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HETEROSIS STUDIES IN MUSTARD

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Five genotypes involving Pusa bold, Rohini, T.M.-17, ACN-9, Pusa bold as male parents and Seeta, BIO-902 as female parents, along with the parents were raised in complete randomized block design with three replications. Observations were recorded on five plants from each replication for days to maturity, plant height, number of branches plant^{-1}, number of siliquae plant^{-1}and seed yield plant^{-1}.The mean squares due to genotypes were significant for all the characters under study. The cross Bio-902xRohini was identified as the best cross amongst all the crosses evaluated. It exhibited highest mean, highest useful hetrosis for seed yield plant^{-1}, number of siliquae plant-^{1} number of branches plant^{-1} and significant negative heterosis for days to maturity. Eventhough heterosis of higher magnitude was observed in most crosses for seed yield plant^{-1} as well as number of siliquae plant^{-1},it cannot be used for complete exploitation in heterosis breeding programme because of variable percentage of natural crossing, lack of effective restorer lines for the CMS system in this crop.

Keywords : Cross; Heterosis; Mustard.

Acute shortage of edible oils in the country makes it necessary to improve the productivity of oilseeds, where a major share has to come from rapeseed-mustard. In order to increase the productivity, it is essential to develop varieties or hybrids with ideal plant type. Thus the major objectives in breeding mustard are oriented towards developing varieties which have high yielding potential, early maturity, dwarf plant type, wider adaptability, disease resistance, high oil content, low euracic acid and glucosynolate and crude fibre content. To achieve these objectives, it is essential to identify parents as well as crosses, which could be exploited to bring about further genetic improvement on both yield and its related components. The *per se* performance of the parents themselves does not always give a correct indication of their breeding potentialities. It should also be based on adaptability, phenotypic stability, genetic diversity and genetic analysis of yield and yield contributing characters. So the present study was undertaken to estimate the extent of heterosis for yield and its components and to identify the potential parents and crosses.

Five genotypes viz. Pusa bold, Rohini, TM-17, ACN-9 and PCR-7 as male parents were crossed with Seeta and BIO-902 as female parents during *rabi* 2004. This complete set of material under study consisting of seven parents and ten crosses were raised in complete randomized block designs with three replications in *rabi* 2005.Aspacing of 45 cms between the rows and 10 cms between plants

Table 1. Analysis of variance for experimental design.

Sr. No.	Source	d.f.	Days to maturity	Plant height (cm)	No. of branches plant^{-1}	No. of siliquae plant^{-1}	Seed yield plant^{-1}
1	Replication	2	0.76	7.03	0.009	48.70	0.05
2.	Genotypes	16	28.58**	447.19**	1.33**	3961.50**	6.37**
3	Parents	6	65.43**	352.02**	1.42**	2339.04**	2.08**
4	Crosses	9	5.25*	426.33**	1.21**	3455.48**	6.35**
5	Parents vs. Crosses	1	17.51**	965.85**	1.90**	18250.41**	32.26**
6	Error	32	2.33	8.89	0.004	46.21	0.09

*, ** Signicificant at 5 and 1% respectively

Table 2. Estimates of mean, heterosis(H), heterobeltiosis(HB), & useful heterosis (UH), for different characters in mustard.

Crosses	Days to maturity				Plant height (cm)				No. of branches plant^{-1}				No. of siliquae plant^{-1}				Seed yield plant^{-1}			
	Mean	H	HB	UH	Mean	H	HB	UH	Mean	H	HB	UH	Mean	H	HB	UH	Mean	H	HB	UH
Seeta x Pusa bold	102	-	-	-	127.9	-2.96	-1.16	-1.16	3.7	5.7	-	-	179.4	36.5**	19.84**	58.7**	6.3	31.2**	31.3**	31.3**
Seeta x Rohini	103	-	-	-	161.0	-	-	-	3.6	9.1*	9.1	-	207.5	46.0**	38.60**	83.6**	7.4	51.02**	48.0**	54.2**
Seeta x TM-17	101	-	-	-	136.8	-	-	-	3.5	20.69**	9.3	-	166.9	32.44**	12.63**	49.2**	5.0	26.6**	6.4**	4.20
Seeta x ACN-9	99	-	-	-1.98	135.6	-	-	-	4.6	24.3**	9.5*	24.3**	203.9	26.45**	18.07**	80.4**	7.8	47.9**	44.8**	47.9**
Seeta x PCR-7	101	-	-	-	144.3	-	-	-	3.5	2.94	-	2.9	172.9	30.79**	15.49**	53.00**	7.1	39.2**	29.1**	47.9**
BIO-902 x Pusa bold	100	-1.96	-0.99	-0.99	123.1	-	-	-	3.6	22.03**	-	-	144.8	30.48**	10.11**	31.06**	6.4	52.4**	33.3**	33.3**
BIO-902 x Rohini	101	-2.88**	-0.98	-	143.9	-	-	-	4.7	67.9**	42.42**	27.02**	196.5	73.13**	4.61**	73.89**	7.9	83.7**	58.00**	64.6**
BIO-902 X TM-17	100	-	-	-0.99	127.0	-	-	-	2.8	5.66	12.0*	-	112.6	14.18**	7.34	-	3.9	14.7	-	-
BIO-902 X ACN-9	99	-	-	-1.98	124.8	-	-	-	2.7	-	-	-	121.0	-	-	7.08	4.1	-	-	-
BIO-902 X PCR-7	101	-1.94	-0.98	-	126.5	-	-	-	3.5	22.80**	-	-	138.8	33.98**	21.7*	22.83**	5.6	24.4**	1.81	16.7**
SE ±	-	1.08	1.24	1.24	-	2.11	2.43	2.43	-	0.145	0.169	0.169	-	5.55	4.81	4.81	0.24	0.209	0.209	0.209
CD (5%)	-	2.19	2.53	2.53	-	4.28	4.95	4.95	-	0.294	0.344	0.344	-	11.28	9.77	9.77	0.49	0.43	0.43	0.43
CD (1%)	-	2.95	3.41	3.41	-	5.77	6.66	6.66	-	0.397	0.462	0.462	-	15.19	13.17	13.17	0.66	0.57	0.57	0.57

*, ** Signicificant at 5 and 1% respectively

Note- - indicates heterosis in undesirable direction were maintained. Recommended fertilizer doses and other package of practices were followed to raise a good crop. Data were recorded on five plants from each replication for five characters viz.days to maturity, plant height (cm), number of branches plant^{-1}, number of siliquae plant^{-1} and seed yield plant^{-1}(g). The data were subjected to statistical analysis as per procedure given by Panse & Sukhatme[1], for all the characters under study and estimation of heterosis (H) over mid parent, heterobeltiosis (HB) over better parent and useful heterosis (UH) by standard procedures were carried out.

The analysis of variance for experimental design have been presented in table 1. The mean squares due to genotypes were significant for all the characters under study indicating the presence of genetic variability for these traits. The wider variability for seed yield plant^{-1} and yield contributing characters like number of siliquae plant^{-1} were also observed by Katiyar *et al*[2]. The variation due to genotypes was further portioned into variation due to parents, crosses and parents vs. crosses. The mean squares due to parents as well as crosses were significant for all the characters under study.

Most of the crosses showed significant heterosis for seed yield plant^{-1} and number of sliquae plant^{-1} (Table 2). A few crosses showed significant heterosis for number of branches plant^{-1}. Only one cross each showed significant useful heterosis for days to maturity. The cross BIO-902 x Rohini exhibited highest mean (7.99), highest significant heterosis (83.7%), heterobeltiosis (58%) and useful heterosis (64.6%) for seed yield plant^{-1}, number of siliquae plant^{-1}(H-73.13%&UH-73.89%), number of branches plant^{-1} (Mean 4.7,H-67.9%, HB-42.42%, & UH-27.02%) and significant negative heterosis for days to maturity (-2.88%), hence this cross was identified the best cross, eventhough a few other crosses also showed significant heterosis for yield and yield contributing characters.

The cross Seeta x Rohini also had higher mean for seed yield (7.4g) and exhibited significant heterosis (51.02%), heterobeltiosis (48%) and useful heterosis (54.2%).The same cross also showed higher mean (207.6), significant useful heterosis (83.6%), heterobeltiosis (38.6%) and heterosis (46%) for number of siliquae plant^{-1} and significant heterosis (9.1%) for number of branches plant^{-1}. Significant heterosis and useful heterosis of 47.9% and heterobeltiosis of 44.8% and high mean of 7.89 was observed for seed yield plant^{-1} in the cross Seeta x ACN-9. The same cross also exhibited higher mean of 203.9, significant useful heterosis (80.4%), heterobeltiosis of (18.07%) and heterosis (26.45%) for number of siliquae plant^{-1} and higher mean (4.6) and significant heterosis and useful of 24.3% and heterobeltiosis of 9.5% for number of branches plant^{-1} and negative useful heterosis for days to maturity. Seeta x PCR-7 also had higher mean (7.1g), useful heterosis (47.9%), heterosis (39.2%) and heterobeltiosis (29.1%) for seed yield plant^{-1} and 53% useful heterosis, 30.79%heterosis and 15.49%heterobeltiosis for number of siliquae plant^{-1}. Reports of more than 100% useful heterosis have been obtained by Joshi[3], Hirve & Tiwari[4] and also less than 50% useful heterosis have been obtained. Even when the heterosis reported was high, commercial exploitation of such crosses for hybrid development and conversion of high heterotic parents to cytoplasmic male sterile lines search for fertility restorers etc has not been possible. Therefore, it would be worth enough that these superior crosses showing high heterosis were able to produce superior segregates which would enable the breeder to concentrate on only few crosses rather than handling many in later generations.

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