3.95		6.74	6.74		5.56	5.56		0.75	0.75
CD value (1%)		5.28	5.28		9.01	9.01		7.43	7.43		1.00	1.00

Table 2. Magnitude of heterobeltiosis for fruit breadth, single fruit weight, fruit number and yield in 15 brinjal hybrids

Parents /hybrids	Fruit breadth			Single fruit weight			No. fruits/plant			Fruit yield		
	Means	Heterosis (%)		Means	Heterosis (%)		Means	Heterosis (%)		Means	Heterosis (%)	
	(cm)	BP	SC	(g)	BP	SC		BP	SC	(t/ha)	BP	SC
P-1	2.43	-		93.7	-		8.7	-		12.50	-	
P-5	8.77	-		194.1	-		16.0	-		43.50	-	
P-14	3.56	-		81.9	-		43.3	-		50.26	-	
P-18	8.77	-		286.7	-		2.8	-		11.60	-	
P-19	3.30	-		126.7	-		15.7	-		28.23	-	
P-20	2.92	-		100.0	-		9.4	-		13.53	-	
Tarapuri	6.60	-		170.2	-		16.4	-		39.20		
P-1X P-14	2.97	-16.67**	-54.77**	80.6	-13.98	-52.6**	47.2	9.01**	187.80**	56.06	11.54**	43.01**
P-1X P-18	5.77	-34.09**	-12.56**	186.7	-34.88**	9.7	6.4	-27.27**	-60.97**	17.97	44.07**	-54.13**
P-1X P-19	2.34	-30.30**	-65.33**	92.4	-27.13**	-45.7**	29.8	88.61**	81.70**	42.53	50.74**	8.52*
P-1X P-20	3.60	24.14**	-45.73**	110.2	10.09	-35.3**	14.8	57.45**	-9.75**	23.70	74.89**	-39.59**
P-1X P-5	4.40	-50.00**	-33.67**	135.0	-30.43**	-20.6*	23.7	48.75**	45.12**	46.40	6.67	18.37**
P-20X P-14	3.63	0.00	-45.73**	86.7	-13.39	-49.1**	45.8	5.77*	179.26**	55.10	9.63*	40.56**
P-20X P-18	3.83	-56.82**	-42.71**	144.6	-49.56**	-15.0	6.6	-17.02**	-52.43**	16.43	21.42**	-58.06**
P-20X P-19	3.16	-3.03**	-51.76**	115.8	-8.68	-32.0**	17.2	8.86**	4.87	31.90	13.04**	-18.62**
P-20X P-5	4.53	-48.86**	-32.16**	108.8	-43.92**	-36.0**	28.7	78.75**	74.39**	45.43	4.46	15.92**
P-14X P-18	5.67	-35.23**	-14.07**	185.7	-35.23**	9.1	11.8	-72.81**	-28.04**	32.87	-34.62**	-16.17**
P-14X P-19	3.40	-5.56**	-48.74**	73.1	-42.35**	-57.1**	58.0	32.42**	253.65**	58.00	15.40**	47.96**
P-14X P-5	5.77	-34.09**	-12.56**	123.1	-36.56**	-27.6**	38.2	-12.79**	132.92**	67.66	34.62**	72.60**
P-5X P-18	8.13	-7.95**	22.11**	293.6	2.41	72.5**	8.8	-45.00**	-46.34**	39.63	-8.87*	1.12
P-5X P-19	5.10	-42.05**	-23.12**	126.2	-35.02**	-25.9**	32.8	105.00**	100.00**	57.03	31.13*	45.51**
P-19XP-18	5.97	-31.82**	-9.55**	203.0	-29.19**	19.3*	13.6	-13.92**	-17.07**	41.76	47.98**	6.53
CD value (5%)		0.20	0.20		17.46	17.46		4.94	4.94		7.72	7.72
CD value (1%)		0.27	0.27		23.36	23.36		6.62	6.62		10.33	10.33

Table 3. Top three desirable crosses with *per se* performance and heterosis for three characters

Sl. No.	Characters	Desirable crosses	F_1	BP	SC
1.	Days to 50% flowering	P-20X P-5	48.3	-27.59	-4.67*
		P-5X P-19	46.7	-27.37	-7.83**
		P-14X P-19	54.0	-16.02	6.58**
2.	Fruit number	P-5X P-19	32.8	105.00	100.00**
		P-1X P-19	29.8	88.61	81.70**
		P-14X P-19	58.0	32.42	253.65**
4.	Fruit yield	P-14X P-5	67.66	34.62	72.60**
		P-5X P-19	57.03	31.13	45.51**
		P-1X P-20	23.70	74.89	-39.59**

BP=Better parent and SC=Standard check

The ultimate goal of any hybridization programme is the maximization of yield. Out of 15 crosses, 11 crosses showed desired significant positive heterobeltiosis for this trait and the magnitude of heterosis ranged from 9.63% (P-20x P-14) to 74.89% (P-1x P-20). On the other hand, 8 cross combinations exhibited significant heterosis in the desired direction when estimated over standard cheek and the magnitude ranged from 8.52% (P-1x P-19) to 72.60% (P-14x P-5). Considerable positive heterosis in different cross combinations were also reported by Shafeeq (2007), Kanthaswamy *et al*. (2003), Bavage *et al*. (2005) and Prakash *et al*. (2008).

3.3. Top three desirable crosses with per se performance and heterosis for three characters

When the yield characteristics are used as assessment criteria, it is desirable that the heterosis levels, shown in the hybrid combinations, be as high as possible. Table 3 depicts top three cross combinations in relation to days to 50% flowering, number of fruits per plant and fruit yield studied for per se performance, heterosis over better parent and standard check.

4. Conclusions

The results give us a clear indication that it would be useful to utilize the promising lines in respect of higher yield, earliness and increased fruit number. In view of the high heterosis values shown for the different characteristics, the importance of the non-additive genetic effects in their expression can be inferred. Thus, it is presumed that the establishment of a population with a wide genetic base, using recurrent selection methods for increasing combining ability, will lead to future new lines which result in hybrids superior to those studied.

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