Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 3866-3871

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-7 pp. 3866-3871**
Journal homepage: http://www.ijcmas.com

Original Research Article

Heterosis for Yield and Its Component in Indian mustard (*Brassica juncea* (L.) Czern & Coss)

Supriya Surin*, Arun Kumar, Suruchi Kumari, Yogendra Kumar, Ashisan Tuti and Aradhna Suman

Department of Genetics and Plant Breeding. Birsa Agricultural University Kanke, Ranchi –6, India
**Corresponding author*

A B S T R A C T

The present investigation was carried out with the set of ten varieties of Indian mustard and forty five F1s obtained through diallel crossing, with the objective to explore hybrid vigour and find out best heterotic crosses. The ten parents and forty five F1s were grown in RBD with two replication for the thirteen quantitative characters. The analysis of variance showed highly significant difference among the genotypes (parents and crosses) for all the characters studied except days to 50 percent flowering and white rust incident. The heterosis is estimated over the mid parent, better parent and also over check for all the characters Highly significant difference were observed for among genotypes for all the traits study. Considerable magnitude of hetrosis and hetrobeltiosis was observed for most of the crosses for the characters number of primary branches, number of secondary branches, number of siliqua per plant and length of siliqua,1000 seed weight, seed yield and, oil content. Cross RH305 x Pusa Bold, for number of primary branches, RRH615 X RRH605 for number of secondary branches, RH 305 x Shivani for number of siliqua and RH 0447 XBBM07- 1 for length of siliqua, expressed highest positive and significant over mid parent better parent and check vardan. Cross RH-305 X Pusa bold expressed highest positive and significant hetrosis for 1000 seed weight while RHO447 XRH305 expressed desirable negative and significant heterosis for days to maturity. High positive significant heterosis for seed yield observed in cross RRH615 X RRH605 over mid parent(137.13),better parent (109.12) and best check vardan.(161.12).Cross RH-0447 x RRH 615 express highest positive and significant heterosis for mid parent (8.920)and better parent (7.030) and check kranti (7.708) for oil content. The cross RH0447 XRH 305(-39.64) and RH0447 X Shivani (-27.05) expressed highest desirable negative and significant heterosis over mid parent and better parent for erusic acid respectively. These crosses can be used as parent in future breeding programme.

Keywords

Indian mustard (*Brassica juncea* L.), heterosis, heterobeltiosis, seed yield, erucic acid

Introduction

Indian mustard (*Brassica juncea* (L) Czern & Coss) is most important oilseeds crop occupying a prominent position in Indian oilseeds scenario and play vital role in oil seeds economy of the country. Rapeseed and mustard ranks third in area (21%) and production (23%) after groundnut and soybean amongst total oilseeds. The per hectare productivity of the crop is quite low in the country (1183 kg/ha) against the world average of 1400 kg/ha. In India it occupied an area of 64.54 lakh hectare with

an annual production of 67.96 lakh tones during 2015-16. (Annual report Mustard 2016). The nutrient requirement of oilseed crops, in general, is very high for almost all the essential mineral nutrients which are to be supplied in sufficient quantities and balanced proportion to harvest genetic potential of the crop. The low erucic acid and low glucosinolate mustard oil is widely used as cooking oil in whole world as well as in our country.

Heterosis is superiority of the hybrid over the mid parent or better parent as standard variety and is result of allelic or non-allelic interaction of gene under the influence of particular environment. Among the various technological option heterosis breeding approach is most successful one and has already been intensively exploited in self-pollinated plant like Indian mustard, the as utilization of heterosis depend upon direction and magnitude of heterosis and feasibility and type of gene action involved. Estimation of heterosis over mid parent (relative heterosis) and over better parent (heterobeltosis) may be useful in identifying true heterotic cross combinations but these crosses can be immense practical value, if they show superiority over the standard or the best variety of the area. This is why apart from heterostic response over mid parent, better parent and standard variety has also been estimated in the present study. With this background, the present investigation was undertaken to identify high heterotic crosses in Indian mustard.

Materials and Methods

The present investigation was carried out with a set of ten varieties of Indian mustard (*Brassica juncea*. L. Czern and Coss) Bio-133-04, RH-0447,Kranti (NC), BBM07-1,Vardan (NC), RH-0305, Pusa Bold (ZC), RRH-615, RRH-605 and Shivani (LC) and their forty five F_1's obtained through diallel crossing excluding reciprocals. The ten parents and forty five F_1's were grown in a randomized block design with two replications for thirteen quantitative characters against four check (Kranti, vardan, Pusa Bold, Shivani) during Rabi season in BAU, Kanke research farm.

Results and Discussion

The analysis of variance showed highly significant difference among the genotypes (parents and crosses) for all the characters studied except days to 50 percent flowering and white rust incident. (Table: 1) All the ten parents and forty five crosses were found to be differ significantly for all the characters studied, except white rust incidence, days to 50 percent flowering, number of primary branches, number of seeds per siliquae and days to maturity. In parent vs cross all the character was significant except number of secondary branches, length of siliquae, number of seeds per siliquae, 1000 seed weight and seed yield per plant. Similar results were also found by Thakur *et al.,* (1997), Shalini *et al.,* (2000).

Forty five F_1 crosses obtained from 10 × 10 half diallel as mentioned earlier were studied for heterosis for thirteen quantitative characters over mid parents, better parents and best check variety in Indian mustard.

One of the most important breeding objectives in Indian mustard was to breed early maturity varieties. The lower values of days to flowering were desirable. Thus heterosis in negative direction for this character was concern of plant breeder. The expression of heterosis for days to 50 percent flowering ranged from -4.52 percent in crosses (Bio-133-04×RH-0447) to 14.66 in crosses (RH-0305×Shivani). Three

crosses showed negative relative heterosis out of which none of them were significant. The expression of heterosis over mid parent for plant height ranged from -14.370 to in (Kranti × Pusa Bold) to 18.634 cross Bio-133-04×BBM07-1 showed maximum significnt heterosis over mid and better parent. The expression of heterosis for number of primary branches over mid parent range from -17.525 to 34.065 percent. Cross RH-0305×Pusa Bold showed maximum significant heterosis. Heterobeltiosis for primary branches significant for cross RRH-605 X Shivani (27.659%). The expression over mid parent for number of secondary branches ranged from -2.941 percent (RH-0447×BBM07-1) to 76.068 (RRH-615×RRH-605). Total twenty crosses showed highly significant heterosis. Highly significant heterobeltiosis observed for cross RRH-615×RRH-605 (60.937 %) for number of secondary branches (Table: 2, 3). Manifestation of heterosis over mid parent for number of siliqua per plant ranged from -5.380 to 71.138 percent (RH-0305×Shivani).

Total thirty one crosses showed highly significant positive heterosis Heterobeltiosis for number of siliqua per plant ranged from -11.049 to 69.851 percent. Crosses RH-0305× Shivani and Bio-133-04×Pusa Bold (69.851) showed highly significance for number of siliqua per plant. This similar work also showed by Pathak *et al.,* (2002) and Parmar *et al.,* (2004). The expression of heterosis over mid parent for length of siliqua ranged from -11.576 to 19.597 percent. Cross RH-0447×BBM07-1 showed maximum significant heterosis. Heterosis over better parent for length of siliqua ranged from-12.864 to 15.815 percent and only one cross (RH-0447×BBM07-1) showed significant heterosis. The expression of heterosis over mid parent for number of seeds per siliqua ranged from-12.598 to 17.408 percent (Kranti×Shivani). The expression of heterosis for 1000 seed weigh over mid parent ranged from -31.103 percent (RH-0305×Pusa Bold) to 27.540 (RH-305 X Pusa Bold). Only two crosses showed highly significant positive effect. The expression of heterosis for days to maturity over mid parent ranged from -5.781 to 5.309 percent and only one cross (RH-0447×RH-0305) showed highly desirable negative significant heterotic effect. Only one cross (RH-0447×RH-0305) showed highly significant negative heterotic effect over better parent

The expression of heterosis for seed yield per plant over mid parent ranged from -14.448 percent (RH-0447×BBM07-1) to 137.137 percent (RRH-615× RRH-605). Total twelve crosses showed highly significant positive heterotic effect. Total sixteen crosses showed highly significant positive heterotic effect over better parent. The maximum heterosis for seed yield per plant were to the extent of 137.13, 109.08 and 161.43 percent over mid parent, better parent and best check (Vardan) respectively for the cross combination RRH-615×RRH-605.Tyagi *et al.,* (2002), Acharya and Swain (2003), Dixit *et al.,* (2005) and Parjapti *et al.,* (2009) also observed highly significant heterosis for seed yield in their studies. The expression of heterosis for white rust over mid parent ranged from -17.142 to 26.315 percent. Only one cross (RRH-0447×vardan) showed negative significant heterotic effect.

The expression of heterosis for oil content over mid parent ranged from -2.027 percent to 8.920 percent (RH-0447×RRH-615). Total fifteen crosses showed positive and highly significant heterosis. Heterobeltiosis for oil content from -3.636 percent (Bio-133-04×BBM07-1) to 7.030 percent (RH-0447×RRH-615). Only two crosses showed highly positive significant heterotic effect.

Table.1 ANOVA for 55 genotype of Indian mustard (*Brassica juncea* L. Czern and Coss) Including parents and crosses

Mean Squares							
		Rep	Treatment	Parents	Crosses	Parents Vs Crosses	Error
SL. Number	Degree of freedom→ / Characters ↓	1	54	9	44	1	54
1.	Days to 50 % flowering	4.009	7.441	7.533	4.294	145.099**	7.027
2.	Plant height (cm)	50.321	123.936**	59.166*	139.138**	274.923**	39.210
3.	No. of primary branch	0.349	0.638**	0.304**	0.639	3.581**	0.207
4.	No. of secondary branch	33.605**	4.779**	1.562*	2.973**	140.786	1.462
5.	No. of siliquae/plant	22694.545**	3210.352**	774.572**	2026.513*	77221.3**	1088.668
6.	Length of siliquae	0.020	0.211**	0.254**	0.186**	0.890	0.074
7.	No. of seeds/siliquae	0.105	1.569*	1.218**	1.571	4.635	1.416
8.	1000 seed weight (g)	0.024	0.982**	1.127*	0.961**	0.575	0.259
9.	Days to maturity	16.809	7.734	9.116**	7.604	1.022**	5.086
10.	Seed yield/plant (g)	6.768	12.839**	5.439**	10.706**	173.301	2.823
11.	Disease Scoring (White rust) (%)	92.736**	8.544	6.605	9.135	0.012**	7.125
12.	Oil content (%)	3.688**	4.439**	6.059**	3.744**	20.465**	0.707
13	Fatty acid (Erucic acid) (%)	15.656**	169.893**	6.059**	3.744**	8954.972**	1.886**

*significant at 5% probability level, **Significant at 1% probability level

Table.2 Range of heterosis and number of significant positive crosses for thirteen characters in Indian mustard (*Brassica juncea*. L. Czern and Coss)

Sl. No.	Characters	Range of heterosis percent over			Number of crosses showing desirable significant effect (positive other than Days to maturity and Erucic acid)		
		MP	BP	NC(vardan)	MP	BP	NC(vardan)
1	Days to 50 % flowering	-4.52 - 14.66	-7.93 - 14.15	-0.85 - 10.25	8	3	4
2	Plant height (cm)	-14.37 - 8.63	-14.59 - 18.51	-4.06 - 25.77	5	5	23
3	No. of primary branch	-17.52 - 34.06	-25.92 -27.65	-13.04 - 34.78	12	5	8
4	No. of secondary branch	-2.94 - 76.06	-9.58 - 60.93	-1.49 - 62.68	20	23	14
5	No. of siliquae/plant	-5.38 – 71.13	-11.04 - 69.85	-7.39 - 74.73	31	18	21
6	Length of siliquae	-11.57 - 19.59	-12.86 - 15.81	-8.41 - 35.20	11	1	19
7	No. of seeds/siliquae	-12.59 - 17.40	-13.28-15.32	0.00 - 35.51	-	-	12
8	1000 seed weight	-31.10 - 27.53	-40.69 - 17.99	-9.64 - 88.30	6	-	21
9	Days to maturity	-5.78 - 5.30	-6.38 - 2.58	-5.98 - 1.704	2	2	2
10	Seed yield/plant (g)	-14.44 - 137.13	-24.81 - 109.08	2.83 - 161.46	22	15	27
11	Disease Scoring (White rust) (%)	-17.64-26.31	-27.27 - 22.22	-15.15 - 45.45	2	-	3
12	Oil content (%)	-1.29 - 8.92	-3.63 - 7.03	-5.33 - 6.55	15	2	-
13	Erucic acid (%)	-39.64 - 74.98	-19.97 - 159.59	-30.20 - 141.43	16	-	3

Table.3 Name of best heterotic crosses on the basis of mid parent, better Parent and Best Check (Vardan)

Sl. No.	Character	Best crosses over Mid parent		Best Crosses over Better parent		Best Crosses over Best Check (Vardan)	
1	Days to 50 % flowering	Non	-	Non	-	Non	-
2	Plant height (cm)	Bio-133-04 x BBM07-1	18.634**	Bio-133-04 x BBM07-1	18.510**	RH-0447 x BBM07-1	17.060**
3	No. of pri.branches	RH-0305 x Pusa Bold	34.065**	RRH-605 x Shivani	27.659**	Kranti x RH-0305 BBM07-1 x Shivani	34.782** 34.782**
4	No. of sec. branches	RRH-615 x RRH-605	76.068**	Vardan x RRH-605 & Vardan x Shivani	58.208** 58.208**	Vardan x RH-0305	62.686**
5	No. of siliquae/plant	RH-0305 x Shivani	71.138**	Bio-133-04 x Pusa Bold	69.851**	Kranti x BBM07-1	72.840**
6	Length of siliqua (cm)	RH-0447 x BBM07-1	19.597**	Non	-	Bio-133-04 x Pusa Bold	35.204**
7	No. of seeds/siliqua	Non	-	Non	-	Kranti x Shivani	3.514**
8	1000 seed weight (g)	RH-0305 x Pusa Bold	27.539*	RRH-615 x Shivani	-40.691**	Bio-133-04 x RH-0447	77.410**
9	Days to maturity	RH-0447 x RH-0305	-5.781*	Bio-133-04 x Pusa Bold	-5.172*	Non	Non
10	Seed yield/plant (g)	RRH-615 x RRH-605	137.137**	RRH-615 x RRH-605	109.08**	RRH-615 x RRH-605	161.463**
11	White rust (%)	Non	-	RH-0447 x Vardan	-27.272*	Non	-
12	Oil content (%)	RH-0447 x RRH-615	8.920**	RH-0447 x RRH-615	7.030**	Non	_
13	Eucic acid (%)	RH-0447 x RH-0305	-39.64**	RH-0447 x Shivani	-19.976**	Kranti x BBM07-1	-30.20**

Desirable heterosis in oil content upto 6.9 percent was also observed by Dixit *et al.*, (2005), Ram (2009) also found similar result.

The expression of heterosis for erucic acid content over mid parent ranged from -39.64 percent (RH-0447×RH-0305) to 7.98 percent (RH-0305×RRH-605). Total thirteen crosses showed highly significant desirable negative heterosis. Cross(RH-0447×RH-0305) showed highly significant desirable negative heterosis over mid, better parent and Vardan -39.64, -19.97 and -30.20 respectively. These crosses can be used as parent in future breeding programme. The similar result also observed by Brown *et al.*, (2000), Pandy *et al.*, (2001).

References

Acharya, N.N. and Swain, D. (2003). Hybrid performance in relation to genetic divergence in Indian mustard (*Brassica juncea* (L.) Czern & Coss). *Crop-Res-Hisar*. 25 (2): 312-31.

Brown, J.; Davis J. B.; Brown, A.P.; Erickson D.A. and Seip, L. (2000). Developing canola-quality cultivars from yellow mustard (*Sinaois alba*). Annual meeting of the western society of crop science, university of Idaho, Moscow, June 20-22.

Dixits, Subhash, Kumar K. and Hauhan, Y.S. (2005). Heterosis in Indian mustard (*Brassica Juncea* L. Czern & Coss). *Agric. Sci. Digest*, 25 (1): 19-22.

Pandey, Lalji B. and Zehar, B.E. (2000). Commercial heterosis of F_1 hybrids in oilseed *Brassica*, mahyo life science research center, dawalwadi jalna 431203, (m. s.) India.

Parmar, A.N.; Patel, K.M. and Thakker, D. A. (2004). Heterosis for yield and its components in Indian mustard, *Brassica juncea* (L.) Czern & Coss. *J. Oilseeds Res*. 21 (2): 325-326.

Prajapati, K.P.; Prajapti, S.B.; Jhakker, Patel. P.S. and Solanki, S.S. (2009). Heterosis for yield and yield component characters in mustard (B. juncea L. Czern & Coss). *J. Oilseed Res. Vol. 26 (special issue*), 723- 724.

Ram, S. (2009). Heterosis for seed yield and yield in Indian mustard (*B. juncea). J. of Oilseed Res. 26 (special issue*), 3-5.

Shalini, T.S.; Sheiff, R.A.; Kulkarni, R.S. and Venkataramana, P. (2000). Variabiliy studies in Indian mustard (*Brassica juncea* L. Czern & Coss.). *Res. Crops*. 1 (2): 230-234.

Tyagi, M.K.; Chauhan, J.S.; Yadav, S.K.; Kumar, P.R. and Tyagi, Poonam (2002), Heterosis in intervarital crosses in Indian mustard (*Brassica juncea* L. Czern & Coss.). *Annals Bio.* 16 (2): 191-194.