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Heterosis studies on three way crosses in Indian mustard (*Brassica juncea* L.)

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The experimental material comprised of 20, three way crosses in mustard to estimate the extent of yield and yield contributing traits in *Rabi* 2006. The crosses (Seeta x Rohini) x Pusa Bold and (Seeta x ACN-9) x Rohini and (Seeta x ACN-9) x PCR-7 exhibited maximum heterosis for seed yield plant^{-1} and hence may be forwarded to later generations to identify a superior recombinant line.

Key words : *Brassica juncea*, Three way cross, Heterosis

INTRODUCTION

Exploitation of hybrid vigour in crop plan for quantum yield and other quantitative is one of the approaches in crop improvement to cope up with the ever increasing demand of oil production. However, this heterosis can be used to assess the worthiness of cross combinations for obtaining superior recombinants (Singh *et al.*, 2003). Genetic architecture of parents and their crosses are important information prior to making good combinations for yield and other yield related parameters (Joshi and Patil, 2003). So, present investigation was undertaken to estimate the level of heterosis in three way cross combinations for identification of good combiners for high yield and other parameters related with yield.

MATERIALS AND METHODS

Five elite genotypes Pusa Bold, Rohini, TM-17, ACN-9, PCR-7 were crossed with parents Seeta during *Rabi* 2004. The F_1's from all cross combinations were again crossed with Rohini, TM-17, ACN-9, PCR-7 and Pusa Bold, respectively during *Rabi* 2005. This complete set of experiment was planted in complete randomized block design with 3 replications in *Rabi* 2006. Recommended package of practices were done for good growth of crop. The data was recorded on five plants for days to maturity, plant height (cm), number of branches plant^{-1}, number of sillique plant^{-1} and seed yield plant^{-1}. The data were subjected to statistical analysis for heterosis (H_1), heterobeltiosis (H_2) and heterosis over check (H_3) by methods given by Panse and Sukhatme (1954).

RESULTS AND DISCUSSION

The cross (Seeta x Rohini) x Pusa Bold showed maximum heterosis for seed yield plant^{-1}. This cross also showed maximum average heterosis (H_1-96.16) heterobeltiosis (H_2-84.00) and heterosis over check (H_3-84.00). Similarly, the crosses (Seeta x ACN-9) x Rohini average heterosis (H_1-94.26), heterobeltiosis (H_2-88.44) and heterosis over check (H_3-76.00) and (Seeta x ACN-9) x PCR-7 average heterosis (H_1-95.65), heterobeltiosis (H_2-84.80) and heterosis over check (H_3-80.00), respectively also had a maximum heterosis for seed yield plant^{-1}.

The cross (Seeta x ACN-9) x Rohini exhibited maximum significant heterosis for plant height. They also showed average heterosis (H_1-16.15), heterobeltiosis (H_2-10.22) and heterosis over check (H_3-12.69). However, this cross also showed good heterobeltiosis for days to maturity (H_2-1.98). The cross (Seeta x Rohini) x Pusa Bold also showed average heterobeltiosis (H_2-3.96) for days to maturity. The other crosses (Seeta x TM-17) x Pusa Bold, (Seeta x PCR-7) x Pusa Bold also showed significant average heterosis, heterobeltiosis and heterosis over check for plant height. They showed (H_1-10.23, H_2-13.04, H_3-10.450) and (H_1-8.27, H_2-10.29, H_3-8.96), respectively.

In cross combinations cross (Seeta x ACN-9) x Pusa bold only had maximum average heterosis (H_1-29.61), heterobeltiosis (H_2-35.54) and heterosis over check (H_3-35.54) in desire direction for character number of sillique plant^{-1}. Similarly, the crosses such as (Seeta x Pusa bold) x TM-17 and (Seeta x Pusa bold) x ACN-9 showed

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Table 1 : Calculation of average Heterosis (H_1), Heterobeltiosis (H_2) and Heterosis over check (H_3)

Crosses	Days to maturity			Plant height (cm)			No. of branches / plant			No. of sillique / plant			Seed yield / plant (gm)		
	H_1	H_2	H_3	H_1	H_2	H_3	H_1	H_2	H_3	H_1	H_2	H_3	H_1	H_2	H_3
(Seeta x Pusa Bold)															
X Rohini	0.64	4.95**	0.95	4.25	1.46	3.73	8.99	0.00	0.00	5.59	-9.04	-9.04	30.70	22.60	22.60
X TM-17	0.65	1.98*	-1.90*	9.97**	6.52	9.70**	50.15	25.00	25.00	8.70	-2.23	5.42	61.69**	49.40*	49.40*
X ACN-9	0.97	2.97**	-0.95	7.75*	3.73	3.73	20.12	0.00	0.00	17.76	7.83	7.83	79.53**	66.60**	66.60**
X PCR-7	0.00	3.96**	0.00	0.75	0.00	0.00	2.12	0.00	0.00	-13.77	-27.11	-27.11	-24.37	-28.00	28.00**
(Seeta x Rohini)															
X P.Bold	-0.31	3.96**	0.00	5.75	2.92	5.22	8.99	0.00	0.00	25.17	7.83	7.83	96.16**	84.00**	84.00**
X TM-17	-0.96	1.98*	-1.90*	2.47	0.00	2.99	20.12	0.00	0.00	-18.55	32.96*	-27.71	13.75	9.85	2.60
X ACN-9	3.50**	0.00	-3.81**	0.00	-5.11	-2.99	20.12	0.00	0.00	12.77	2.63	-6.02	28.04	24.20	16.00
X PCR-7	4.38**	0.99	-2.86**	3.73	1.46	3.73	20.12	0.00	0.00	16.84	7.25	-10.84	30.54	24.64	21.40
(Seeta x TM-17)															
X P.Bold	0.65	1.98*	-1.90*	10.23**	13.04**	10.45**	20.12	0.00	0.00	-21.74	29.61*	-24.10	21.21	12.00	12.00
X Rohini	2.88**	0.00	-3.81*	0.25	-2.17	0.75	20.12	0.00	0.00	7.92	-11.17	-4.22	52.33*	47.11*	37.40
X ACN-9	2.63**	-1.98*	-5.71*	-2.56	-7.97*	-5.22	33.33	33.33	0.00	-18.76	29.05*	-23.49	17.90	16.34	5.40
X PCR-7	-0.65	1.98*	-1.90*	-3.22	-5.80	-2.99	0.00	0.00	25.00	0.23	18.99	-12.65	31.00	23.20	20.00
(Seeta x CAN-9)															
X P. Bold	-0.97	0.99	-2.86**	-1.55	-5.22	-5.22	20.12	0.00	0.00	29.61*	35.54*	35.54*	-16.59	-22.60	-22.60
X Rohini	-1.60	1.98*	-1.90*	16.15**	10.22**	12.69**	20.12	0.00	0.00	31.57	19.74	9.64	94.26**	88.44**	76.00**
X TM-17	-0.66	0.00	-3.81**	4.35	-1.45	1.49	33.33	33.33	0.00	5.55	-7.82	-0.60	26.85	25.17	13.40
X PCR-7	-1.27	1.98*	-1.90*	4.11	-0.74	0.75	0.00	0.00	25.00	30.46	16.45	6.63	95.65**	84.80**	80.00**
(Seeta x PCR-7)															
X P. Bold	-3.81**	0.00	-3.81**	-8.27*	10.29**	-8.96*	20.12	0.00	0.00	-1.66	-16.87	-16.87	5.04	0.00	0.00
X Rohini	-3.44**	1.98*	-1.90*	-8.21*	10.22**	-8.21*	20.12	0.00	0.00	-11.58	-18.84	32.53*	13.33	8.21	5.40
X TM-17	-2.58**	0.00	-3.81**	-4.71	-7.25*	-4.48	0.00	0.00	25.00	-17.74	33.52*	-28.31	7.64	1.23	-1.40
X ACN-9	-2.33**	0.99	-2.86**	1.80	-2.94	-1.49	33.33	33.33	0.00	21.62	8.55	-0.60	73.91**	64.27**	60.00**
CD at 5%	1.72	1.98	1.98	8.41	9.71	9.71	--	--	--	44.20	51.03	51.03	1.85	2.13	2.13
CD at 1%	2.29	2.64	2.64	11.22	12.95	12.95	--	--	--	--	--	--	2.47	2.85	2.85

* and ** indicates significance of values at P=0.05 and 0.01

significant heterosis for seed yield plant^{-1}. They showed average heterosis (H_1-61.69), heterobeltiosis (H_2-49.90) and heterosis over check (H_3-49.90) and average heterosis (H_1-79.53), heterobeltiosis (H_2-66.60) and heterosis over check (H_3-66.60), respectively. The other crosses (Seeta x PCR-7) x ACN-9 also showed significant average heterosis (H_1-73.91), heterobeltiosis (H_2-64.27) and useful heterosis (H_3-60.00) for character seed yield plant^{-1}. These types of results were obtained by Swarnakar *et al*. (2001) and Tyagi *et al.* (2001) for character seed yield plant^{-1} and number of sillique per plant. Thus it would be worth enough that these superior crosses having high heterosis were able to produce superior segregates which could enable the breeder to concentrate of any few crosses rather handling many in later generations.

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