

## STUDIES ON HETEROSIS IN MUSTARD (*BRASSICA JUNCEA* L.)

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Fifteen elite genotypes of mustard were crossed with two testers in line x tester fashion, and F<sub>1</sub>'s along with parents were evaluated to estimate the magnitude of heterosis for yield and yield contributing characters in mustard. Highest magnitude of heterosis for seed yield per plant was obtained in crosses viz, vardhan x TM-17, Vardhan x Laxmi and vardhan x RL-1359. Hence, these crosses may be utilized to identify superior recombinants after homozygosity has reached in mustard improvement programme.

**Keywords:** *Brassica juncea*; Heterosis; Mean performance.

### Introduction

Seed yield in mustard is a complex character which is influenced by several components, traits. For improvement of such traits, selection on the basis of *per se* performance is less likely to be efficient. Hence, heterosis provides a basis to identify superior crosses and for building better gene pool for population improvement. In the present investigation an attempt has been made to estimate heterosis for seed yield and its components.

### Materials and Methods

Fifteen elite genotypes namely Bio-902, Laxmi, PCR-7, Pusa bahar, Pusa baroni, Pusa bold, RH-819, TM-17, PL-1359, Rohini, RW-351, Seeta, TNM-1 and TPM-1 were crossed with Kranti and Vardhan. The parents and F<sub>1</sub>'s were grown in randomized complete block design with 3 replications during *rabi* 2006. Recommended doses of fertilizers with other package of practices were followed to raise the good crop. Data was recorded on five competitive plants from crosses and parents for days to 50% flowering, days to maturity, number of branches per plant, plant height (cm), number of siliques per plant and seed yield per plant (gm). The heterosis over mid parents (H<sub>1</sub>), heterobeltiosis (H<sub>2</sub>), and heterosis over check (H<sub>3</sub>) was calculated by following standard procedures. The data were subjected to statistical analysis as per given by Panse and Sukhatme<sup>1</sup>.

### Results and Discussion

The mean performance of all crosses for experiment has been given in table 1 and 2. The crosses Vardhan x TM-17 have high mean for seed yield per plant. Also, the cross Vardhan x Laxmi and Vardhan x RL-1359 have a high mean for seed yield per plant and also for number of siliques per plant<sup>1</sup>.

The cross Vardhan x TM-17 showed maximum

significant average heterosis, heterobeltiosis and useful heterosis for most of the characters. For the character seed yield, the average heterosis and heterobeltiosis (Table 2) was 126.14% and 53.27%. The same cross exhibited maximum heterosis for number of siliques per plant (H<sub>1</sub>- 72.61, H<sub>2</sub>- 42.13 & H<sub>3</sub> - 78.63). The same cross also showed significant heterosis for days to 50% flowering and days to maturity in the desired direction. Average heterosis for days to 50% flowering was (-17.30%) and heterobeltiosis was (-23.21%); for days to maturity the average heterosis was (-3.38%) and heterobeltiosis was (7.40%) with useful heterosis of (-3.84%). For the character plant height it is also exhibited significant heterosis (H<sub>1</sub>- 10.89%).

The cross Vardhan x Laxmi and Vardhan x RL-1359 had highest *per se* performance for seed yield per plant 14.05 and 14.21 gm respectively and number of siliques per plant (277.6 and 277.2). The same cross Vardhan x RL-1359 also had high significant heterosis for seed yield per plant (H<sub>1</sub>- 66.98, H<sub>2</sub>-63.52 and H<sub>3</sub> - 48.48). It also had a significant heterosis (H<sub>1</sub>-61.96%), heterobeltiosis (H<sub>2</sub>-46.35%) and heterosis over check (H<sub>3</sub>- 83.94%) for number of siliques per plant.

There was significant superior heterosis for heterosis over mid parent (H<sub>1</sub>-83.18%), heterobeltiosis (H<sub>2</sub>-61.68%) and heterosis over check (H<sub>3</sub>-46.81%) for seed yield per plant for cross Vardhan x Laxmi. The same cross exhibited significant heterosis (H<sub>1</sub>-63.53%), heterobeltiosis (H<sub>2</sub>-46.56%) and heterosis over check (H<sub>3</sub>- 84.20%) for number of siliques per plant and also for days to flowering (H<sub>1</sub>- -15.04, H<sub>2</sub>-17.85) respectively.

This type of result was also obtained by Thakur and Bhatia<sup>2</sup> where they found high magnitude of superior heterosis for the above characters such as seed yield per

Table 1. Mean performance of all cross combinations.

Crosses	Days to 50% Flowering	Days to maturity	Plant height (cm)	Branches per plant	No of siliques per plant	Seed yield per plant (g)
Kranti x Bio 902	49	104	160.1	5.1	226.2	11.65
Kranti x Laxmi	48	03	152.5	3.9	171.2	7.76
Kranti x PCR-7	49	104	154	4.0	210.5	9.87
Kranti x P.Bahar	49	105	153.4	3.6	148.0	6.49
Kranti x P.Baroni	49	104	145	4.0	177.5	8.20
Kranti x P.Bold	48	104	145.75	4.0	204.5	7.74
Kranti x RH-819	48	102	148.4	4.2	173.2	10.17
Kranti x Tm-17	48	102	161.9	4.0	200.8	10.06
Kranti x RL-1359	48	106	154.1	4.5	236.4	12.01
Kranti x RLM-619	47	105	164.7	4.0	194.3	8.40
Kranti x Rohini	54	109	167.8	3.6	181.4	10.65
Krantix RW-351	44	103	163.3	4.8	191.6	8.36
Kranti x Seeta	43	101	152	4.7	187.6	7.80
Kranti x TNM-1	49	105	156.6	4.7	177.0	8.49
Kranti x TPM-1	46	98	155.6	5.0	271.6	10.13
Vardhan x Bio-902	46	103	157.9	4.6	210.6	10.61
Vardhan x Laxmi	46	104	161.4	5.2	277.6	14.05
Vardhan x PCR-7	47	105	150.8	4.5	199.0	7.52
Vardhan x P.bahar	46	106	155.0	5.3	244.6	10.78
Vardhan x P.Baroni	48	106	153.8	5.0	258.9	11.51
Vardhan x P.Bold	48	106	153.8	4.5	208.5	9.78
Vardhan x RH-819	47	105	156.0	4.8	256.8	11.56
Vardhan x Tm-17	43	100	154.7	5.6	269.2	13.32
Vardhan x RL-1359	53	108	155.8	5.7	277.2	14.21
Vardhan x RLM-619	44	103	134.6	4.6	180.0	8.09
Vardhan x Rohini	53	107	167.0	4.5	187.7	11.24
Vardhan x RW-351	46	105	139.3	4.8	163.7	7.58
Vardhan x Seeta	45	101	157.2	4.6	230.7	10.42
Vardhan x TNM-1	47	103	153.6	5.2	265.5	11.75
Vardhan x TPM-1	43	099	151.0	4.7	187.8	8.45

**Table 2.** Calculated average heterosis ( $H_1$ ), heterobeltiosis ( $H_2$ ) and heterosis of over check ( $H_3$ ).

Crosses	Days to 50% Flowering			Days to maturity			Branches per plant		
	$H_1$	$H_2$	$H_3$	$H_1$	$H_2$	$H_3$	$H_1$	$H_2$	$H_3$
Kranti x Bio 902	4.25	0.00	4.25	-2.34	-2.80	0.00	13.33	6.25	30.76
Kranti x Laxmi	-5.88	-8.16	2.12	-3.32 *	-3.73	-0.961	-18.75	-18.75	0.00
Kranti x PCR-7	-4.85	-11.11	4.08	-2.34	-2.80	0.00	-12.80	-16.66	2.56
Kranti x p.Bahar	2.08	0.00	4.25	0.00	-0.943	0.96	-33.40	-25.00	-7.69
Kranti x P.Baroni	2.08	0.00	4.25	-0.95	-1.88	0.00	-13.97	-16.66	2.56
Kranti x P.Bold	0.00	-2.04	2.12	-0.95	-1.88	0.00	-6.89	-15.62	3.84
Kranti x RH-819	-4.95	-7.69	2.12	-3.77 *	-3.77 *	-1.92	-3.44	-12.50	7.69
Kranti x Tm-17	-1.03	-2.04	2.12	-0.48	-3.77 *	-1.92	1.265	-16.66	2.56
Kranti x RL-1359	-4.95	-7.69	2.12	3.92 *	0.00	1.92	-9.09	-6.25	15.38
Kranti x RLM-61	-4.08	-4.08	0.00	-1.40	-1.86	0.96	-11.11	-16.66	25.64
Kranti x Rohini	10.20	10.20	14.89	1.86	0.92	4.80	-23.40	80.83	-7.69
Kranti x RW-351	-11.11 *	-12.00	6.38	-3.28	-3.73 *	-0.96	2.12	0.00	23.07
Kranti x Seeta	-9.47	-12.24	8.51	-0.98	-4.71 *	-2.88	1.07	-0.20	20.51
Kranti x TNM-1	3.15	0.00	4.25	0.00	-0.94	0.96	-3.09	-2.80	20.51
Kranti x TPM-1	-2.12	-6.12	-2.12	-7.54 **	-7.54 **	-5.76 **	11.11	4.16	28.20
CD 5 %	5.35	6.18	6.18	3.26	3.78	3.78	1.199	1.38	1.38
1 %	7.14	8.26	8.26	4.35	5.05	5.05	1.600	1.848	1.848
Crosses	Plant height			Number of silique per plant			Seed yield per plant (g)		
Kranti x Bio 902	0.53	-3.78	11.25	10.47**	-2.28	50.09**	14.94	-9.26	21.73
Kranti x Laxmi	-0.130	-8.35	5.98	10.278	-26.04*	13.60	-20.36	-39.56**	-18.91
Kranti x PCR-7	-3.32	-7.45	7.03	-2.13	-9.07	39.68*	-18.26	-23.13	3.13
Kranti x p.Bahar	-5.19	-7.81	6.60	-26.67*	-36.05**	-1.79	-31.14	-49.95**	32.18
Kranti x P.Baroni	-4.16	-12.86*	0.764	-7.76	-23.32*	17.78	-20.74	-36.13*	-14.31
Kranti x P.Bold	-6.54	-12.40*	1.285	8.56	-11.66	35.70*	-3.93*	-39.71**	-19.12
Kranti x RH-819	1.74	-10.81*	3.127	-12.47	-25.18*	14.93	8.77	-20.79	6.26
Kranti x Tm-17	8.11	-2.70	12.50	13.44	-13.26	33.24*	26.30	-21.65	5.12
Kranti x RL-1359	-1.28	-7.39	7.08	22.99*	2.11	56.86*	13.46	-6.46	25.49
Kranti x RLM-61	12.30**	-1.021	14.45*	-0.48	16.06	28.93	-9.19	-35.47*	-12.22
Kranti x Rohini	3.90	0.841	16.60**	-14.04	-21.64*	20.37	-4.47	-17.05	11.28
Kranti x RW-351	4.65	-1.86	13.48*	0.94	-17.23	27.14	-8.43	-34.89*	-12.6+4
Kranti x Seeta	0.762	-8.65	5.62	-12.84	-18.96	24.48	-22.69	-39.25**	-18.49
Kranti x TNM-1	-2.18	-5.88	8.82	-22.52*	0.43*	17.45	-30.50*	-33.87*	-11.28
Kranti x TPM-1	7.83	-6.49	8.13	38.18**	17.32	80.22**	15.37	-21.10	5.85
CD 5 %	12.33	17.45	17.45	42.05	49.50	49.50	3.99	3.21	3.21
1 %	16.47	23.24	23.24	56.87	63.87	63.87	4.21	4.48	4.48

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Crosses	Days to 50% Flowering			Days to maturity			Branches per plant		
	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>	H <sub>1</sub>	H <sub>2</sub>	H <sub>3</sub>
Vardhan x Bio902	-8.85	-17.85**	-2.12	-4.18**	-4.62**	-0.96	8.23	6.97	17.94
Vardhan x Laxmi	-15.04**	-17.85**	-2.12	-3.25*	-3.70*	0.00	14.28	8.33	33.33
Vardhan x PCR-7	-14.54**	-16.07**	0.00	-2.32	-2.77	0.961	4.65	4.65	15.38
Vardhan x P.Bahar	-10.67*	-17.85**	-2.12	0.00	-1.85	1.92	19.10	15.21	35.89*
Vardhan x P.Baron	-6.79	-14.28*	2.12	0.00	-1.85	1.92	13.63	11.11	28.20
Vardhan x P.Bold	-6.79	-14.28*	2.12	0.00	-1.85	1.92	9.75	4.65	15.38
Vardhan x RH-819	-12.96*	-16.07**	0.00	-1.86	-2.77	0.96	17.07	11.62	20.70
Vardhan x Tm-17	-17.30**	-23.21**	-8.51	-3.38*	7.40**	-3.84*	51.35*	30.23	43.58
Vardhan x RL-1359	-1.851	-5.35	12.76	0.00	0.00	3.84*	19.14	11.76	46.15**
Vardhan x RLM-61	-16.19**	-21.42**	-6.38	-2.36	-4.62*	-0.96	8.23	6.97	17.94
Vardhan x Rohini	0.952	-5.35	12.76	-0.92	-0.92	2.88	1.123	-2.17	15.38
Vardhan x RW-351	-13.20*	-17.85**	-2.12	-2.32	-2.77	0.96	7.86	4.34	23.70
Vardhan x Seeta	-11.76*	-19.64**	-4.25	-1.94	-6.48**	-2.88	4.34	2.22	17.94
Vardhan x TNM-1	-7.84	-16.07**	0.00	-2.83	-4.62*	-0.96	13.04	6.12	33.33*
Vardhan x TPM-1	-14.85*	-23.21**	-8.51	-7.47**	-8.33**	-4.80*	11.76	10.46	21.79
CD 5 %	5.35	6.18	6.18	3.26	3.78	3.78	1.199	1.38	1.38
1 %	7.14	8.26	8.26	4.35	5.05	5.05	1.600	1.848	1.848
Crosses	Plant height			Number of silique per plant			Seed yield per plant (g)		
Vardhan x Bio902	6.04	3.94	9.72	14.64	11.19	39.74*	31.63	22.09	10.86
Vardhan x Laxmi	13.30**	10.62	12.16*	63.53**	46.56**	84.20**	83.18**	61.68**	46.81*
Vardhan x PCR-7	1.17	-0.91	4.79	2.50	0.150	32.05	-24.80	-43.61	-21.42
Vardhan x P.Bahar	2.27	-50.69	7.71	35.28**	29.14*	62.30**	46.66	24.05	12.64
Vardhan x P.Baron	9.03*	5.41	6.87	51.05**	36.69**	71.79**	39.17	32.45	20.27
Vardhan x P.Bold	6.14	5.41	6.87	22.61	10.08	38.35*	7.11	2.19	2.19
Vardhan x RH-819	15.04**	6.92**	0.75	45.95**	35.58**	70.40**	59.59**	33.02	20.79
Vardhan x Tm-17	10.89*	6.03	7.50	72.61**	42.13**	78.63**	126.14**	53.27*	39.18
Vardhan x RL-1359	6.82	6.78	8.26	61.96**	46.35**	83.94**	66.98**	63.52**	48.48**
Vardhan x RLM-61	-1.31	-7.74	-6.46	3.33	-4.96	19.44	11.58	-6.90	-15.46
Vardhan x Rohini	10.41*	6.70	16.05*	-1.21	-1.46	24.55	23.44	18.06	17.45
Vardhan x RW-351	-4.45	-4.52	-3.19	-2.99	-13.56	8.62	7.44	-12.77	-20.79
Vardhan x Seeta	11.80**	7.74	9.24	18.79	15.92	53.05**	30.00	19.90	8.88
Vardhan x TNM-1	2.50-	-0.13	6.74	27.91**	17.70	76.04**	15.87	1.38	22.77
Vardhan x TPM-1	12.64**	3.49	4.93	7.02	-0.81	24.65	26.20	-2.76	-11.70
CD 5 %	12.33	17.45	17.45	42.05	49.50	49.50	3.99	3.21	3.21
1 %	16.47	23.24	23.24	56.87	63.87	63.87	4.21	4.48	4.48

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plant and number of siliques per plant.

The cross Kranti x TPM-1 showed maximum significant heterosis for days to maturity ( $H_1$  - 7.54%), heterobeltiosis ( $H_2$  - 7.54%) and heterosis over check ( $H_3$  - 5.76%). This cross also showed relatively better heterosis ( $H_1$  - 38.18%) and superior heterosis ( $H_3$  - 80.22%) for the number of siliques per plant. There was significant heterosis in cross Vardhan X TPM-1. This cross showed significant average heterosis ( $H_1$  - 7.47%), heterobeltiosis ( $H_2$  - 8.33%) and useful heterosis ( $H_3$  - 4.80%).

There was significant superior heterosis for number of siliques plant<sup>-1</sup> in crosses such as Vardhan x Pusa Bahar ( $H_1$  - 35.23,  $H_2$  - 29.14 and  $H_3$  - 62.30); Vardhan x Pusa Baroni ( $H_1$  - 51.05,  $H_2$  - 36.69 and  $H_3$  - 71.73); Vardhan x RH-819 ( $H_1$  - 45.95,  $H_2$  - 35.58 and  $H_3$  - 70.40).

The significant maximum heterosis for number of siliques plant<sup>-1</sup> and seed yield plant<sup>-1</sup> was also obtained earlier<sup>3,4</sup>.

High mean and significantly superior heterosis in the crosses Vardhan x TM-17, Vardhan x Laxmi and

Vardhan x RL-1359 for seed yield plant<sup>-1</sup>, identifies them as superior  $F_1$ 's which may be carried forward to  $F_6$  generation preferably by single seed descent method without any loss of recombinant till desired homozygosity is reached. Further superior recombinants may be evaluated in trials to identify a few genotypes having desirable traits.

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