Heterosis for seed yield and yield contributing traits in mustard (*B. juncea* L. Czern & Coss)

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Abstract

Mustard (*B. juncea* L.) is the second most important edible oil yielding crop in India after groundnut. The present study was carried out to estimate the extent of heterosis for seed yield and yield contributing traits in 28 F_1 hybrids of mustard obtained by 8x8 diallel crosses excluding reciprocals. Means over plants and replications were worked out for yield and yield contributing traits and heterosis over better parent (heterobeltiosis) and over check variety, Pusabold (economic heterosis) was analyzed. Out of 28 crosses, 14 showed highly significant economic heterosis for seed yield viz, Laxmi×BR-40 (90.48 %), Laxmi×Pusabold (71.43%), Pusabold×CM-3 (54.76 %), Laxmi×Varuna (54.76 %), BIO-902×CM-3 (54.76 %), RH-30×BIO-902 (54.76 %), BR-40×CM-3 (38.9 %), Pusabold×BR-40 (30.95 %), SEJ-2×Varuna (30.95 %), RH-30×CM-3 (30.95%), RH-30× Varuna (30.95 %), RH-30× Pusabold (26.19 %), BIO-902×Varuna (23.81 %), SEJ-2×BR-40 (23.81%). The economic heterosis for seed yield ranged from - 35.71 % for BIO-902×SEJ-2 to 90.48 % for Laxmi×BR-40. In general, crosses showed significant heterobeltiosis were also showing significant economic heterosis and *per se* performance for seed yield. The result indicated that gain in seed yield was mainly due to increased siliquae.

Key words: *Brasica juncea,* mustard, seed yield, heterosis

Introduction

Mustard (*B. juncea* L. Czern & Coss) is one of the most important edible oil yielding crops in India grown during the winter season. The simple breeding efforts have not been adequate to increase seed yield of mustard. Heterosis breeding could be a potential alternative for achieving quantum jumps in productivity. Scope for exploitation of heterosis depends mainly on its direction and magnitude for seed yield to develop commercial hybrids. The present study was undertaken to select parents for effective hybridization programme for hybrid varieties development.

Material and methods

The material consisted of 8 parents and their 28 F_1 cross combinations obtained by 8X8 diallel crosses excluding reciprocals.The eight parents; RH-30, BIO-902,SEJ-2, Laxmi, Varuna, Pusabold, BR-40, and CM-3 (local selection) alongwith 28 crosses (F_1) were raised in 2 rows of 5m length with spacing of 30cm×10cm in randomized block design(RBD) with three replications during winter season of 2003-04 at Birsa Agricultural University, Ranchi, India. All recommended package of practices were applied to raise good crop. The observations were recorded on number of primary branches per plant (PB), number of secondary branches per plant (SB), number of siliquae per plant (SPP) and plant height(cm) at physiological maturity on 10 competetive plants per plot. After complete maturity, 1000-seed weight (g), seed yield per plant (g) and oil content (%) were recorded. The mean values of each genotype were subjected to analyze heterosis over better parent (heterobeltiosis) and over check variety (economic heterosis).

Results and discussion

The analysis of variance (Table1) revealed highly significant differences for all the characters studied in all the genotypes including parents. Out of 28 crosses, 14 showed highly significant economic heterosis for seed yield per plant (Table 2). None of the top heterotic cross was heterotic for all traits simultaneously. The cross Laxmi×BR-40 exhibited maximum heterosis over check variety, Pusabold for seed yield per plant (90.48%) with corresponding highly significant positive heterosis for number of siliquae per plant (44.40%), number of primary branches per plant (38.20%), number of secondary branches per plant (48.78%), and desirable significant heterosis for days to maturity (-1.70%). But, this cross did not show desirable significant heterosis for oil content and 1000-seed weight. This indicates that enhanced number of siliquae per plant contributing positive significant heterosis for seed yield. Similar results were also reported by Singh *et al*. (2005), Ghosh *et al*. (2002), Verma and Kushwaha (1999), Verma *et al.* (1998) and Pradhan *et al.*(1993).

Oil content is an important economic component of oilseed crops. The crosses, SEJ-2×CM-3 and SEJ-2×Laxmi showed maximum positive significant heterosis for oil content (4.40%), but these crosses did not show positive heterosis fo seed yield. The cross, RH-30×BR-40 showed significant positive economic heterosis for oil content (3.20%) simultaneously showed highly significant positive economic heterosis for seed yield too (23.81%).

1000-Seed weight is also an important character of mustard. Bold seed size attracts the market. Out of 28 crosses, only 3 could exhibit the significant positive economic heterosis for seed size. These are; BIO-902×SEJ-2 (18.90%), BIO-902×Pusabold (9.40%) and RH-30×CM-3 (7.50%). Among these, only RH-30×CM-3 (7.50%) simultaneously showed significant positive economic heterosis for seed yield (30.95 %) without any penalty on oil content.

The present study suggests that high heterotic crosses for seed yield; Laxmi×BR-40 (90.48 %) and other crosses, for oil content; SEJ-2×CM-3 (4.40%), SEJ-2×Laxmi (4.40%), RH-30×BR-40 (3.20%) and BIO-902×SEJ-2 (2.90%) and for bold seed size; BIO-902×SEJ-2 (18.90%), BIO-902×Pusabold (9.40%) and RH-30×CM-3 (7.50%) may be exploited for hybrid varieties development in mustard.

References

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Table 1. Analysis of variance for 8 characters in mustard

Source	d.f.	Mean squares							
		DM	PB	SB	SPP	PH	SW	SY	OC
Replication	2	5.842	0.018	1.235	269.287	19.509	0.098	0.271	0.168
Treatment	35	1095.075**	0.887**	7.384**	2887.628**	189.812**	0.842**	5.569**	6.632**
Error	70	0.929	0.150	0.851	181.201	29.271	0.053	0.176	0.249

** Significant at 1% level
DM = Days to maturity; PB = Primary Branches per plant; SB = Secondary Branches per plant; SPP = Number of Siliquae per plant; PH=Plant height (cm); SW= 1000 seed weight; SY= Seed yield(g); OC= Oil content (%)

Table 2. Heterosis per cent over better parent (Heterobeltiosis) and over check variety, Pusabold (Economic Heterosis) for 8 characters in different crosses of mustard

Crosses	DM		PB		SB		SSP	
	Heterosis over better parent	Economic Heterosis	Heterosis over better parent	Economic Heterosis	Heterosis over better parent	Economic Heterosis	Heterosis over better parent	Economic Heterosis
RH-30×BIO-902	-2.50**	-1.70*	5.70	8.80	40.00	2.44	34.20*	17.80
RH-30×SEJ-2	0.90	-2.70**	5.90	5.90	50.00*	9.70	59.50**	40.00**
RH-30×Laxmi	-0.90	-4.30**	5.60	11.80	43.33*	4.88	39.20*	22.20
RH-30×Varuna	0.90	-2.70**	10.50	23.50*	4.88	4.88	40.00**	40.00**
RH-30×Pusabold	-1.70*	-1.70*	17.60	17.60	60.00*	17.07	75.60**	75.60**
RH-30×BR-40	0.90	-3.40**	18.90*	29.40**	61.29*	21.95	67.50**	48.90**
RH-30×CM-3	-4.20**	-3.40**	5.90	5.90	106.67**	51.22**	127.80**	100.00**
BIO-902×SEJ-2	0.00	-3.40**	-25.70**	-23.50**	10.53	-48.78**	9.60*	-11.11
BIO-902×Laxmi	1.80*	-1.70*	8.30	14.70	105.00**	0.00	77.61**	32.22**
BIO-902×Varuna	0.00	-3.40**	5.30	17.60	9.76	9.76	71.64**	27.80*
BIO-902×Pusabold	-2.70**	-3.40**	28.60**	32.40**	44.83	2.44	46.70**	46.70**
BIO-902×BR-40	-1.70*	-0.90	2.70	11.80	67.74**	26.83	82.50**	62.22**
BIO-902×CM-3	0.00	0.90	40.00**	44.10**	200.00**	39.02*	97.30*	60.00**
SEJ-2×Laxmi	0.90	-2.70**	11.11	17.50	180.00**	36.59*	90.40**	54.40**
SEJ-2×Varuna	-0.90	-4.30**	21.10*	35.30**	41.46*	41.46*	97.30**	60.00**
SEJ-2×Pusabold	-0.90	-4.30**	14.70	14.70	158.62**	82.93**	-16.70	-16.70
SEJ-2×BR-40	-0.90	-5.10**	5.40	14.70	54.84*	17.07	77.50**	57.80**
SEJ-2×CM-3	-0.90	-4.30**	29.00**	17.60	226.67**	19.51	53.40**	24.40
Laxmi×Varuna	5.30**	1.70*	23.70**	38.20**	70.73**	70.73**	136.90**	71.10**
Laxmi×Pusabold	3.50**	0.00	30.60**	38.20**	120.69**	56.90**	82.20**	82.20**
Laxmi×BR-40	2.70**	-1.70*	27.00**	38.20**	96.77**	48.78**	62.50**	44.40**
Laxmi×CM-3	0.00	-3.40**	11.11	17.60	205.00**	48.78**	69.90**	37.80**
Varuna×Pusabold	-0.90	-4.30**	0.00	11.80	-4.88	-4.88	31.10*	31.10*
Varuna×BR-40	0.00	-4.30**	-5.30	5.90	4.88	4.88	28.80	14.40
Varuna×CM-3	-0.90	-4.30**	-2.60	8.80	-4.88	-4.88	80.80**	48.90**
Pusabold×BR-40	0.90	-3.40**	16.20	26.50**	67.74**	26.83	52.20**	52.20**
Pusabold×CM-3	-2.60**	-2.60**	17.60	17.60	72.41**	21.95	45.60**	45.60**
BR-40×CM-3	0.90	-3.40**	16.20	26.50**	93.55**	46.34*	75.00**	55.60**

Table 2 continued

Crosses	PH		SW		SY		OC	
	Heterosis over better parent	Economic Heterosis	Heterosis over better parent	Economic Heterosis	Heterosis over better parent	Economic Heterosis	Heterosis over better parent	Economic Heterosis
RH-30×BIO-902	0.90	1.90	-8.33**	3.80	58.54**	54.76**	2.40	-3.90**
RH-30×SEJ-2	26.1*0	8.80*	5.80	3.80	21.95**	19.05*	-3.30**	1.50
RH-30×Laxmi	-1.80	5.90	-5.80	-7.50	-2.44	4.76	-2.00	-4.40**
RH-30×Varuna	11.70**	12.70**	-7.70*	-9.50	34.15**	30.95**	-1.30	-5.20**
RH-30×Pusabold	3.90	3.90	1.90	1.90	26.19**	26.19**	-4.20**	-4.20**
RH-30×BR-40	9.10*	5.90	0.00	-1.90	23.81**	23.81**	0.70	3.20*
RH-30×CM-3	5.10	1.90	9.60**	7.50	17.02*	30.95**	1.50	2.50
BIO-902×SEJ-2	2.30	-11.80**	5.00	18.90	-12.90	-30.71**	-1.90	2.90*
BIO-902×Laxmi	1.90	2.90	-13.30**	-1.90	20.00*	0.00	-3.3*0	-5.70**
BIO-902×Varuna	3.90	4.90	-16.70**	-5.70	48.57**	23.81**	-4.10**	-7.90**
BIO-902×Pusabold	2.90	2.90	-3.30	9.40	7.14	7.14	-2.70*	-2.70*
BIO-902×BR-40	-1.00	-3.90	-8.30**	3.80	-35.71**	-35.71**	-6.50**	-4.20**
BIO-902×CM-3	10.20*	5.90	-15.00**	-3.80	38.30**	54.76**	-7.60**	-6.60*
SEJ-2×Laxmi	31.80**	13.70**	-9.50**	-20.80	-5.71	-21.43**	-0.50	4.40**
SEJ-2×Varuna	32.90**	14.70**	0.00	-11.30	57.14**	30.95**	-3.50**	1.20
SEJ-2×Pusabold	27.30**	9.80*	-1.90	-1.90	-33.33**	-33.33**	-2.40	2.50
SEJ-2×BR-40	25.00**	7.80*	-8.00**	-13.20	23.81**	23.81**	-3.50**	1.20
SEJ-2×CM-3	29.50**	11.80**	-2.30	-18.90	-8.50	2.38	-0.50	4.40*
Laxmi×Varuna	11.70**	12.70**	-2.10	-13.20	85.71**	54.76**	-0.80	-3.20*
Laxmi×Pusabold	15.70**	15.70**	-1.90	-1.90	71.43**	71.43**	-1.50	-1.50
Laxmi×BR-40	8.10*	4.90	-8.00*	-13.20	90.48**	90.48**	-1.70	0.70
Laxmi×CM-3	26.50**	21.60**	-6.50	-18.90	-19.15**	-9.52	-4.20**	-3.20*
Varuna×Pusabold	8.80*	8.80*	5.70	5.70	2.38	2.38	0.50	0.50
Varuna×BR-40	2.00	-0.90	-16.00**	-20.80	-23.81**	-23.81**	-2.40	0.00
Varuna×CM-3	21.40**	16.70**	-8.50*	-18.90**	2.13	14.29	-7.60**	-6.70**
Pusabold×BR-40	13.10**	9.80*	-5.70	-5.70	30.95**	30.95**	-2.90*	-0.50
Pusabold×CM-3	5.80	1.90	-5.70	-5.70	38.30**	54.76**	-3.40**	-2.50
BR-40×CM-3	9.20*	4.90	-8.00*	-13.20**	23.40**	38.91**	-3.10**	0.70

* Significant at 5% level; ** Significant at 1% level

DM = Days to maturity; PB = Primary Branches per plant; SB = Secondary Branches per plant; SPP = Number of Siliquae per plant; PH=Plant height (cm); SW= 1000 seed weight; SY= Seed yield(g); OC= Oil content (%)