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Modh Zeal A

Vegetable Research Station,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Jivani LL

Vegetable Research Station,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Kachhadia VH

Vegetable Research Station,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Valu MG

Vegetable Research Station,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Vadavia AT

Vegetable Research Station,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Correspondence

Jivani LL

Vegetable Research Station,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Heterosis for fruit yield and its components in brinjal (*Solanum melongena* L.)

Modh Zeal A, Jivani LL, Kachhadia VH, Valu MG and Vadavia AT

Abstract

A study conducted to estimate the magnitudes of heterosis for fruit yield and its components in brinjal. Thirty two F₁ hybrids (generated by line x tester mating design using diverse eight lines and four testers) along with 12 parents and one check were evaluated in a randomized block design with three replications at Vegetable Research station, Junagadh Agricultural University, Junagadh, Gujarat (India). Appreciable heterosis was found over better and standard parents for all the traits studied in desirable direction. In order of merit, the highest heterobeltiosis was recorded by cross NSR 1 x Swarna Mani Black (46.00%) followed by NBR-14-01 x Swarna Mani Black (40.03% and NSR-1 x Pant Rituraj (39.35%), while cross NSR 1 x Swarna Mani Black ranked first by recording the highest standard heterosis (62.00%) for fruit yield per plant followed by NBR-14-01 x Swarna Mani Black (55.39%) and AB-15-07 x Swarna Mani Black (50.09%). The above crosses also exhibited desirable heterosis for important yield attributing characters like fruit length, fruit girth, fruit weight and number of fruits per plant. The present study revealed good scope for isolation of pure lines from the progenies of heterotic F₁s as commercial exploitation of heterosis breeding in brinjal.

Keywords: Brinjal fruit yield, heterobeltiosis, standard heterosis, total soluble solids

Introduction

Brinjal (*Solanum melongena* L.) also known as eggplant is one of the important vegetable crops of India and is grown throughout the year. However, it is widely cultivated in both temperate and tropical regions of the globe mainly for its immature fruits as vegetables (Rai *et al.*, 1995) ^[1], but in the temperate regions, it is cultivated mainly during warm season. India is regarded as the primary centre of origin/diversity of brinjal (Vavilov, 1931; Bhaduri, 1951; Genebus, 1963) ^[15,4,6].

Recently, the exploitation of hybrid vigour in vegetable crops considered to be one of the outstanding achievements in vegetable breeding. To know the potentiality of hybrid in particular crop, the magnitude and direction of heterosis is of paramount important. Heterosis response largely depends upon genetic divergence among the parents involved in particular study. In India, wide genetic variability was reported by several workers in vegetables. Very meagre work has been done especially in Saurashtra region of Gujarat on brinjal, which is one of major vegetable crops of Gujarat state. For the first time, Bailey and Munson (1891) ^[2] reported artificial hybridization in brinjal. However, none of the hybrids exhibited any heterosis. Nagai and Kida (1926) ^[9] were probably the first to observe hybrid vigour in a cross combination of some Japanese varieties of brinjal. To obtain high yield per unit area, exploitation of hybrid vigour is one of the good ways and particularly in crop like brinjal, where more seeds per fruit are obtained. Therefore, in the present study, an attempt has been made to obtain information on the extent of hererosis in L x T crosses to produce promising hybrids/pure lines in brinjal.

Materials and Methods

Eight diverse brinjal pure lines *viz.*, AB-08-14, AB-15-07, AB-15-08, JB-12-06, JBR-14-07, NSR-01, NBR-14-01 and NBR-15-05 and four testers *viz.*, Swarna Mani Black, GJLB-4, Pant Rituraj and GJB-3 were chosen on the basis of their diverse variation in fruit yield and its contributing traits and were crossed in a line x tester mating design. The parents along with their F₁s and one check (GJBH-4) were grown in a randomized block design with three replications during *kharif* 2017 at Vegetable Research Station, Junagadh Agricultural University, Junagadh. The spacing of 75 x 60 cm was adopted in rows of 6.00 m length. Recommended cultural practices and plant protection measures were followed to raise good

crop. The observations were recorded on five randomly selected plants from each replication for days to 50 per cent flowering, days to first picking, days to last picking, number of pickings, fruit length (cm), fruit girth (cm), fruit weight (g), number of fruits per plant, number of branches per plant, plant height (cm), total fruit yield per plant (kg), total soluble solids (°B) and fruit borer infestation (%). Line x tester analysis was carried out by the method suggested by Kempthorne (1957)^[8]. Heterosis was worked out over better parent and standard check as per standard procedure.

Results and Discussion

The analysis of variance for experimental design revealed highly significant differences among genotypes, parents and hybrids for all the characters except for days to first picking for parents, indicating the presence of sufficient genetic variability for the 13 characters studied. The mean squares due to parents vs hybrids were also found highly significant for all the traits except days to last picking and number of fruits per plant (Table 1).

Wide range of variability exists among parents and their F₁ hybrids for different traits under study. Out of the 32 hybrids, the significant desirable heterotic effects over their respective better and standard parent were noticed in 31 and 19 crosses for days to 50 per cent flowering ; 0 and 3 crosses for days to first picking; 9 and 19 crosses for days to last picking; 4 and 25 crosses for number of pickings; 1 and 0 crosses for fruit length; 0 and 1 crosses for fruit girth; 13 and 15 crosses for fruit weight; 5 and 7 crosses for number of fruits per plant; 3

and 0 for number of branches per plant; 2 and 2 crosses for plant height; 9 and 12 total fruit yield per plant; 16 and 14 for total soluble solids and 10 and 0 crosses for fruit borer infestation, respectively (Table 2). The heterobeltiosis and standard heterosis ranged from -50.95 to 46 per cent and -37.24 to 62.00 per cent for fruit yield per plant, respectively.

Top three hybrids for different traits with respect to heterosis over better parent and standard check (GJBH-4) are presented in Table 3. The highest heterobeltiosis was recorded by cross NSR 1 x Swarna Mani Black (46.00%) followed by NBR-14-01 x Swarna Mani Black (40.03%) and NSR-1 x Pant Rituraj (39.35%), while cross NSR 1 x Swarna Mani Black ranked first by recording the highest standard heterosis (62.00%) for fruit yield per plant followed by NBR-14-01 x Swarna Mani Black (55.39%) and AB-15-07 x Swarna Mani Black (50.09%). The above crosses also exhibited desirable heterosis for important yield attributing characters like fruit length, fruit girth, fruit weight and number of fruits per plant. The heterotic response over better parent and standard check in brinjal was also reported by Ashwini and Khandelwal (2003)^[1], Prabhu *et al.* (2005)^[10], Kamal *et al.* (2006)^[7], Vaddoria *et al.* (2007)^[14], Sao and Mehta (2010)^[13], Reddy and Patel (2014)^[12], Gadhiya *et al.* (2015)^[5], Viradiya *et al.* (2016)^[16] and Balwani *et al.* (2017)^[3].

The hybrids exhibited desirable heterobeltiosis and economic heterosis for fruit yield per plant and other characters could be further evaluated to exploit the heterosis or utilized in future breeding programme to obtain desirable segregants for the development of superior genotypes.

Table 1: Analysis of variance for experimental design for different characters in brinjal

Source	d.f.	Days to 50% flowering	Days to first picking	Days to last picking	Number of pickings	Fruit length (cm)	Fruit girth (cm)	Fruit weight
		1	2	3	4	5	6	7
Replication	2	8.47*	43.43*	22.15	3.12*	0.05	0.68*	206.64**
Genotypes	43	32.09**	72.82**	202.42**	4.71**	8.17**	67.92**	1702.92**
Parents	11	8.51**	18.18	127.17**	5.23**	14.20**	53.34**	1569.48**
Hybrids	31	6.75**	86.26**	235.45**	2.33**	3.84**	14.52**	1613.78**
P. vs H.	1	1076.83**	257.38**	6.09	73.03**	75.91**	1883.94**	5933.96**
Error	86	2.32	13.80	7.17	0.96	0.01	0.177	42.14

Source	d.f.	Number of fruits per plant	Number of branches per plant	Plant height (cm)	Total fruit yield per plant (kg)	Total soluble solids (TSS) (°B)	Fruit borer infestation (%)
		8	9	10	11	12	13
Replication	2	8.27**	0.10*	129.51*	0.07*	0.24**	9.10**
Genotypes	43	70.79**	1.22**	436.75**	0.71**	0.50**	28.38**
Parents	11	90.11**	1.35**	712.97**	0.54**	0.14**	47.74**
Hybrids	31	66.18**	0.91**	343.16**	0.75**	0.51**	10.22**
P. vs H.	1	1.23	9.62**	299.32**	1.22**	3.93**	378.28**
Error	86	1.83	2.25	38.16	0.02	0.03	1.40

Table 2: Magnitude of heterobeltiosis (H₁) and standard heterosis (H₂) for various characters in brinjal

Sr. No.	Characters	Desirable aspects	Number of crosses with significant hererosis							
			Heterobeltiosis H ₁ (%)		Standard Heterosis H ₂ (%)		H ₁		H ₂	
							+Ve	-Ve	+Ve	-Ve
1	Days to 50% flowering	Early	-3.09 to -12.37		-8.60 to 1.61		0	31	0	19
2	Days to first picking	Early	-7.18 to 24.26		-10.40 to 24.26		12	0	6	3
3	Days to last picking	Late	-13.35 to 8.55		-7.04 to 10.26		9	13	19	6
4	Number of pickings	More	-9.76 to 16.22		5.71 to 31.43		4	0	25	0
5	Fruit length	High	-42.31 to 6.72		-49.00 to 0.00		1	29	0	32
6	Fruit girth	High	-72.45 to 0.00		-63.79 to 8.42		0	32	1	31
7	Fruit weight	High	-50.30 to 63.60		-24.47 to 65.09		13	12	15	4
8	Number of fruits per plant	More	-58.58 to 38.10		-43.38 to 48.65		5	21	7	16
9	Number of branches per plant	More	-50.54 to 13.66		-39.79 to 4.51		3	23	0	21
10	Plant height	High	-41.32 to 39.11		-36.43 to 21.76		2	17	2	12

11	Total fruit yield per plant	High	-50.95 to 46.00	-37.24 to 62.00	9	17	12	11
12	Total soluble solids	High	-8.06 to 13.02	-9.35 to 13.55	16	3	14	4
13	Fruit borer infestation	Less	-37.76 to 67.73	-53.06 to -5.58	10	10	0	28

Table 3: Top three hybrids selected separately on the basis of heterosis over better parent and standard hybrid GJBH-4

Characters	Rank	Most Heterotic Crosses over			
		Better Parent	Value (%)	Standard Parent	Value (%)
Days to 50% flowering	I	AB-15-8 x Pant Rituraj	-12.37	AB-15-8 x Pant Rituraj	-8.60
	II	AB-15-08 x GJB-3	-12.24	AB-15-08 x GJB-3	-7.53
	III	NBR-14-1 x GJB-3	-12.24	NBR-14-1 x GJB-3	-7.53
Days to first picking	I	-	-	AB-15-8 x Pant Rituraj	-10.40
	II	-	-	AB-15-08 x GJB-3	-10.40
	III	-	-	NBR-14-1 x GJB-3	-10.40
Days to last picking	I	NBR-15-5 x GJLB-4	8.55	JBR-14-07 08 x Pant Rituraj	10.26
	II	NBR-155 x Pant Rituraj	7.96	NBR-14-1 x GJB-3	9.86
	III	AB-8-14 x Swarna Mani Black	5.01	AB-8-14 x Swarna Mani Black	9.66
Number of pickings	I	JBR-14-07 x Swarna Mani Black	16.22	AB-15-08 x GJLB-4	31.43
	II	NBR-14-1 x Swarna Mani Black	16.22	AB-15-08 x Pant Rituraj	31.43
	III	AB-15-08 x Pant Rituraj	12.20	NBR-14-1 x GJB-3	31.43
Fruit length	I	AB-15-07 x Pant Rituraj	6.72	-	-
	II	-	-	-	-
	III	-	-	-	-
Fruit girth	I	-	-	AB-8-14 x Swarna Mani Black	8.42
	II	-	-	-	-
	III	-	-	-	-
Fruit weight	I	JBR-14-07 x Pant Rituraj	63.60	JBR-14-07 x Pant Rituraj	65.09
	II	NRS-1 x Swarna Mani Black	46.48	NSR-1 x Pant Rituraj	63.98
	III	NBR-15-5 x GJB-3	43.49	AB-8-14 x Swarna Mani Black	50.94
Number of fruits per plant	I	AB-15-07 x GJLB-4	38.10	NSR-1 x Swarna Mani Black	48.65
	II	NSR-1 x GJB-3	19.80	JBR-14-07 x GJB-3	41.86
	III	JB-13-06 x GJB-3	19.37	AB-15-07 x GJLB-4	38.76
Number of branches per plant	I	AB-15-08 x Pant Rituraj	13.66	-	-
	II	NSR-1 x GJB-3	8.86	-	-
	III	AB-15-08 x Pant Rituraj	7.16	-	-
Plant height	I	NSR-1 x GJB-3	39.11	NSR-1 x GJB-3	21.-76
	II	AB-15-08 x Pant Rituraj	27.67	JBR-14-07 x GJB-3	20.54
	III	-	-	-	-
Total fruit yield per plant	I	NSR-1 x Swarna Mani Black	46.00	NSR-1 x Swarna Mani Black	62.00
	II	NBR-14-01 x Swarna Mani Black	40.03	NBR-14-01 x Swarna Mani Black	55.39
	III	NSR-1 x Pant Rituraj	39.35	AB-15-07 x Swarna Mani Black	50.09
Total soluble solids	I	NSR-1 x Pant Rituraj	13.02	NSR-1 x Pant Rituraj	13.55
	II	JB-12-06 x Swarna Mani Black	12.02	JBR-14-01 x GJLB-4	11.21
	III	JBR-14-01 x GJLB-4	11.74	NBR-15-5 x GJLB-4	10.75
Fruit borer infestation	I	NBR-14-01 x Swarna Mani Black	-37.76	AB-15-07 x GJLB-4	-53.06
	II	AB-15-07 x GJB-3	-36.81	NBR-14-01 x Swarna Mani Black	-47.52
	III	NBR-15-5 x GJB-3	-33.86	AB-8-14 x Pant Rituraj	-45.51

Conclusion

On the basis of above results and discussion, it can be concluded that the highest heterobeltiosis was recorded by cross NSR 1 x Swarna Mani Black followed by NBR-14-01 x Swarna Mnai Black and NSR-1 x Pant Rituraj, while cross NSR 1 x Swarna Mani Black ranked first by recording the highest standard heterosis (62.00%) for fruit yield per plant followed by NBR-14-01 x Swarna Mani Black (55.39%) and AB-15-07 x Swarna Mani Black (50.09%). The study revealed good scope for isolation of pure lines from the progenies of heterotic F₁s as well as commercial exploitation of heterosis breeding in brinjal.

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