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Heterosis for fruit yield in diverse Brinjal (*Solanum melongena* L.) germplasm

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Abstract

With prime objective of developing season/region specific hybrid, the present investigation was undertaken to obtain the information on the heterosis for fruit yield in brinjal (Solanum melongena* L.*) using line x tester analysis. The experimental material comprised of ten lines, four testers and resultant 40 hybrids along with two checks which were raised in a randomized block design with three replications in three environments (different seasons) viz., Late Kharif, Rabi and Early Summer at Navsari during 2014-15. The degree of heterosis varied from cross to cross for fruit yield per plant. Considerable heterosis in certain crosses and low in other crosses revealed that nature of gene action varied with the genetic architecture of parents. Fourteen crosses over check ABH – 1 and thirty one crosses over check Surati Ravaiya, reported significant and positive standard heterosis for fruit yield per plant which appeared to be due to the diversity among the parents involved. The maximum standard heterosis for fruit yield per plant over both the checks was recorded by the cross combination JB-12-6 X PLR-1. Rigorous testing of superior crosses identified through this experiment in an array of environments/season may further be performed before its commercial exploitation.

Keywords- brinjal; heterosis; hybrids; fruit yield;

I. INTRODUCTION

Vegetable crops offer higher yield, income and calories as compared to agronomical crops, hence vegetable farming has become profitable enterprise. Vegetables are natural source of protective food as they supply vitamins and minerals along with roughages. Brinjal (*Solanum melongena* L.) belongs to the family Solanaceae with chromosome number of 2n=24. It is a self-pollinated, annual herbaceous versatile crop plant, which is well adopted to different agro-climatic regions and grown round the year. Brinjal is perennial in nature but grown commercially as an annual vegetable crop. Brinjal is grown for its immature, unripe fruits which are used in the variety of ways as cooked vegetable in curries. Exploitation of heterosis on a commercial scale in vegetable crops have resulted in the development of the several high yielding hybrid varieties. This technique has been proved to be the most important genetic tool for enhancing yield potential. In the development of promising varieties through hybridization, proper selection of the parents is of the almost importance. High yielding genotypes may or may not transmit its superiority to the progenies. Thus, the outcome of a breeding programme depends largely on useful gene combinations in the form of high combining inbreds.

II. MATERIALS AND METHODS

The experiment was conducted at College Farm, Navsari Agricultural University, Navsari. The experimental material for the present investigation was crossed in Line X Tester fashion [1] using 10 females and 4 males. These 40 F_1s, 14 parents (10 females, 4 males) and two commercial check varieties (parents and checks details as given in Table 1) composed the material for the present investigation on standard heterosis. The crossing programme was carried out during *Rabi* 2013-14 with ten females and four testers in L x T mating design by hand emasculation and pollination. The emasculated flowers of the female parent and crossed flowers were labeled. To ensure purity the

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pollinated flower buds were bagged to avoid out crossing. Later, mature ripe fruits were harvested separately and seeds extracted from these fruits following standard extraction procedures. The experiment was laid out in Randomized Block Design (RBD) with three replication during late *kharif* (E_1), *rabi* (E_2) and early summer season (E_3) of 2014-15. The recommended agronomic practices and plant protection measures were adopted for raising a good crop.

$$\text{Standard Heterosis (\%)} = \frac{\overline{F_1} - \overline{SC}}{\overline{SC}} \times 100$$

Where,

$\overline{F_1}$ = Mean performance of F_1 hybrid

$\overline{SC}$ = Mean performance of standard check

III. RESULTS AND DISCUSSION

Through Line × tester analysis, large number of parents and crosses could be evaluated and analysis is also free from any assumptions. This analysis also provided very reliable information about the genetic architecture of inheritance pattern from its standard estimates. Performance of brinjal hybrids and estimates of standard heterosis over two checks ABH-1 and Surati ravaiya have been discussed below.

3.1. Estimates of Standard heterosis

The estimates of heterosis measured as per cent increase or decrease over standard checks (standard heterosis) ABH 1 (Check-1) and Surati Ravaiya (Check 2) estimated for fruit yield in individual environment and on pooled basis are presented in Table 2.

In E_1, the range of standard heterosis over check-1 was -13.27 per cent (JBL-12-6-1-2 X PLR-1) to 56.42 per cent (AB-7-2 X PLR-1) along with twenty two hybrids having significant positive standard heterosis. AB-7-2 X PLR-1 (56.42 %), JB-12-6 X PLR-1 (56.17 %) and JBL-12-8-1-1 X Pant Rituraj (56.14 %) were the top three hybrids with significant positive standard heterosis. The range of standard heterosis over check-2 was 1.74 per cent (JBL-12-6-1-2 X PLR-1) to 83.49 per cent (AB-7-2 X PLR-1) and total thirty hybrids had registered significant positive standard heterosis. Three promising hybrids observed were AB-7-2 X PLR-1 (83.49 %), JB-12-6 X PLR-1 (83.20 %) and JBL-12-8-1-1 X Pant Rituraj (83.16 %)

In E_2, the estimates of standard heterosis revealed that none of the hybrids have manifested significant positive heterosis over check-1 and the range of standard heterosis was -38.25 per cent (JBG-10-208 X GJB-2) to 22.61 per cent (JBCL-1 X PLR-1). In case of check-2 standard heterosis ranged from -22.39 per cent (JBG-10-208 X GJB-2) to 54.12 per cent (JBCL-1 X PLR-1) while, eleven hybrids were having significant heterosis in desired direction over check-2. Promising combinations observed were JBCL-1 X PLR-1 (54.12 %), AB-7-2 X PLR-1 (51.14 %) and JBL-12-8-1-1 X Pant Rituraj (47.51 %).

The perusal of results revealed that in E_3 the range of standard heterosis over check-1 was -24.35 per cent (AB-8-14 X Pant Rituraj) to 55.52 per cent (JB-12-6 X PLR-1) and fourteen hybrids had significant positive heterosis over check-1. Three promising hybrids were JB-12-6 X PLR-1 (55.52 %), JBL-12-8-1-1 X Pant Rituraj (43.51 %) and AB-7-2 X PLR-1 (41.87 %), whereas the range of standard heterosis over check-2 was 0.09 per cent (AB-8-14 X Pant Rituraj) to 105.75 per cent (JB-12-6 X PLR-1) and total twenty eight hybrids had registered significant positive heterosis. The cross combinations JB-12-6 X PLR-1 (105.75 %), JBL-12-8-1-1 X Pant Rituraj (89.87 %) and AB-7-2 X PLR-1 (87.69 %) were recorded as promising hybrids over check-2.

The range of standard heterosis in case of check-1 over environments was observed from -15.99 per cent (JBL-12-6-1-2 X PLR-1) to 44.27 per cent (JB-12-6 X PLR-1) and fourteen hybrids had significant positive heterosis over check-1. Three promising hybrids observed were JB-12-6 X

PLR-1 (44.27 %), AB-7-2 X PLR-1 (40.86 %) and JBL-12-8-1-1 X Pant Rituraj (40.44 %). In case of check-2 the range of standard heterosis was 4.52 per cent (JBL-12-6-1-2 X PLR-1) to 79.49 per cent (JB-12-6 X PLR-1) and total thirty one hybrids had registered significant positive heterosis. The cross combinations JB-12-6 X PLR-1 (79.49 %), AB-7-2 X PLR-1 (75.25 %) and JBL-12-8-1-1 X Pant Rituraj (74.73 %) were recorded as promising hybrids over check-2.

In the present investigation, standard heterosis ranged from -15.99 to 44.27 per cent over check-1 ABH-1 and 4.52 to 79.49 per cent over check-2 Surati Ravaiya for fruit yield per plant in pooled analysis. Fourteen crosses over check-1 and thirty one crosses over check-2 reported significant and positive standard heterosis for fruit yield per plant which is appeared to be due to the diversity among the parents involved.

The maximum standard heterosis for fruit yield per plant over check-1 was recorded by the cross combination JB-12-6 X PLR-1 (44.27 %) followed by AB-7-2 X PLR-1 (40.86 %), JBL-12-8-1-1 X Pant Rituraj (40.44 %), JBCL-1 X PLR-1 (36.20 %), AB-7-2 X Pant Rituraj (31.92 %), JBL-12-6-1-2 X Pant Rituraj (31.60 %), AB-8-6 X PLR-1 (29.02 %), JBL-12-8-1-1 X PLR-1 (28.68 %), JBCL-1 X Pant Rituraj (28.05 %) and JB-12-6 X GJB-2 (27.16 %). Whereas, over check-2 maximum standard heterosis for fruit yield per plant was recorded by the cross combination JB-12-6 X PLR-1 (79.79 %) followed by AB-7-2 X PLR-1 (75.25 %), JBL-12-8-1-1 X Pant Rituraj (74.73 %), JBCL-1 X PLR-1 (69.45 %), AB-7-2 X Pant Rituraj (64.12 %), JBL-12-6-1-2 X Pant Rituraj (63.73 %), AB-8-6 X PLR-1 (60.53 %), JBL-12-8-1-1 X PLR-1 (60.10 %), JBCL-1 X Pant Rituraj (59.32 %) and JB-12-6 X GJB-2 (58.20 %) (Table 3).These findings were in close association with results reported by several workers in past [2], [3], [4], [5], [6], [7], [8], [9], [10].

The crosses JB-12-6 X PLR-1, AB-7-2 X PLR-1 and JBL-12-8-1-1 X Pant Rituraj displayed high magnitude of standard heterosis over both checks along with high per se performance for fruit yield per plant and some of its components. These crosses could be exploited for obtaining desirable traits in brinjal. More importantly, these crosses may be evaluated over multi-location trials to identify high yielding and stable hybrids of brinjal. They can be further exploited commercially under different environments for consumer acceptance based on taste and other quality traits.

IV. CONCLUSION

From the results obtained in the present findings it can be concluded that sufficient diversity was evident in the material for fruit yield and its components. Significant and considerable differences were also observed in the environmental conditions. This suggested that heterosis breeding or biparental mating would be more suitable for the improvement of these traits in brinjal.

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Table 1: List of parental lines used for experiment.

Sr. No.	Genotype	Seed source
Lines (Female parent)		
1.	JBL-12-06-4-1	Junagadh Agricultural University, Junagadh
2.	JB-12-06	Junagadh Agricultural University, Junagadh
3.	JBL-12-06-1-2	Junagadh Agricultural University, Junagadh
4.	JBCL-1	Junagadh Agricultural University, Junagadh
5.	JBL-08-07	Junagadh Agricultural University, Junagadh
6.	JBG-10-208	Junagadh Agricultural University, Junagadh
7.	JBL-12-08-1-1	Junagadh Agricultural University, Junagadh
8.	AB-08-6	Anand Agricultural university, Anand
9.	AB-07-2	Anand Agricultural university, Anand
10.	AB-08-14	Anand Agricultural university, Anand
Testers (Male parent)		
11.	PLR-1	Vegetable Research Station, TNAU, Palur
12.	Pant Rituraj	GBPUAT, Pantnagar
13.	GJB-2	Junagadh Agricultural University, Junagadh
14.	JBGR-1	Junagadh Agricultural University, Junagadh
Checks		
15.	ABH – 1 (Check-1)	Anand Agricultural university, Anand
16.	Surati Ravaiya (Check-2)	R. H. R. S, N. A. U., Navsari

Table 2. Estimates of heterosis over standard checks under individual environment and pooled over environments for fruit yield per plant (g)

Sr. No.	Name of the crosses	*Kharif* (E_1)		*Rabi* (E_2)		*Early Summer* (E_3)		Pooled	
		Check-1	**Check-2**	**Check-1**	**Check-2**	**Check-1**	**Check-2**	**Check-1**	**Check-2**
1.	JBL 12-6-4-1 X PLR-1	25.52	47.24 **	-17.70	3.45	18.06 *	56.20 **	10.19	37.10 **
2.	JBL 12-6-4-1 X Pant Rituraj	11.55	30.85	-22.57	-2.68	-3.39	27.82 *	-3.53	20.03 *
3.	JBL 12-6-4-1 X GJB-2	35.16 *	58.55 **	-8.41	15.12	0.31	32.71 **	10.72	37.76 **
4.	JBL 12-6-4-1 X JBGR-1	26.71	48.64 **	-14.92	6.94	0.23	32.60 **	5.60	31.39 **
5.	JB-12-6 X PLR-1	**56.17** **	**83.20** **	16.92	46.97 **	**55.52** **	**105.75** **	**44.27** **	**79.49** **
6.	JB-12-6 X Pant Rituraj	33.38 *	56.46 **	5.73	32.90 *	33.16 **	76.17 **	25.07 **	55.61 **
7.	JB-12-6 X GJB-2	51.30 **	77.48 **	-4.51	20.02	28.44 **	69.92 **	27.16 **	58.20 **
8.	JB-12-6 X JBGR-1	39.55 **	63.70 **	-5.76	18.45	-7.97	21.76 *	10.43	37.39 **
9.	JBL-12-6-1-2 X PLR-1	**-13.27**	**1.74**	-28.10 *	-9.63	-8.10	21.58 *	**-15.99** *	**4.52**
10.	JBL-12-6-1-2 X Pant Rituraj	45.52 **	70.71 **	16.69	46.67 **	29.29 **	71.05 **	31.60 **	63.73 **
11.	JBL-12-6-1-2 X GJB-2	23.08	44.38 **	-7.86	15.82	-4.10	26.87 *	4.93	30.55 **
12.	JBL-12-6-1-2 X JBGR-1	8.62	27.42	-23.04	-3.26	-20.13 *	5.67	-10.26	11.65
13.	JBCL-1 X PLR-1	45.29 **	70.44 **	**22.61**	**54.12** **	38.17 **	82.80 **	36.20 **	69.45 **
14.	JBCL-1 X Pant Rituraj	53.72 **	80.33 **	5.02	32.00 *	19.78 *	58.46 **	28.05 **	59.32 **
15.	JBCL-1 X GJB-2	27.82	49.95 **	-7.71	16.00	29.42 **	71.22 **	17.76 *	46.52 **
16.	JBCL-1 X JBGR-1	8.16	26.88	-4.07	20.58	14.25	51.15 **	6.52	32.53 **
17.	JBL-8-7 X PLR-1	2.30	20.01	-32.57 **	-15.24	-17.95 *	8.55	-14.74 *	6.07
18.	JBL-8-7 X Pant Rituraj	7.45	26.05	-11.10	11.74	-2.10	29.52 **	-1.22	22.90 **
19.	JBL-8-7 X GJB-2	4.40	22.47	-33.00 **	-15.78	-21.15 **	4.32	-15.14 *	5.58
20.	JBL-8-7 X JBGR-1	-4.55	11.97	-18.83	2.02	-6.06	24.28 *	-9.30	12.84
21.	JBG-10-208 X PLR-1	14.10	33.85 *	-22.03	-1.99	-22.09 **	3.07	-8.56	13.76
22.	JBG-10-208 X Pant Rituraj	52.81 **	79.26 **	-23.43	-3.75	13.90	50.68 **	17.31 *	45.95 **
23.	JBG-10-208 X GJB-2	42.35 **	66.99 **	**-38.25** **	**-22.39**	-14.62	12.95	-0.39	23.93 **
24.	JBG-10-208 X JBGR-1	38.60 **	62.59 **	-9.35	13.95	-6.37	23.87 *	9.53	36.27 **
25.	JBL-12-8-1-1 X PLR-1	51.64 **	77.89 **	3.81	30.49 *	25.13 **	65.55 **	28.68 **	60.10 **
26.	JBL-12-8-1-1 X Pant Rituraj	**56.14** **	**83.16** **	17.35	**47.51** **	**43.51** **	**89.87** **	**40.44** **	**74.73** **

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27.	JBL-12-8-1-1 X GJB-2	27.48	49.54 **	-16.11	5.44	-10.31	18.66	2.07	26.99 **
28.	JBL-12-8-1-1 X JBGR-1	1.57	19.14	-21.54	-1.38	-3.83	27.23 *	-7.09	15.59
29.	AB-8-6 X PLR-1	43.87 **	68.76 **	6.00	33.24 *	33.03 **	76.00 **	29.02 **	60.53 **
30.	AB-8-6 X Pant Rituraj	34.78 *	58.10 **	14.36	43.74 **	21.70 **	61.01 **	24.40 **	54.77 **
31.	AB-8-6 X GJB-2	33.39 *	56.48 **	-18.46	2.50	-11.32	17.32	3.24	28.45 **
32.	AB-8-6 X JBGR-1	35.84 *	59.35 **	-11.33	11.45	-1.13	30.81 **	9.63	36.40 **
33.	AB-7-2 X PLR-1	**56.42 ** **	**83.49 ** **	20.24	**51.14 ** **	**41.87 ** **	**87.69 ** **	**40.86 ** **	**75.25 ** **
34.	AB-7-2 X Pant Rituraj	49.16 **	74.98 **	12.36	41.24 **	30.04 **	72.05 **	31.92 **	64.12 **
35.	AB-7-2 X GJB-2	44.61 **	69.63 **	-16.39	5.09	-16.06 *	11.05	6.49	32.49 **
36.	AB-7-2 X JBGR-1	19.97	40.74 *	-19.91	0.67	-18.37 *	7.99	-4.52	18.80 *
37.	AB-8-14 X PLR-1	30.26 *	52.80 **	-16.97	4.37	-16.54 *	10.41	0.80	25.41 **
38.	AB-8-14 X Pant Rituraj	25.68	47.43 **	-34.02 **	-17.07	**-24.35 ** **	**0.09**	-8.55	13.77
39.	AB-8-14 X GJB-2	45.01 **	70.11 **	-13.03	9.32	-4.48	26.38 *	11.45	38.66 **
40.	AB-8-14 X JBGR-1	4.95	23.11	-30.64 *	-12.82	-20.91 *	4.64	-14.15 *	6.81
Significant	**Positive**	**22**	**30**	**0**	**11**	**14**	**28**	**14**	**31**
	Negative	**0**	**0**	**6**	**0**	**9**	**0**	**4**	**0**
Maximum		**56.42**	**83.49**	**22.61**	**54.12**	**55.52**	**105.75**	**44.27**	**79.49**
Minimum		**-13.27**	**1.74**	**-38.25**	**-22.39**	**-24.35**	**0.09**	**-15.99**	**4.52**
S.E.±		400.53		275.10		201.42		175.33	
C.D. at 5 %		797.39		547.68		401.00		345.43	
C.D. at 1 %		1057.54		726.35		531.82		455.34	

***, ** Significant at 5 and 1 per cent probability levels, respectively.**

Table 3: Top ten hybrids based on fruit yield per plant across environments.

Sr. No.	Hybrid	Fruit yield per plant (g)	Standard heterosis-1 (%)	Standard heterosis-2 (%)
1.	JB-12-6 X PLR-1	3687.80	44.27**	79.79**
2.	AB-7-2 X PLR-1	3600.65	40.86**	75.25**
3	JBL-12-8-1-1 X Pant Rituraj	3589.82	40.44**	74.73**
4	JBCL-1 X PLR-1	3481.46	36.20**	69.45**
5	AB-7-2 X Pant Rituraj	3372.02	31.92**	64.12**
6	JBL-12-6-1-2 X Pant Rituraj	3363.87	31.60**	63.73**
7	AB-8-6 X PLR-1	3298.13	29.02**	60.53**
8	JBL-12-8-1-1 X PLR-1	3289.29	28.68**	60.10**
9	JBCL-1 X Pant Rituraj	3273.29	28.05**	59.32**
10	JB-12-6 X GJB-2	3250.39	27.16**	58.20**

***, ** Significant at 5 and 1 per cent probability levels, respectively.**

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