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Study of heterosis in brinjal (*Solanum melongena* L.) for yield attributing traits

S. DAS[1], A. B. MANDAL[2] AND P. HAZRA[3]

[1] Department of Genetics and Plant Breeding,
Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, Coochbehar
[2] Department of Plant Breeding: [3] Department of Vegetable Crops
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur– 741252, Nadia, West Bengal

ABSTRACT

Heterosis has been amply exploited in developing hybrids in brinjal. In India, only 17.8% area of brinjal cultivation is under hybrid seed due to lack of appropriate hybrids for specific area and purpose. In the present investigation, eight parents were selected on the basis of divergence and mated in line × tester design hybrids and parents were raised to measure heterosis for different yield attributes. Lines, testers and hybrids exhibited wide variation among them for different characters under study. Most of the hybrids exhibited positive relative heterosis and heterobeltiosis. In case of plant height, thirteen and ten number of hybrids exhibited positive relative heterosis and heterobeltiosis respectively. For primary branches per plant, all the hybrids registered significant positive relative heterosis and heterobeltiosis indicating increased vigor in the hybrids in lateral direction also. In case of days to 50% flowering, where negative heterosis is desirable, all the hybrids showed significant negative relative heterosis and ten hybrids showed negative heterobeltiosis. Six hybrids showed significant positive relative heterosis for fruit number per plant, whereas, four hybrids had negative values. In case of fruit length and fruit girth, both positive and negative heterosis was observed. For fruit weight, only six hybrids showed positive relative heterosis among which the hybrid BCB 38 × BCB 23 had the highest value (22.18%). Yield, the ultimate product of different yield components, exhibited up to 70.62% average heterosis and 37.9% heterobeltiosis in the hybrid BCB 75 × BCB 15. The mean performance also revealed the superiority of the hybrid BCB 75 × BCB 15.

Key words: Brinjal, heterosis and yield attributes.

Heterosis breeding has become the widely used breeding method for increasing productivity of the important solanaceous vegetable crops including brinjal. Exploitation of hybrid vigor in these crops is commercially possible due to manifestation of high heterosis for yield and other important characters, ease of handling the flowers during artificial emasculation and pollination and realization of higher number of hybrid seeds per effective pollination. In India, only 17.8% area of brinjal cultivation is under hybrid seed. Lack of appropriate hybrids for specific area and purpose is the major problem in popularizing the hybrids of brinjal. In the present investigation, eight parents were selected on the basis of divergence. They were mated in line × tester mating design to raise hybrids and relative heterosis and heterobeltiosis was measured for different yield attributes.

MATERIALS AND METHODS

Three female (line) and five male parents (tester) for hybridization were selected on the basis of divergence among the genotypes which was initially tested among fourty genotypes of brinjal. The three selected female parents were HE 12 (BCB 38), Uttara (BCB 75) and Pusa Purple Cluster (BCB 43) and the male parents were Muktakeshi (BCB 14), Bhangar (BCB 15), Nadia Local (BCB 23), Duli (BCB 24) and Makra (BCB 87).Crossing was made in line × tester mating design statistical analysis was done as per Kempthorne (1957) model to evaluate the hybrids along with parents for different yield attributes. Field experiment was conducted at Central Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, lying at 23^0N latitude, 89^0E longitude and 9.75 m above mean sea level. Hybrids were evaluated for two successive year in 2004-05 and 2005-06 crop season. The layout of the experiment was Randomized Block Design with three replications. Each plot consisted of 20 plants spaced by 60 cm in 2 rows, each of which are 6 m long. Data were taken from random 5 numbers of plants from each replication. Pooled magnitude of heterosis over mid-parent (MP) and better-parent (BP) were calculated on the basis of mean values as suggested by Mather and Jinks (1971).

RESULTS AND DISCUSSION

Mid parent heterosis or relative heterosis and better parent heterosis or heterobeltiosis are important parameters as they provide information about presence of dominance and over dominance type of gene action in the expression of various traits. Analysis of variance for parents and hybrids exhibited that the parents were significantly different for all the characters (Table 1). Lines and testers also differed significantly from each other for most of the characters except fruit girth in case of lines. So, these highly divergent parents indicated their suitability for developing superior hybrids. Performance of lines, testers and hybrids exhibited wide variation among the parents and hybrids for different characters under study (Table 2). Among fifteen hybrids most of the hybrids exhibited positive relative heterosis and heterobeltiosis (Table 3 and 4).

Plant height

The results on heterosis for plant height indicated existence of positive significant relative heterosis and heterobeltiosis in thirteen and ten number of hybrids respectively. Maximum positive relative heterosis was observed in the cross BCB 43 × BCB 15 (31.2%) and maximum heterobeltiosis was observed in BCB 43 × BCB 15 (22.15%).The result was in agreement with earlier studies of Ingale and Patil (1997) and Mandal and Dana (1993).

Primary branches per plant

For primary branches per plant, all the hybrids registered significant positive relative heterosis indicating increased vigor in the hybrids in lateral direction also. Regarding heterobeltiosis, only the cross BCB 38 × BCB 24 showed negative effect (-4.55%).

Days to flowering

In case of days to 50% flowering, where negative heterosis is desirable all the hybrids showed significant negative relative heterosis and ten hybrids showed negative heterobeltiosis which was in conformity with the study of Singh *et al*.,(2002).

Number of fruit per plant

Six hybrids showed significant positive relative heterosis for fruit number per plant, whereas, four hybrids had negative values. Regarding heterobeltiosis, all the hybrids except BCB 43 × BCB 23 showed significant value among which 11 had negative values for this trait and highest magnitude of heterosis was observed in the hybrid BCB 75 × BCB 15.

Fruit weight

For fruit weight, only six hybrids showed positive relative heterosis among which the hybrid BCB 38 × BCB 23 had the highest value (22.18%). Regarding heterobeltiosis, all the hybrids except two produced negative value. Pronounced negative heterosis for fruit weight suggested dominance of negative alleles coming from the lower scoring parents (Patil *et al.,* 2001).

Yield per plant

Yield in any crop is the final product of different yield components. This ultimate produce in the plant is expressed through mutual balancing of characters. In the present study, the hybrid BCB 75 × BCB 15 exhibited up to 70.62% average heterosis and 37.9% heterobeltiosis. The mean *per se* performance revealed that the highest yielding hybrid was BCB 75 × BCB 15 which also possessed highest number of fruits per plant suggesting that the high yield potential in this hybrid was mainly due to high fruit number per plant. Several previous reports amply justified that heterosis in fruit yield was manifested mainly through heterosis in fruit number (Ingale and Patil, 1997, Varghese and Vahab, 1994, Mandal *et al.,* 1994).

Parents involved in the production of best hybrid were medium to low yielder (BCB 75 -3.65 kg, BCB 15-2.25 kg) suggesting that medium × medium or medium × low potential crosses would be fruitful for obtaining high heterosis in brinjal.

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Table 1: Analysis of variance for different yield traits of parents and hybrids

Sources of variation	Plant height (cm)	Primary branches	Days to 50% flowering	No. of fruits/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield/ plant (kg)
Replication	8.01	2.36	2.15	11.75	0.26	0.07	16.08	0.12
Parents (P)	189.33**	8.47**	523.23**	1602.74**	24.27**	33.92**	6139.57**	2.62**
Lines (L)	102.80**	10.77*	217.00**	907.00**	18.65**	0.33	563.44**	1.05**
Tester (T)	269.20**	3.167	179.01**	801.27**	33.03**	14.4**	4585.94**	0.56**
L vs T	42.85*	25.07**	2512.23**	6200.1**	0.48	179.21**	23506.33**	13.98**
Hybrids (H)	391.27**	9.97**	211.83**	373.23**	5.25**	6.23**	862.23**	2.03**
P vs H	1751.50**	131.38**	3630.82**	1068.2**	82.74**	28.99**	799.08**	9.69**
Error	6.64	2.27	5.46	13.04	0.83	0.52	15.14	0.08

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

Table 2: Mean (*per se*) performance of parents and hybrids for different yield traits

Genotypes	Plant height (cm)	Primary branches	Days to 50% flowering	No. of fruits/plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield/ plant (kg)
Lines								
BCB-38	68.00	14.67	35	71.67	16.40	3.50	50.17	4.56
BCB-75	71.00	15.67	52	38.67	12.43	4.10	77.4	3.65
BCB-43	79.30	12.00	44	45.67	11.80	3.57	61.10	3.45
Testers								
BCB-14	86.53	13.00	62	15.33	13.77	8.50	135.80	2.37
BCB-15	68.37	10.33	75	15.67	16.80	12.33	143.60	2.25
BCB-23	64.13	12.00	54	47.00	12.60	6.50	61.63	2.90
BCB-24	63.5	12.00	68	11.00	8.97	9.00	165.37	2.35
BCB-87	67.50	12.67	65	5.00	17.00	10.50	131.27	1.68
Hybrids								
38 x 14	95.80	16.00	32	45.67	17.20	6.77	96.50	4.41
38 x 15	65.50	17.00	29	47.33	17.50	10.23	98.83	4.68
38 x 23	72.33	16.00	36	52.67	16.80	6.67	68.30	3.59
38 x 24	75.87	14.00	31	38.67	17.50	8.20	115.47	4.47
38 x 87	66.83	16.00	36	32.33	16.50	9.30	105.30	3.40
75 x 14	94.60	18.00	45	45.33	14.50	7.60	92.30	4.17
75 x 15	73.83	17.00	54	58.67	17.20	10.50	85.80	5.03
75 x 23	72.83	16.33	48	50.33	13.50	6.90	75.33	3.79
75 x 24	80.33	18.00	50	33.67	14.80	8.50	122.82	4.14
75 x 87	75.67	18.33	55	20.33	16.30	10.80	96.87	1.97
43 x 14	102.33	15.00	38	30.33	15.50	7.80	102.35	3.11
43 x 15	96.87	14.00	36	33.67	17.50	10.20	96.67	3.25
43 x 23	81.67	13.00	40	48.67	14.80	7.30	66.50	3.24
43 x 24	85.33	13.67	45	29.33	14.50	8.60	120.50	3.53
43 x 87	84.50	13.00	49	25.67	16.20	9.80	98.67	2.54
Grand mean	77.94	14.68	47	36.64	15.22	8.14	98.63	3.41
SEm (±)	**1.488**	**0.87**	**1.35**	**2.08**	**0.525**	**0.415**	**2.246**	**0.16**
LSD(0.05)	**4.24**	**2.48**	**3.85**	**5.94**	**1.497**	**1.18**	**6.4**	**0.456**

Table 3: Estimates of percent relative heterosis (over mid parent)

Hybrids	Plant height (cm)	Primary branches	Days to 50% flowering	No. of fruits/ plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield/ plant (kg)
38 x 14	23.99**	15.66**	-34.02**	4.98	14.03**	12.78**	3.78	27.24**
38 x 15	-3.94**	36.00**	-47.27**	8.40**	5.42**	29.26**	2.01	37.35**
38 x 23	9.49**	20.00**	-19.1**	-11.24**	15.86**	33.33**	22.18**	-3.66**
38 x 24	15.39**	5.00**	-39.81**	-6.45*	37.98**	31.20**	7.15*	29.28**
38 x 87	-1.35	17.07**	-26.67**	-15.65**	-1.20	32.86**	16.08**	8.92**
75 x 14	20.1**	25.58**	-21.05**	67.90**	10.69**	20.63**	-13.41**	38.73**
75 x 15	5.96**	30.77**	-14.96**	115.95**	17.67**	27.79**	-22.35**	70.62**
75 x 23	7.79**	18.07**	-9.43**	17.51**	7.86**	30.19**	8.37**	15.83**
75 x 24	19.45**	30.12**	-16.67**	35.57**	38.32**	29.77**	1.18	37.89**
75 x 87	9.27**	29.41**	-5.98**	-6.87*	10.76**	47.95**	-7.16*	-26.00**
43 x 14	23.42**	20.00**	-28.3**	-0.55	21.25**	29.28**	3.96	6.82**
43 x 15	31.2**	25.37**	-39.5**	9.78**	22.38**	28.3**	-5.55	14.15**
43 x 23	13.87**	8.33**	-18.37**	5.04	21.31**	45.03**	8.37**	2.05**
43 x 24	19.51**	13.89**	-19.64**	3.53	39.65**	36.87**	6.42*	21.84**
43 x 87	15.12**	5.41**	-10.09**	1.32	12.50**	39.34**	2.58	-1.17**
SEm (±)	**1.82**	**1.065**	**1.65**	**2.55**	**0.64**	**0.51**	**2.75**	**0.196**
LSD(0.05)	**5.187**	**3.035**	**4.703**	**7.28**	**1.83**	**1.45**	**7.84**	**0.56**

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

Table 4: Estimates of percent heterobeltiosis (over better parent)

Hybrids	Plant height (cm)	Primary branches	Days to 50% flowering	No. of fruits / plant	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield/ plant (kg)
38 x 14	10.71**	9.09**	-8.57**	-36.28**	4.88**	-20.39**	-28.94**	-3.36**
38 x 15	-4.19	15.91**	-17.14**	-33.95**	4.17**	-17.03**	-31.17**	2.56**
38 x 23	6.37**	9.09**	2.86	-26.51**	2.44**	2.56**	10.82**	-21.2**
38 x 24	11.57**	-4.55**	-11.43**	-46.05**	6.71**	-8.89**	-30.18**	-2.05**
38 x 87	-1.72	9.09**	4.76*	-54.88**	-2.94**	-11.43**	-19.78**	-25.44**
75 x 14	9.32**	14.89**	-13.46**	17.24**	5.33**	-10.59**	-32.03**	14.34**
75 x 15	3.99	8.51**	3.85*	51.72**	2.38**	-14.86**	-40.25**	37.9**
75 x 23	2.58	4.26**	-7.69**	7.09*	7.14**	6.15**	-2.67	3.93**
75 x 24	13.15**	14.89**	-3.85*	-12.93**	19.03**	-5.56**	-25.73**	13.33**
75 x 87	6.57**	17.02**	5.77**	-47.41**	-4.12**	2.86**	-26.21**	-45.94**
43 x 14	18.26**	15.38**	-13.64**	-33.58**	12.59**	-8.24**	-24.63**	-9.95**
43 x 15	22.15**	16.67**	-18.18**	-26.28**	4.17**	-17.3**	-32.68**	-5.7**
43 x 23	2.98	8.33**	-9.09**	3.55	17.46**	12.31**	7.9*	-6.09**
43 x 24	7.61**	13.89**	2.27	-35.77**	22.88**	-4.44**	-27.13**	2.42**
43 x 87	6.56**	2.63*	11.36**	-43.8**	-4.71**	-6.67**	-24.83**	-26.47**
SEm (±)	**2.1**	**1.23**	**1.9**	**2.95**	**0.743**	**0.586**	**3.177**	**0.226**
LSD(0.05)	**5.985**	**3.506**	**5.415**	**8.408**	**2.12**	**1.67**	**9.055**	**0.64**

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