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HETEROSIS IN RELATION TO GENETIC DIVERGENCE AND SPECIFIC COMBINING ABILITY IN INDIAN MUSTARD, *BRASSICA JUNCEA* L. CZERN

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ABSTRACT

Eighteen parents along with their 45 F_1 hybrids were assessed for genetic divergence and heterosis with respect to seed yield and other quantitative characters. The parents and their F_1, in general, were distributed in different clusters. There was no correspondence between parental divergence and heterosis exhibited by hybrids. The optimum level of parental divergence to obtain economic heterosis in F_1 was provided by the intermediate divergence class. The occurrence of differential frequencies of heterotic crosses in classes was related to the parental divergence and/or specific combining ability of the crosses.

Key words: Genetic divergence, heterosis, combining ability, Indian mustard, *Brassica juncea* L.

It is known that selection of parents on the basis of their genetic divergence helps to realise heterosis in F_1. But desirable and high magnitudes of heterosis are not directly related to extreme parental divergence as has been discussed by [1]. It is of interest, therefore, to examine heterosis in Indian mustard in this context. Such studies would also throw light on the prospects of commercial hybrids and their possible yield advantage.

MATERIALS AND METHODS

The F_1 of 45 crosses among 15 promising lines of Indian mustard (RH 75–1, RH 761, RLM 134, RK 10, Gonda 3, RLM 193, RC 14–1, RC 7–4, R 71–2, Ferozpur 2, Raya 10, RS 18, Ferozpur Tripa 5, No. 5422–2, and No. 5506) and 3 well adapted testers (Varuna, Kranti and RH 30) were grown in randomised block design with three replications during rabi 1983–84. Each line was grown in a single 3 m long row, spaced 30 cm apart with the intrarow distance of 10 cm. Data were recorded on five competitive plants per line for nine economic traits (Table 1). Oil content of random samples from each replication was estimated by NMR [2]. Combining ability effects were estimated following Kempthorne [3]. The parental genetic divergence was studied as suggested by Rao [4] and grouped into four classes, as suggested by Arunachalam et al. [1]. Heterosis was estimated as per cent improvement of a character over its better parent when hybrid mean differed from the better parent significantly.

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the progenies including parents and F_1 for all the traits indicating the presence of considerable amount of variability. The 45 crosses were grouped into 10 clusters. The range of intra- and intercluster D values varied from 5.76 (clusters I and III) to 23.99 (clusters VII and VIII). The divergence class DC_4 showed significant heterosis for 7 characters, followed by DC_3 and DC_2 for 6 and 5 traits, respectively (Table 1) which may due to high parental divergence associated with that class, as was also argued by Arunachalam et al. [1] in groundnut. The frequency of heterotic crosses and range of heterosis were higher in DC_3 than DC_4.

Table 1. Range (r), per cent heterosis (m), and number crosses showing significant positive heterosis (nh) in relation to divergence between parents in Indian mustard

Divergence class & parameter	Yield per plant	Primary branches per plant	Secondary branches per plant	No. of siliquae per plant	No. of seeds per siliqua	1000-seed weight	Oil content
DC_1 (18.53–29.13)							
m	—	—	—	—	—	—	—
r	—	—	—	—	—	—	—
nh	—	—	—	—	—	—	—
DC_2 (12.02–18.52)							
m	12.0	—	16.9	—	3.3	6.9	2.9
r	—	—	—	—	—	—	—
nh	1	—	1	—	1	1	1
DC_3 (5.54–12.01)							
m	31.5	12.6	21.8	—	8.55	21.5	
r	5.7–90.7	1.6–29.8	6.6–64.9	—	1.9–18.9	3.4–61.5	2.8–11.0
nh	16	12	12	—	24	19	13
DC_4 (2.97–5.53)							
m	18.4	17.6	42.8	56.3	8.6	24.5	4.2
r	5.9–29.5	6.3–27.9	12.4–84.7	52.7–59.9	3.8–16.7	04.7–52.3	2.2–5.0
nh	12	4	9	2	9	10	5

Note: Here and in Table 3, the dashes indicate absence of heterosis.

In general, crosses involving divergent parents did not give high heterosis for seed yield/plant (Table 1). For instance, the parents in cross RLM 134 × Kranti showed highest divergence (D^2 = 179.5) with 12% average heterosis for seed yield, whereas the parental divergence in cross Gonda 3 × RH 30 was moderate (D^2 = 54.5) but heterosis was the highest (90.7%).

This study leads to the conclusion that there should be an optimum level of genetic divergence to obtain economic heterosis in F_1. Such an optimum level was provided by the divergence class DC_3, which is in agreement with Arunachalam et al. [1]. The five crosses showing high levels of heterosis were found in the divergence class DC_3 (Table 2). These heterotic crosses involved one high/average and the other

Table 2. Information on five most heterotic crosses for grain yield in a 15×3 line-tester cross in Indian mustard

Cross	No. of characters heterotic in F_1	Clusters of parents		Cluster D value	Divergence class	sca effect
		male	female			
Gonda-3 × RH 30 (H) (L)	7	II	III	6.21	DC_3	1.81
Gonda-3 × Varuna (H) (L)	4	II	III	6.21	DC_3	3.04*
RLM 193 × RH 30 (A) (L)	6	II	III	6.21	DC_3	2.43
RH 76 × RH 30 (A) (L)	3	I	III	5.76	DC_3	2.38
RC 7 × Varuna (A) (L)	8	II	III	6.21	DC_3	3.85*

H—high gca, A—average gca, and L—low gca.
*Significance at 5% level.

low general combining parent, and most of them had high specific combining ability effects as well. More than the extremely divergent parents, parents from intermediate divergent classes would have a high probability of producing heterotic F_1 hybrids.

Table 3. Frequency of crosses heterotic for at least one character (h) and total crosses (t) in relation to its sca and parental divergence in Indian mustard

Divergence class		Overall sca status of the crosses		Total
		high	low	
DC_1	h	—	—	—
	t	—	—	—
DC_2	h	1	—	1
	t	1	—	1
DC_3	h	9	5	14
	t	15	16	31
DC_4	h	6	2	8
	t	7	6	13
Total	h	16	7	23
	t	23	22	45

In this study, about 45% of the heterotic crosses in DC_3 had high sca (Table 3). More than 50% of the heterotic crosses in DC_4 were characterised by low parental divergence, had either high sca or possessed heterosis for one character only. As reported by Arunachalam et al. [1], these crosses had other contrasting attributes like divergence in gca or adaptation to the growing environment.

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