Frontiers in Crop Improvement 1(2) : 160-164 (2013)

HETEROSIS FOR EARLINESS AND PLANT STATURE IN BRINJAL (*Solanum melongena* L.)

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ABSTRACT

Line x tester analysis involving nine divers lines and four testers of brinjal was carried to study the extent of heterosis for seven characters including fruit yield per plant. The range of mean performance of the hybrid was higher than parents for all characters studied except number of branches per plant. The magnitude of heterosis ranged from -56.57 to 23.94 % over standard parent for fruit yield per plant. The frequency and magnitude of potential heterotic hybrids were observed more toward desired direction for days to flowering, plant height; plant spread and stem girth indicating presence of over dominance for these characters. The hybrids GP 188 x GOB 1 and GP 115 x JBL 1 could be exploited for higher fruit yield and plant stature, while the hybrid GP 118 x GJB 2 could be useful for earliness and plant stature for future breeding programme in brinjal.

Key words: *Heterosis, line x tester, earliness, plant stature*

Brinjal (*Solanum melongena* L.) is one of the most commercial vegetable crops grown in all the seasons throughout the country. Rigid regional preferences of both growers and consumers are the major limiting factors in developing a brinjal variety /hybrid with earliness and high yielding potentially. Exploitation of hybrid vigour has been identified as potential technological option for raising the genetic yield ceiling in many vegetables including brinjal. At present, exploitation of heterosis is receiving considerable attention as a tool to increase fruit yield in brinjal. The exploitation of hybrid vigour was possible commercially due to ease in production of cross seed by hand pollination in brinjal. F_1 hybrids offer advantages of earliness and increase yield has been reported by several workers (1,2). The production of hybrid is much easier in brinjal because of the large quantity of seeds produced from each fruit resulting in reduced cost of seed production of hybrid seeds. Studies on extent of heterosis give an idea about the potential heterotic cross for fruit yield, earliness and many other important traits. The present investigation was, therefore, undertaken to study the nature and magnitude of heterosis for earliness and plant stature in brinjal.

MATERIALS AND METHODS

The experiment was conducted at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during Kharif 2011-12. The materials for the study consisted of genetically diverse genotypes of brinjal namely, GP 9, GP 11, GP 58, GP 112, GP 115, GP 118, GP 123, GP 188 and JBGR 06-07 as a female lines, and JBL 1, GJB 2, JBGR 1 and GOB 1 as a male tester. The crosses were made by following line x tester model (3). The trial was laid out in randomized block design with three replications which comprised of 36 hybrids, 13 parents (9 lines and 4 testers) and standard check GBH 2. Each entry was planted in single row of 6 m length comprising 10 plants. The observations on days to flowering, days to first picking, plant height (cm), plant spread (cm), number of branches per plant, stem girth (cm) and fruit yield per plant (kg) were recorded from five randomly selected plants. The data were statistically analyzed and heterosis over better parent (BP) and standard parent (SP) were calculated as per standard procedure.

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences among all the parents as well as crosses for all the characters studied. This indicated that parents and hybrids had significant variation for different traits. Variance due to parents vs hybrids was also significant for all the traits except for days to first picking indicating presence of considerable variability among the material studied and existence of overall heterosis for the characters under study.

Table-1: Range of per se performance, magnitude of heterosis and frequency of significant heterotic for earliness and plant stature in brinjal.

Particulars	Days to flowering	Days to first picking	Plant height (cm)	Plant spread(cm)	No of branches / plant	Stem girth (cm)	Fruit yield per plant (kg)
I Mean performance							
(a) Parent							
(i) Range	82.00 - 102.33	98.33 - 116.00	40.49 - 63.22	64.80 - 81.72	5.00 - 7.07	2.40 - 2.70	0.82 - 2.18
(ii) Parent	GP 123-JBGR 06-07, JBGR 1	GP 112- JBGR 06-07	GP 188-GP 58	GP 9-GJB 2	JBGR 06-07-GP 118	GP 118- GP 9	GP 115- GP 118
(b) Hybrid							
(i) Range	83.67-102.67	99-116.33	42.71-66.50	65.11-94.96	4.93-7.00	2.41-2.85	6.45-10.31
(ii) Hybrid	GP 123 x JBL 1-JBGR 06-07 x JBGR 1	GP 11x GJB 2- JBGR 06-07 x GJB 2	GP 11x JBL 1- GP 58 x JBGR 1	GP 9x GJB 2-GP123 x GJB 2	GP 9x JBGR 1-GP 188x JBL 1	GP 9 x GOB 1- GP 9 x GJB 2	GP 112 x GJB 2- GP 112 x JBGR 1
II Magnitude of heterosis (%) over							
(a) Better Parent							
(i) Range	-4.36-15.45	-3.76-14.24	-22.83-18.06	-20.32-15.59	-26.21-19.10	-14.00-10.95	-56.57-47.25
(ii) Hybrid	GP 118 x GJB 1-GP 123 x JBGR 1	GP 118 x GJB 1-GP 112 x JBGR 1	GP 58GJB 2-GP 11 x JBGR 1	GP 9 x GJB 2-GP 123 x GJB 2	JBGR 06.07 x JBL 1-GP 112x JBGR 1	GP 9 x GJB 2- GP 11 x JBGR 1	GP 118x JBL 1-GP 118 x GOB 1
(b) Standard Parent							
(i) Range	-13.75-5.84	-10.09-6.73	-18.20-27.36	-17.30-19.98	-15.91-26.14	-21.36-1.15	-51.62-27.94
(ii) Hybrid	GP 123 x JBL 1-JBGR 06-07 x JBGR 1	GP 11 x GOB 1- JBGR 06-07 x GJB-2	GP 11x JBL 1 –GP58 x JBGR 1	GP 9x GJB 2-GP 123 x GJB 2	GP9 x JBGR 1- GP 188 x JBL 1	GP 9 x GOB 1- GP 9 x GJB 2	GP 118x JBL 1-GP 188 x GOB 1

III Frequency of hybrids with significant heterosis in desired (D) and Undesired (UD) direction														
	D	UD	D	UD	D	UD	D	UD	D	UD	D	UD	D	UD
(a) Better Parent	4	21	4	17	11	10	15	7	5	15	5	2	12	18
(b) Standard Parent	22	7	12	8	20	3	18	7	15	4	4	2	11	21

D= desired Direction, UD = Undesired Direction

Table-2: Mean performance of hybrids (F_1) and percentage of heterobeltiosis (BP) for earliness and plant stature in brinjal.

Hybrids	Days to first flowering		Days to first picking		Plant height (cm)		Plant spread (cm)		No of Branches /plant		Stem girth(cm)		Fruit yield /plant(kg)	
	Mean	BP	Mean	BP	Mean	BP	Mean	BP	Mean	BP	Mean	BP	Mean	BP
GP 9 x JBL 1	95.67	4.74**	109.00	4.47**	51.09	3.34	78.56	4.13	5.27	-23.30**	2.74	4.10	1.46	-13.75**
GP 9 x GJB 2	92.00	0.73	107.00	2.56*	49.65	-13.54**	65.11	-20.32**	5.73	-15.69**	2.67	3.94	1.67	-4.57
GP 9 x JBGR 1	89.67	-1.82*	102.00	2.24*	43.86	-19.63**	76.08	0.40	4.93	16.85**	2.81	9.65*	1.24	-38.31**
GP 9 x GOB 1	93.00	1.82*	107.00	2.56*	63.54	4.89	77.98	-0.92	5.80	-10.31*	2.65	3.38	1.66	0.81
GP 11 x JBL 1	84.00	-3.45**	104.00	3.31**	42.71	-13.62**	73.26	-2.90	5.53	-19.42**	2.71	3.00	1.02	-39.88**
GP 11 x GJB 2	86.67	-0.38	99.00	-1.66	52.78	-8.09**	65.35	-20.03**	7.13	4.90	2.66	5.38	2.15	22.67**
GP 11 x JBGR 1	99.00	13.79**	114.00	13.25**	64.42	18.06**	82.55	8.93**	6.87	14.44**	2.64	3.66	2.11	4.81
GP 11 x GOB 1	87.33	0.38	98.00	-2.65*	59.06	-2.50	85.60	8.76**	6.33	-2.06	2.77	9.67*	2.07	25.45**
GP 58 x JBL 1	95.00	0.00	108.00	-0.31	63.48	0.42	72.98	-8.93**	6.67	-2.91	2.53	-3.93	1.56	-7.86*
GP- 58 x GJB 2	99.00	5.32**	113.00	4.31**	48.79	-22.83**	84.35	3.22	7.07	3.92	2.65	4.89	2.21	26.48**
GP 58 x JBGR 1	98.67	3.50**	111.00	2.46*	66.50	5.18*	82.28	2.67	6.13	-1.08	2.64	3.57	1.35	-32.84**
GP 58 x GOB- 1	96.00	0.70	109.33	0.92	49.72	-21.35**	80.65	0.64	5.93	-8.25	2.57	1.89	1.20	-27.07**
GP 112 x JBL 1	84.33	-1.17	99.33	1.02	56.24	-6.51*	75.53	-7.22**	7.13	3.88	2.49	-5.24	2.18	28.68**
GP 112 x GJB 2	91.00	6.64**	107.33	9.15**	62.39	3.71	93.21	14.07**	6.27	-7.84	2.66	3.99	1.68	-4.19
GP 112 x JBGR 1	95.67	12.11**	112.33	14.24**	51.58	-14.26**	87.25	7.18**	7.07	19.10**	2.63	2.65	1.94	-3.48
GP 112 x GOB 1	92.00	7.81**	110.67	12.54**	63.56	4.93	73.69	-9.47**	7.20	11.34*	2.65	3.30	1.41	-14.55**
GP 115 x JBL 1	94.00	6.82**	109.33	4.79**	51.13	-2.42	69.47	-9.60**	6.27	-8.74*	2.46	8.29*	2.42	42.63**
GP 115 x GJB 2	87.33	-0.76	101.33	-2.88*	64.32	12.00**	83.29	1.90	6.80	0.00	2.50	-6.63	2.46	40.57**
GP- 15 JBGR 1	93.00	5.68**	109.00	4.47**	53.19	-2.53	80.96	5.34*	6.27	1.08	2.57	-4.23	2.33	16.09**
GP 115 x GOB 1	87.67	-0.38	102.33	-1.92	62.23	2.73	90.64	15.16**	7.33	13.40**	2.51	-6.30	1.37	-16.97**
GP 118 x JBL 1	92.00	0.36	104.33	-1.88	65.58	5.57*	92.34	13.94**	5.73	-18.87**	2.72	3.59	0.95	-56.57**
GP 118 x GJB 2	87.67	-4.36**	102.33	-3.76**	65.31	4.97	83.26	1.89	6.87	-2.83	2.77	8.28*	1.52	-30.12**
GP 118 x JBGR 1	100.33	9.45**	115.00	8.15**	53.66	-13.75**	83.41	2.92	5.60	-20.75**	2.51	-1.86	1.64	-24.77**
GP 118 x GOB 1	98.00	6.91**	111.33	4.70**	53.25	-14.40**	79.66	-1.71	7.07	0.00	2.41	-5.90	2.39	9.63**
GP 123x JBL 1	83.67	2.03*	99.33	0.00	55.83	9.46**	81.18	6.78**	5.80	-15.53**	2.60	-131	1.33	-30.90**
GP 123 x GJB-2	86.33	5.28**	100.67	1.34	64.64	12.56**	94.46	15.59**	5.87	-14.56**	2.69	5.67	1.76	-8.51**
GP 123 x JBGR 1	94.67	15.45**	108.33	9.06**	53.10	-2.70	83.22	9.46**	6.80	-0.97	2.44	-4.10	1.45	-27.69**
GP 123 x GOB 1	86.00	4.88**	101.00	1.68	64.58	6.61*	89.84	14.15**	6.20	-9.71*	2.43	-4.54	1.76	-8.51**
GP 88 x JBL 1	98.00	5.00**	109.33	-0.30	53.04	7.27*	84.91	12.55**	7.40	7.77	2.83	-7.44	1.71	0.59
GP 188 x GJB 2	95.67	2.50**	108.33	-0.31	57.29	-0.23	85.21	4.28*	5.27	-22.55**	2.63	1.81	1.25	-28.76**
GP-188 x JBGR-1	94.33	1.07	11067	-3.21**	64.13	17.52**	86.76	14.48**	6.87	15.73**	2.55	-1.38	2.21	9.78**
GP 188 x GOB 1	91.67	-1.79*	111.33	-1.76*	59.03	-2.56	77.74	-1.23	5.80	-10.31*	2.25	-13.03**	2.50	47.25**
JBGR 06-07 x JBL1	97.00	2.11*	112.33	2.43*	57.71	15.06**	86.63	8.23**	5.07	-26.21**	2.51	-4.48	2.11	24.17**
JBGR 06-07 x GJB 2	99.33	5.67**	116.33	7.06**	62.28	8.45**	66.60	-18.49**	6.87	0.98	2.64	4.58	1.98	12.95**
JBGR 06-07x JBGR1	102.67	0.33	115.67	1.17	54.21	-0.66	79.20	2.50	6.27	5.62	2.53	-0.61	1.85	-7.96**
JBGR 06-07 x GOB1	99.33	4.20**	113.33	0.00	48.97	-19.16**	75.81	-3.68	5.73	-11.34*	2.50	-0.88	1.31	-20.40**
S.Em .±	1.20	0.78	2.27	1.20	4.54	1.60	4.98	1.72	0.39	0.29	0.16	0.10	0.12	0.05

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

Table-3: Promising heterotic crosses over better parent and standard parent for earliness and plant stature in brinjal

Character	Cross combinations	Heterosis (%)	
		BP	SP
Days to first flowering			
	GP 118 x GJB 2	-4.36**	-3.76**
	GP 11 x JBL 1	-3.45**	-13.40**
	GP 9 x JBGR 1	-1.82*	-7.56**
	GP 118 x GOB 1	-1.79*	-1.76*
Days to first flowering			
	GP 118 x GJB 2	3.76**	6. 12**
	GP118 x JBGR 1	-3.21**	1.53
	GP 115 x GJB 2	-2.88*	-7.03**
	GP 11 x GOB 1	-2.65*	-10.09**
Plant height			
	GP 112 x JBGR 1	19.10**	20.45**
	GP 118x JBGR 1	15.73**	-1.14
	GP 11 x JBGR 1	14.44**	17.05**
	GP 115 x GOB 1	13.40**	17.05**
Plant spread			
	GP 123 x GJB 2	15.59**	19.98**
	GP 118 x JBGR 1	14.48**	10.20**
	GP 123 x GOB 1	14.15**	14.12**
	GP 112 x GJB 2	14.07**	18.40**
No. of braches/per			
	GP 112 x JBGR 1	19.10**	20.45**
	GP 118 x JBGR 1	15.73**	17.05**
	GP 11 x JBGR 1	14.44*	17.05**
	GP 115 x GOB 1	13.40**	25.00**
Stem girth			
	GP 11 x GOB 1	9.67**	10.27**
	GP 9 x JBGR 1	9.65**	12.30**
	GP 115 x JBL 1	8.29**	7.15**
	GP 118 x GJB 2	8.28**	6.80**
Fruit yield			
	GP 118 x GOB 1	47.25**	27.94**
	GP 115 x JBL 1	42.63**	23.68**
	GP 115 x GJB 2	40.57**	25.72**
	GP 58 x GJB 1	26.48**	13.12**

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

The range of per se performance of parents and hybrids are presented in Table-1. The range of per se performance of hybrids was higher than parents for all the characters under study. Among the parents, GP 123 showed earliest for days to flowering (82.00 days). GP 188 was recorded the highest fruit yield per plant (2.18 kg) though it was late in days to flowering (114.33 days). Plant height and plant spread was minimum in GP 118 and GP 9, respectively, while it was maximum in GP 188 and GJB 2, respectively. Number of branches per plant and thickness was maximum in GP 123.

Among hybrids the earliest days flowering (83.67 days) was recorded in GP 123 x JBL 1. The cross GP 118 x GOB 1 showed the highest fruit yield per plant (2.50 kg). The number of branches per plant was the highest in GP 118 x JBL 1. The cross GP 58 x JBGR 1 had maximum plant height, while plant spread was maximum in cross GP 123 x GJB 2. The GP 188 x JBL1 showed maximum stem girth. The above observations indicated that the best performing hybrids were heterotic for different traits. These findings are in agreement with the findings of (2, 4).

The magnitude of heterosis over standard parent ranged from -51.62 to 27.94% for fruit yield per plant (Table-1). Similarly wider range of heterosis was observed for days to flowering, days to first picking, plant height, plant spread, number of branches per plant and fruit yield per plant. The narrow range of heterosis was recorded for stem girth. It was observed that the cross with high mean performance showed

higher degree of heterosis for the same characters indicating positive association between per se performance and heterotic effects. Frequency with significant heterosis in desirable direction was observed for days to flowering, days to first picking, plant height, plant spread, number of branches per plant and fruit yield per plant.

The mean value for F_1 hybrids and their percentage heterosis over better parent (BP) are presented in Table 2. Out of 36 F_1 hybrids, in desired direction for earliness (4 hybrids, each for days to flowering and days to first picking). For plant stature, 36 hybrids (11 hybrids for plant height, 15 hybrids for plant spread and 5 hybrids each for number of branches per plant and stem girth) exhibited significant heterosis over better parent in favourale direction. Four crosses namely, GP 118 x GJB 2 (except plant height, plant spread, number of braches per plant and fruit yield). GP 11 x JBL 1 only for days to flowering, GP 9 x JBGR 1 (except pant height and fruit yield, GP 188 x GOB 1 (except plant height, plant spread, number of branches per plant stem girth) expressed significant and desirable heterobeltiosis for all the characters studied.

Promising crosses over better parent (BP) and standard parent (SP) for different characters are presented in Table 3. Earliness is more desirable in vegetables as it fetches higher price in this direction, the cross GP 188 x GJB 2 had expressed significant and desirable heterobeltiosis for days to flowering and days to first picking. This hybrid also exhibited significant and favourable heterosis for plant spread as this trait is considered desirable for production of more number of fruits and there by higher fruit yield in brinjal. The other desirable heterotic hybrids for earliness and plant stature were GP 11 x JBL 1, GP 9 x JBGR 1 and GP 188 x GOB 1which showed significant and desirable heterobeltiosis for yield per plant and plant height. The results of present findings are akin to (2, 4). Table-3 also revaled most of heterotic crosses involving parents GP 118, GP 112, GP 115 GJB 2, JBL 1, JBGR 1 and GOB 1. Therefore, these parents could be utilized to produce higher yielding hybrids along with earliness and plant stature.

It can be concluded that the hybrids GP 118 x GOB 1 and GP 115 x JBL 1 could be exploited for fruit yield and plant stature, while the hybrid GP 118 x GJB 2 could also be exploited for earliness and plant stature in future breeding programme in brinjal.

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Received : February-2013; Revised : March-2013; Accepted : April-2013