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HETEROSIS IN INDIAN MUSTARD *BRASSICA JUNCEA* (L.) COSS.

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Abstract

F_1 hybrids of a 3 parent complete diallel crosses including reciprocals of 3 *Brassica juncea* L., cultivars were studied to estimate heterosis in 6 agronomic characters. Results demonstrated that the parent and their F_1 hybrids differed significantly for all the parameters studied, indicating substantial variation within parents and their hybrids. Manifestation of heterosis was observed for all the traits in atleast one or more crosses. Highest heterotic values were found for branches per plant. Only one hybrid exceeded the performance of its best parent for seed yield. The extent of the heterotic effects was appreciably influenced by the hybrid genotype, the direction of cross and the trait concerned. The cross P-43 x S-9 may be selected out as the superior hybrid combination which can be exploited as source for generating new high yielding *Brassica juncea* variety for commercial production.

Introduction

Brassica juncea L., (2n = AABB = 36), is the most common source of edible oil in many Afro-Asian countries. This is amphidiploid allopolyploid originated through natural crossing between *B. nigra* (2n = BB = 16) and *B. campestris* (2n = AA = 20). Heterosis occurs widely in both auto and allogamous crops. An essential factor in breeding for heterosis is identification of hybrids that are more productive than the best available cultivars. However, the availability of cytoplasmic male sterility and fertility restorer systems and self-incompatibility mechanisms (Rawat & Anand, 1979) have made the utilization of heterosis relatively easy. Earlier studies (Singh & Singh, 1985; Singh *et al.*, 1985) showed considerable hybrid vigour in certain F_1 crosses of Indian mustard (*Brassica juncea* L.).

A diallel crossing system involving 3 standard cultivars was initiated to evaluate comparative performance of F_1 hybrids, and to determine the magnitude and the direction of heterosis in Indian mustard.

Materials and Methods

A diallel cross including reciprocals was made among 3 cultivars of *Brassica juncea* (P-433, S-9 and Early Raya) which previously had been maintained by self pollination for several generations (Hussain, 1989). The parents and their F_1 hybrids were grown during winter 1987-88 in a randomized complete block design with two replications at the Oil Seed Section, Agriculture Research Institute, Tandojam, Pakistan. Each replication had a

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Table 1. Heterosis (%) values over mid parent (MP) and better parent (BP) for 6 agronomic traits in Indian mustard (*Brassica juncea* L.)

Cross	Plant height		Branches/plant		Pod length		Seeds per pod		Seed index		Seed yield/plant	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
P-43 X E. RAYA	19.63**	1.56	77.77*	42.85*	15.62**	5.71	12.70*	5.73*	–6.36	–18.03	11.76	–14.28
E. RAYA X P-43	29.44*	9.89	126.66**	82.14**	25.00*	14.28**	16.52**	9.83*	–11.95*	–22.95*	15.68	–11.27
S-9 x E. Raya	31.62**	6.45	24.32	–19.29	19.40**	5.26	–1.22	–1.62	–2.35	–4.91	–6.91	–9.85
E. Rya x S-9	13.96*	–7.83	102.70**	31.57*	16.41**	2.63	–23.26**	–23.57**	6.06	3.27	25.09	21.12
P-43 x S-9	–4.64	–10.13*	–1.17	–26.31*	15.08**	10.52*	16.01**	8.94*	117.30**	94.82**	69.95*	29.46*
S-9 x P-43	–2.20	–7.83	12.94	–15.78	9.58*	5.26	1.29	–4.87*	13.46	1.72	24.88	–6.33

*, ** Significant at 5% and 1% level of probability, respectively.

4m long single row. The seeds were planted at a commercial sowing density i.e., at distance of 15cm plant to plant and 30cm row to row. Standard cultural practices were followed throughout the growing season. Ten plants at random were selected and tagged in each replication from parent and each cross for the present study. Two applications of 75-50 NP Kg/ha of fertilizer were applied, half dose at the time of sowing and remaining half at first and second irrigation. Characters studied were plant height, branches per plant, pod length, seeds per pod, seed index and yield per plant.

Heterosis over mid parent (MP) and better parent (BP) were calculated using the following formulae:

Mid parent heterosis (%) = 100 (F_1 – MP)/MP

Better parent heterosis (%) = 100 (F_1 – BP)/BP

Significance of effects were determined using L.S.D. test.

Results and Discussion

Mid parent and better parent heterosis for 6 F_1 hybrids is presented in Table 1. Among the traits studied maximum heterosis manifested was for branches per plant. A number of reports highlight the positive contribution of number of branches to yield heterosis (Singh *et al.*, 1985; Yadava *et al.*, 1985). In our study E. Raya x P-43 displayed very high significant (P≥0.01) positive heterosis of 126.66% and 82.14% over mid and better parent, indicating dominance or overdominance of positive genes, respectively.

The heterosis observed for plant height, pod length, seeds per pod is of common occurrence in *Brassica* (Yadava *et al.*, 1985). According to East (1936) hybrid vigour may also be due to accumulation of favourable genes, the maximum number of which is brought together in F_1 hybrids, but the intensity of action of certain genes which manifest heterosis may be very low as a result of inbreeding. For seed index hybrid P-43 x S-9 displayed impressive amount of heterosis by 117.30% and 94.82% increase over mid and better parent, respectively, indicating the importance of additive genes in determining the genetic control of this trait (Yadava *et al.*, 1985). The hybrids which exhibited significant positive or negative heterosis over mid and better parent indicate dominance or overdominance of positive or negative genes, respectively.

Hybrid P-43 x S-9, on an average, out yielded both mid and better parent. Heterosis in yield is an artifact, since it can be accounted for by the yield components in the hybrid. Table 1 indicates that heterosis for grain yield was mainly due to heterosis of seed index (1000-seed wt.) showing 117.30% increase over MP and 94.82% over BP, whereas seeds per pod and pod length contributed at second and third order. These characters have important bearing on grain yield in Indian mustard (Singh *et al.*, 1985; Yadava *et al.*, 1985). The multiple correlation coefficient analyses of Yadava *et al.*, 1985) has clearly demonstrated that only seed index and seeds per pod directly influenced the seed yield in mustard.

Important factor that emerges out of this study, is the general absence of F_1 heterosis in yield. hagberg (1952) suggested that for characters such as yield, where breeder have

exerted strict positive selection pressure, the F_1 hybrids will seldom be superior to the best parent. The best hybrid in our study gave as much as 70% and 30% more yield over mid and better parent, respectively. This, coupled with other reports of substantial yield heterosis, presents an encouraging picture for exploiting heterosis by producing F_1 hybrids. Efforts should be made to locate source of genetic or preferably genetic-cytoplasmic male sterility mechanisms or in their absence to transfer sporophytic system of self-compatibility from its diploid wild relatives to make commercial exploitation of hybrid vigour in *Brassica juncea*.

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