Journal of Tropical Agriculture 42 (1-2): 39-41, 2004

Short communication

Heterosis in Indian mustard (*Brassica juncea* L. Czern & Cosson)

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Received 16 June 2000; received in revised form 15 June 2004; accepted 18 May 2004

Abstract

An investigation involving 45 genotypes (nine parents and their diallels, excluding reciprocals) to identify the high heterotic crosses in *Brassica juncea* L. was undertaken during the winter seasons of 1995-96 and 1996-97 at Ranchi. The cross combinations RH 843 x RH 851 and PR 18 x BR 40 showed high relative heterosis and heterobeltiosis, respectively, for most characters. Overall, crosses PR 18 x BR 40, PR 830 x RH 851 and RH 843 x RH 851 were superior to others in heterotic effects.

Key Words: relative heterosis, heterobeltiosis

The study of heterosis provides basic information on the breeding behavior of parents as well as the expression of cross combinations. In a self-pollinated crop like Indian mustard (*Brassica juncea* L.), the utilization of heterosis depends on the direction and magnitude of heterosis feasibility and the type of gene action involved. Estimation of heterosis over mid-parent (relative heterosis), therefore, may be useful in identifying true heterotic cross combinations. Indeed, the partitioning of the total effect of F_1 progeny into effects of general and specific ability deciphers the causes of heterosis. The higher yields in F_1 may be due to fixable (additive) and/or non-fixable (non-additive) gene action. With this background, the present investigation was undertaken to identify high heterotic crosses in Indian mustard.

The study was conducted during the winter seasons of 1995-96 and 1996-97 at the experimental area of Birsa Agricultural University, Ranchi. The experimental materials consisted of 45 genotypes (nine parents and their diallels, excluding reciprocals), seeds of which were sown on three dates at weekly intervals in north-south and east-west directions (replicated twice). The distance between the rows and the plants were 30 and 10 cm, respectively. Local agronomic recommendations were followed for crop management. Observations on yield and yield attributes (including oil content) on 10 random plants were analyzed as suggested by Rai (1979).

Data presented in Table 1 indicate that the degree and direction of heterosis varied vastly for different characters among the crosses. The cross combination RH 843 x RH 851 showed high relative heterotic effects for most of the characters (Table 1) and was followed by PR 18 x 'Vardan', PR 830 x BR 40, PR 18 x BR 40 and PR 830 x RW 29-6-3; in that order.

No cross combination, however, could stamp heterosis over the mid-parent and better parent for all parameters studied. Nonetheless, the cross combination PR 18 x BR 40 showed high heterotic effect over the better parent for most of the characters. Other combinations worth mentioning for heterobeltiosis include RW 873 x 'Vardan', PR 830 x PR 18, PR 830 x 'Vardan', RW 29-6-3 x 'Vardan', PR 18 x 'Vardan' and RW 873 x RW 29-6-3. Furthermore, for relative heterosis and heterobeltiosis, the cross combinations *viz*, PR 18 x BR 40, PR 830 x RH 851 and RH 843 x RH 851, showed superiority over others. This is consistent with the findings of Singh et al. (1996), Thakur and Sagwal (1997) and several others.

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Table 1. Magnitude of heterosis over mid parent in different characters of Indian mustard

Crosses	Characters										
	1	2	3	4	5	6	7	8	9	10	11
RW 873 x PR 830	-8.5**	15.9**	-24.3**	7.7	12.6	6.7**	3.8	26.6**	-5.8**	91.2**	7.2**
RW 873 x 'Kranti'	3.2*	-16.6**	32.7**	6.8	-16.4	14.1**	-4.7	4.1**	-2.3**	-7.3**	-10.3**
RW 873 x RW 29-6-3	-11.7**	-1.2**	-24.7**	12.3	47.3	-9.9**	-10.3**	16.4**	-2.8**	106.6**	0.5**
RW 873 x PR 18	0.1	-3.4**	13.2**	13.2*	21.2	-17.7**	2.3	17.6**	30.3**	165.9**	-2.1*
RW 873 x RH 843	-6.5*	-23.9**	-26.3**	-1.6	0.0	26.7**	-4.8	30.3**	22.7**	80.8**	-5.1**
RW 873 x RH 851	6.7*	4.3**	52.6**	6.2	68.8	-4.5**	4.0	-3.5**	2.7**	101.6**	-2.8**
RW 873 x 'Kranti'	7.7*	9.3**	18.3**	1.9	1.5	7.9**	4.8	-1.6**	17.5**	0.8	0.6
RW 873 x BR 40	-1.3	3.4**	26.1**	6.6	15.3	0.1	-0.5	-6.7**	-14.3**	59.4**	-4.4**
PR 830 x 'Kranti'	2.5	-2.1**	-42.1**	-6.3	7.6	-10.1**	1.7	-18.3**	-11.1**	-62.7**	1.8*
PR 830 x RW 29-6-3	-7.5*	10.6**	5.9**	-6.6	23.9	7.6**	-3.3	68.8**	-1.6**	71.5**	-1.7
PR 830 x PR 18	-1.1	21.3**	30.9**	2.7	47.9	2.7**	0.4	6.3**	-3.5**	54.6**	1.2
PR 830 x RH 843	4.8	13.3**	15.8**	5.8	29.5	3.9**	-3.5	1.2**	-6.5*	113.4**	-1.5
PR 830 x RH 851	-0.3	25.5**	67.9**	9.3	72.4	-4.5**	0.9	5.9**	-4.2**	159.9**	-8.3**
PR 830 x 'Vardan'	15.7**	6.9**	27.5**	-0.3	-15.1	-2.9**	7.3*	15.1**	35.6**	30.5**	-4.7**
PR 830 x BR 40	-4.3	1.1**	10.0**	-13.5*	-14.6	-21.8**	3.3	58.9**	19.9**	58.8**	2.1*
'KRANTI' x RW 29-6-3	-2.7	1.1**	11.5**	0.5	-4.9	0.2	-2.6	-1.4**	1.5**	-25.6**	-3.7**
'Kranti' x PR 18	-4.6	7.4**	2.6	-8.3	26.0	-12.7**	1.3	-6.4**	7.9**	-24.8**	0.2
'Kranti' x RH 843	8.8**	-5.8**	-9.7**	1.8	25.9	16.6**	0.7	24.3**	-0.6*	-54.4**	-0.8
'Kranti' x RH 851	4.9	-1.9**	17.9**	6.5	-0.0	-11.8**	5.2	-2.7**	7.1**	-11.3**	-13.6**
'Kranti' x 'Vardan'	14.5**	23.9**	12.9**	6.1	6.7	-1.2	9.2**	6.5**	3.3**	-42.2**	-6.3**
'Kranti' x BR 40	-6.4*	-3.1**	-6.5**	-11.7	-29.3	-22.4**	-0.6	-29.6**	-0.1	-44.7**	1.9*
RW 29-6-3 x PR 18	11.6**	18.6**	-18.4**	-1.8	-22.8	-6.6**	0.2	-25.5**	-17.8**	-35.1**	4.8**
RW 29-6-3 x RH 843	-4.8	3.6**	45.5**	1.6	29.5	2.8**	-6.0*	13.7**	-6.2**	32.9**	-0.6
RW 29-6-3 x RH 851	1.9	1.5**	4.7	-6.6	-1.1	0.5	-1.6	-26.0**	-1.5**	30.1**	-0.9
RW 29-6-3 x 'Vardan'	-2.4	8.4**	14.1**	13.1*	42.4	-17.7**	0.6	12.3**	24.1**	91.7**	-3.3**
RW 29-6-3 x BR 40	-3.3	13.9**	-26.7**	-13.9*	-33.6	-3.6**	-2.3	-7.1**	-19.8**	-6.0**	0.9
PR 18 x RH 843	-3.7	-29.8	51.1**	-10.4	-32.8	21.8**	-4.4	30.8**	-14.5**	68.9**	1.5
PR 18 x RH 851	5.6	3.2**	15.5**	4.4	37.4	-9.6**	-1.8	-14.4**	-9.9**	40.3**	-1.2
PR 18 x 'Vardan'	-2.5	8.1**	30.9**	-5.5	-32.9	5.4**	-0.7	18.9**	2.5**	34.7**	7.5**
PR 18 x BR 40	-3.5	17.7**	-5.8**	7.6	172.1**	13.8**	0.7	33.9**	-11.0**	317.3**	3.9*
RH 843 x RH 851	-6.5*	4.2**	66.9**	15.9*	98.7*	26.4**	4.0	4.5**	2.7**	23.9**	-8.6**
RH 843 x 'Vardan'	3.8	22.5**	-1.2	12.9	44.2	5.6**	1.9	26.9**	9.3**	139.2**	-0.3
RH 843 x BR 40	-10.9**	-22.8**	-9.3**	3.0	-1.6	10.4**	-4.2	34.2**	10.3**	6.7**	3.6**
RH 851 x 'Vardan'	6.6*	-10.9**	-4.9*	-2.4	-5.9	-5.8**	1.4	13.9**	3.8**	-31.8**	-1.3
RH 851 x BR 40	-9.4**	3.2**	60.9**	3.7	82.9	3.9**	4.7	18.9**	-11.1**	84.4**	-1.5
'Vardan' x BR 40	-5.0	14.9**	69.9**	7.5	38.1*	4.4**	1.2	15.9**	-2.3**	-4.3**	-4.1**
SE±	3.26	0.305	2.46	6.77	46.57	0.938	3.07	0.025	0.28	1.30	0.92

*, ** Significant at 5 and 1% probability levels, respectively

1. Days to 50% flowering
2. Primary branches/plant
3. Secondary branches/plant
4. Plant height (cm)
5. Siliquae/plant
6. Seeds/siliqua
7. Days to maturity
8. Harvest index
9. 1000-seed weight (g)
10. Seed yield/plant (g)
11. Oil content (%)

A comparison of the data in Table 1 also indicate that four desirable crosses showed highly significant negative relative heterosis for days to 50% flowering, whereas for heterobeltiosis no desirable cross could be observed. For primary branches per plant, 25 desirable crosses for heterosis over mid-parent and 15 crosses for heterobeltiosis could be recorded. Likewise, for the number of secondary branches per plant, 22 crosses for relative heterosis and 12 crosses for heterobeltosis could be observed. One cross each for relative heterosis and heterobeltiosis also was observed for the number of siliquae per plant. In addition, for number of seeds per siliqua, 17 crosses showed ralative heterosis while 10 crosses exhibited heterobeltiosis. However, for days to maturity, only one cross showed desirable relative heterosis. For harvest index 24 and 18 crosses exhibited relative heterosis and heterobeltiosis respectively. Similarly, 16 crosses showed heterosis over mid-parent and 12 crosses for heterosis over better parent for 1000-seed weight, while 24 crosses expressed relative heterosis and 20 crosses showed heterobeltiosis for seed yield per plant. As regards to oil content, six crosses showed relative heterosis and four crosses exhibited heterobeltiosis.

Acknowledgements

Part of the thesis of senior author submitted to Birsa Agricultural University**,** Ranchi

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