

COMBINING ABILITY FOR SEED YIELD AND ITS COMPONENTS IN BROWN SARSON IN ARID ENVIRONMENT

D. KUMAR

Central Arid Zone Research Institute, Jodhpur - 342 003, Rajasthan

ABSTRACT

A diallel involving 10 inbreds of brown sarson, revealed the significance of non-additive gene effects in inheritance of plant height, main shoot length, number of siliquae on main shoot, number of primary branches/plant, 1000-seed weight and seed yield/plant, whereas non-additive gene effects were important for number of secondary branches/plant. Two inbreds (IB 14 and IB 15) were best general combiners for seed yield, the former with maximum seed yield was also a good combiner of siliquae on main shoot. IB 19 was characterized with maximum general combining ability estimates and means for main shoot length, number of siliquae on main shoot and number of secondary branches/plant. IB 10 x IB 19 followed by IB 10 x IB 15 and IB 15 x IB 19 were the best specific combiners for seed yield.

INTRODUCTION

Efforts on yield improvement of oilseeds have largely been concentrated under the irrigated and rainfed situations of the semi-arid and arid environments. However, arid environment which comprises 3.2 lac sq km area in north west part of India, has consistently been neglected as far the genetic improvement of rapeseed is concerned. Information on the combining ability of parents so as to select them for hybridization is, therefore quite necessary. Information on combining ability in brown sarson, an important rape is available to some extent in semi-arid conditions (Patnaik and Murthy 1978; Kumar and Yadav, 1985). Such information is, however, completely lacking for hot desert of Rajasthan. A study was, therefore, undertaken to gather information on general and specific combining ability in brown sarson grown with limited irrigations.

MATERIAL AND METHODS

Forty inbred lines of brown sarson (*Brassica campestris* L. subsp. *sarson* Prain) developed by crossing/selection of genetically diverse strains after 4 cycles of selfing were numbered serially. First 9 lines were used in a line x tester programme (Kumar and Yadav, 1985), The next 10 inbreds, viz. BSH-1 (IB10), BS-5 x BS-30 (IB 11), 1-150-135 x Pusa Kalyani (IB 12), 68305 x 1-135 (IB 13), BS-2 x BS-5 (IB 15), BSH-x BS-5 (IB 16), Com. 111-79 x BS-2 (IB 17), BS-30 x Assam Selection (IB 18) and Pusa

Kalyani x BSH-1 (IB 19) were crossed in all possible ways excluding reciprocals. The 40 inbreds and their 10 inbred parents were grown in field in a randomized block design with 3 replications on loamy sand light textured soils of Jodhpur during *rabi* 1985-86. Each genotype was sown in 3 m long single row spaced 30 cm apart. One month after sowing 30 plants were retained in each row. Crop received only 2 irrigations of 6 cm each including pre-sowing.

Observations were recorded on ten randomly selected plants from each row, on plant height (cm), main shoot length (cm), number of siliquae on main shoot, number of primary and secondary branches/plant, 1,000-seed weight (g) and seed yield/plant (g). Analysis of variance for combining ability was done following Griffing's (1956) model 1 method 2.

RESULTS AND DISCUSSION

Mean squares due to general (gca) and specific combining ability (sca) were highly significant for main shoot length, number of siliquae on main shoot and seed yield/plant, thereby indicating the importance of both additive and non-additive gene effects in inheritance of these traits (Table 1). However, the proportion of general and specific combining ability, variances (σ^2g/σ^2s) indicated the importance of non-additive gene effects in expression of plant height, main shoot length, number of siliquae on main shoot, number of primary branches/plant, 1,000-seed weight and seed yield/plant. However, number of secondary branches/plant was influenced through additive gene effects. Earlier results of Rishi Pal and Hari Singh (1980) and Kumar and Yadav (1985) fall in line with the present results.

General combining ability

IB 19 was the best general combiner for main shoot length, number of siliquae on main shoot and number of secondary branches (Table 2). For number of primary branches, IB 17 was the best general combiner. For seed yield IB 14 and IB 15 gave significant positive gca. The IB 14 was also a good general combiner for number of siliquae on main shoot. There appears to be no close agreement between the gca

Table 1. Analysis of variance for combining ability in brown sarson

Source	df	Plant height	Main shoot length	No. of siliquae on main shoot	No. of primary branches/plant	No. of secondary branches/plant	1,000-seed weight	Seed yield/plant
GCA	9	124.69	68.80*	152.75**	597.54	11.69**	0.021	18.59**
SCA	45	254.07**	43.79**	66.35**	754.52	3.38	0.031*	12.36**
Error	108	106.83	26.95	36.75	726.05	2.83	0.021	5.59
σ^2g/σ^2s	—	-0.087	0.14	0.30	-0.55	5.53	-0.10	0.091

*P = 0.05; **P = 0.01

Table 2. General combining ability estimates and the corresponding mean values in brown sarson

Parents	Plant height		Main shoot length		No. of siliquae on main shoot		No. of primary branches/plant		No. of secondary branches/plant		1,000-seed weight		Seed yield/plant	
	GCA	Mean (cm)	GCA	Mean (cm)	GCA	Mean	GCA	Mean	GCA	Mean	GCA	Mean (g)	GCA	Mean (g)
IB 10	3.63	100.93	1.63	61.83	1.09	42.70	3.71	7.53	1.23	6.33	0.016	4.46	0.40	4.67
IB 11	0.93	138.27	-2.09	58.10	0.56	41.87	13.28**	8.03	-0.34	9.93	0.001	4.20	-0.26	6.77
IB 12	-3.29	142.10	-0.55	65.43	-3.92*	49.93	-3.67	9.13	-0.95*	10.23	-0.049	4.26	-0.70	7.07
IB 13	-0.60	142.13	-2.82*	54.10	-5.46**	42.07	-3.41	5.73	-0.98*	6.20	-0.021	4.46	-0.28	5.63
IB 14	1.17	135.33	1.66	66.07	4.50**	48.90	-3.44	7.47	0.43	10.40	0.037	4.80	2.27**	10.93
IB 15	2.36	145.33	-0.06	66.67	0.40	54.23	-3.28	7.50	-0.41	10.00	10.00	4.94	1.30*	5.63
IB 16	-0.79	162.43	1.65	62.43	1.82	54.80	-3.13	8.83	0.86*	12.80	0.004	4.56	-0.63	9.60
IB 17	-2.69	143.43	-3.65	55.40	-2.83	55.33	13.47**	7.73	0.54	12.63	0.04	4.50	-1.51*	6.40
IB 18	-5.51*	132.50	0.08	68.97	0.02	50.57	-3.13	9.73	0.13	11.13	-0.06	5.00	-1.59*	4.27
IB19	4.78	168.53	4.16**	70.67	5.99**	60.67	-2.95	7.23	1.95**	14.33	0.07*	4.84	1.02	6.93
SE ± (g)	2.83	-	1.42	-	1.65	-	3.37	-	0.45	-	0.04	-	0.64	-

*P = 0.05, **P = 0.01

Table 3. Specific combining ability estimates for 10 top ranking crosses on the basis of seed yield in brown sarson

Crosses	Plant height	Main shoot length	No. of silique on main shoot	No. of primary branches/plant	No. of secondary branches/plant	1000-seed weight	Seed yield/plant
IB 10 x IB 19	-14.67**	7.52**	-6.51**	3.10	-2.96**	0.05	10.73**
IB 13 x IB 19	-5.47	-1.73	3.35	6.73	4.44**	0.09	5.57**
IB 14 x IB 15	-1.27	10.33**	2.63	4.59	1.30	0.05	5.91**
IB 15 x IB 19	2.52	2.84	3.14	3.33	1.77**	0.18**	5.76**
IB 16 x IB 18	-18.54**	4.43*	3.09	2.99	0.33	-0.02	4.01**
IB 12 x IB 18	0.92	-10.32**	-8.52**	2.36	-0.84	-0.10	3.98**
IB 11 x IB 15	25.51**	-3.03	3.64	-13.07	0.68	-0.04	3.88**
IB 11 x IB 17	5.24	3.48	14.11**	169.59**	-0.57	0.10	3.83**
IB 13 x IB 17	3-57	-2.05	-4.55	-13.86	0.96	0.02	3.51**
IB 10 x IB 18	23.35**	5.57**	3.58	4.17	0.59	-0.003	2.54**
SE \pm (d.f.)	4.21	2.11	2.47	11.00	0.68	0.06	0.90

*P = 0.05, **P = 0.01.

estimates and mean values of the parents. However, IB 19 had highest gca estimates and the mean values for main shoot length, number of siliquae on main shoot and number of secondary branches. Similarly, IB 14 was another parent characterized with maximum mean and gca for seed yield. Since, high gca estimates represent additive or additive x additive genetic variation (Sprague, 1966) and show fixable component the two inbreds IB 14 and IB 19, may be useful in the breeding programmes under arid environments of Jodhpur.

Specific combining ability

Out of 45 cross combinations, 13 gave significant positive sca for seed yield. Estimates of sca on 10 top ranking crosses on the basis of yield are given in Table 3. IB 10x IB 19 (10.73), followed by IB14 x IB 13 (5.91), IB 15 x IB 19 (5.76), IB 13xIB 19 (5.57) and IB 16xIB 18 (4.01) had maximum sca for seed yield. The first cross also showed maximum sca for main shoot length whereas, the second cross gave maximum sca for number of secondary branches.

Highest sca estimates for plant height were shown by IB 11xIB 15; for main shoot length by IB 10xIB 19; for number of siliquae on main shoot and number of primary branches by IB 11xIB 17; for number of secondary branches by IB 13xIB 19; and for 1,000-seed weight by IB 15xIB 19. This indicates marked contribution of non-additive gene effects in the inheritance of the yield components.

The crosses IB 10xIB 19 and IB 13xIB 19 with maximum sca for yield, involved both the parents showing absence gca, whereas IB 15xIB 19 and IB 11xIB 15 involved only one parent with significant gca estimate. The cross IB 14 x IB 15 which reflected significant sca for yield however, involved both the parents lacking gca for yield. Thus, estimates of gca for the parents may not necessarily indicate sca in their cross combinations (Kumar and Yadav, 1986). Generally high sca were expected in the crosses having diversified parents.

Additive and perhaps additive x additive gene effects were involved in the cross combinations of IB 14 x IB 15 for seed yield and IB 11 x IB 17 for primary branches. The parents involved had high sca and showed significant sca in their combinations. These combinations may throw some desirable segregants because they have fixable components (Paul et al., 1976).

Non-additive components of gene effects appear to have affected the yield of IB 10 x IB 19, IB 13 x IB 19, IB 16 x IB 18, IB 12 x IB 18, IB 13 x IB 17 and IB 10 x IB 18. The parents showed low gca but gave high sca in cross combination.

To seek genetic improvement in main shoot length, number of siliquae on main shoot, number of secondary branches, 1,000-seed weight and for number of pri-

mary branches, it would be worthwhile to grow best general combiners IB 19 and IB 17 in isolation to intermating for the development of synthetics.

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REFERENCES

- Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Australian Journal of Biological Research*. 9 (2) : 463-493.
- Kumar, D. and Yadav, I.S. 1985. Line x tester analysis for certain quantitative traits in brown sarson on normal and alkaline soil. *Society for the Advancement of Breeding Researches in Asia and Oceania*. 17 (1) : 21-28
- Kumar, D. and Yadav, I.S. 1986 Combining ability in taramira under rainfed conditions. *Indian Journal of Agricultural Sciences*, 56 (4) : 229-233.
- Paul, M.L., Joarder, D.I. and Eumus, A.M. 1976. Analysis of yield and some of its components in mustard. *Indian Journal of Agricultural Sciences*. 46 (8) : 517-524.
- Patnaik, M.C. and Murthy, B.R. 1978. Gene action and heterosis in brown sarson. *Indian Journal of Genetics and Plant Breeding*. 38 : 119-125.
- Rishi Pal and Hari Singh 1980. Combining ability in rapeseed. *Indian Journal of Agricultural Sciences*. 50 (1) : 9-13.
- Sprague, G.F. 1966. *Plant Breeding*. pp. 315-354. The Iowa State University Press, Ames, Iowa.