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COMBINING ABILITY ANALYSIS OF SEED YIELD AND OIL CONTENT IN *BRASSICA JUNCEA* (L.) COSS & CZERN.

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ABSTRACT

Combining ability analysis of a 10 × 10 diallel set of crosses in Indian mustard for ten characters revealed preponderance of non-additive gene action for most of the characters including seed yield and oil content. Additive genetic variance was more important for plant height and length of siliqua for which high estimate of heritability was also observed. The parent Pusa Barani was the best general combiner for seed yield, oil content, 1000 seed weight, days to flowering, plant height, length of main axis and length of siliqua. Varuna and RH-30 were also good general combiners for seed yield and several other characters. Poorbijaya and Glossy mutant showed desirable g.c.a for dwarfness also. Among the crosses, Pusa Barani × Glossy mutant showed superior sca effects for seed yield, oil content, plant height, primary branches and length of main axis. Majority of the crosses showing high sca effects for seed yield involved high × low gca parents.

Key words: Combining ability, *Brassicia juncea*, diallel, transgressive segregates.

Seed and oil yield in Indian mustard is low in India in comparison to developed countries. Research efforts made in the past in this crop have mostly been directed towards individual plant selection in naturally varying land races and progeny selection followed by hybridization. However, varieties good in *per se* performance may not necessarily produce desirable progenies when used in hybridization. Knowledge about the combining ability is, therefore, important in selecting suitable parents for hybridization, proper understanding of inheritance of quantitative traits and also in identifying the promising crosses for further use in breeding programmes.

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MATERIALS AND METHODS

The experimental material comprised of ten improved and local cultivars as well as advanced breeding materials of diverse origin, their 45 F_1s and 45 reciprocal F_1s. The seeds of these 100 genotypes were sown in randomised block design with three replications during rabi, 1992-93 at the Research Farm of Genetics Division, Indian Agricultural Research Institute, New Delhi. Each plot comprised two rows of 5.0 m length. The inter and intra-row distances were maintained at 45 cm and 15 cm, respectively. All the crop management and plant protection operations were carried out as per recommended package of practices. The observations were recorded on ten quantitative traits including seed yield and oil content on five random plants of each genotypes in each replication. The combining ability analyses were carried out following Method 1, Model I of griffing [1].

RESULTS AND DISCUSSION

The ANOVA showed significant difference among parents and crosses for all the characters. Variations due to gca and sca were also significant for all the characters except for length of siliqua in latter indicating the importance of both additive and non- additive gene actions (Table 1). However, the ratio $6^2g/6^2p$ indicated high additive gene action for only plant height and length of siliqua. Non-additive type of gene action was observed to be predominant for other characters including seed yield per plant. Similar results were also reported by several workers [2-4]. This indicated depletion of additive variance among Indian mustard strains. Human selection for last many centuries and systematic breeding in the last few decades may be attributed to the cause of such depletion in additive variance in this crop [5]. The character 1000-seed weight, however, showed importance of both additive and non-additive gene actions.

The above results would have important consequences for breeding and selection schemes. As non-fixable component of variation was high for seed yield, oil content and other related characters, it would be worth while to resort to breeding methodologies such as biparental mating [6], recurrent selection or diallel selective mating [7] than to conventional pedigree or backcross techniques as the latter two methods would leave the non-fixable component unexploited for seed yield and oil content.

Significant reciprocal differences were observed for all the characters indicating the role of cytoplasmic genes in the control of these characters in this crop as also reported earlier [8].

Table 1. Analysis of variance for combining ability in 10 × 10 diallel set of *Brassica juncea* for ten characters

Source	D.F.	Days to 50% flowering	Plant height	No. of primary branches	No. of secondary branches	Length of main axis	Length of siliqua	No. of seeds/ siliqua	Seed yield plant	1000 seed weight	Oil content %
GCA	9	27.53**	1168.6**	1.71**	20.76*	298.7**	1.53**	2.28**	26.2**	5.55*	4.03**
SCA	45	4.80**	50.7**	0.77**	13.3**	43.3**	0.03	1.10**	10.0**	0.42**	4.93**
REC	45	4.67**	48.6**	0.71**	12.8**	30.9**	0.04**	0.78**	11.2**	0.42**	7.36**
Error	198	0.84	11.5	0.23	2.5	12.3	0.03	0.29	3.3	0.03	0.99

*,** : Significant at 5% and 1% level, respectively

The estimates of gca indicated that the parents Varuna, Pusa Barani and RH-30 were good general combiners for seed yield per plant and several other yield related characters based on their gca effects and mean performances (Table 2). The parents Pusa Bold, Pusa Bahar and Pusa Barani were good general combiners for oil content and 1000-seed weight. Poorbijaya and glossy mutant were desirable for early flowering,the latter being desirable for dwarfness also. Since most of the characters showed non-additive or both additive and non-additive gene actions, it would be beneficial to develop a population by crossing these parents *inter se* before initiating random mating in F_2 to allow higher recombination. This is likely to break unfavourable linkages and confer a wide genetic base [9].

The crosses Pusa Barani × glossy mutant, Pusa Bahar × PR-1108, Pusa Barani × BJ-38 and Varuna × PR-1108 showed desirable sca effects for seed yield per plant and two to five yield attributing characters (Table 3). When gca effects of the parents and sca effects of the crosses were compared together, it could be noticed that Pusa Barani and Varuna were good general combiners for seed yield per plant and a number of component characters studied whereas glossy mutant, PR- 1108 and BJ-38 were poor general combiners for most of the characters including seed yield. This indicated that the superior specific combinations in the above crosses resulted due to high × low gca parents. Desirable transgressive segregates may be released by the above crosses which may be further exploited for future breeding programme.

None of the crosses showed superior specific combinations for seed yield, 1000 seed weight and oil content together. However, Pusa Barani × glossy mutant and Varuna × PR-1108 showed significant sca effects for seed yield and oil content, and Pusa Bold × RH-30 and Poorbijaya × BJ-38 for 1000-seed weight and oil content. It

Table 2. Estimates of gca effects of ten parents for ten charactes in a 10 × 10 diallel cross of *Brassica juncea*

Parents	Days to 50% flowering	Plant height	No. of primary branches	No. of secondary branches	Length of siliqua	Length of main axis	No. of seeds/ siliqua	Seed yield/ plant	1000 seed weight	Oil content %
Pusa Bold	0.61**	5.34**	–0.07	0.57	0.26	0.21**	–0.23*	–0.06	0.28**	0.67**
Varuna	0.28	4.92**	0.05	0.86*	2.55**	0.14**	0.04	0.97*	0.35**	–0.20
Pusa Bahar	0.75**	4.44**	0.24*	–0.28	–1.80*	0.24**	0.09	0.36	0.45**	0.44*
Pusa barani	0.43*	2.59**	–0.01	–1.81**	2.27**	0.51**	0.10	1.17**	0.60**	0.42*
RH-30	0.56**	1.60*	–0.31**	–0.61	2.32**	–0.01	–0.46**	1.71**	0.44**	–0.18
PR-1108	0.63**	6.46**	–0.12	–0.96**	2.13**	–0.10**	–0.39**	-0.79*	-0.01	–0.66**
Poorbijaya	–0.32	–8.10**	0.34**	1.60**	–8.55**	–0.25**	0.66**	–1.50**	–0.67**	–0.08
Glossy mutant	–3.19**	–18.33**	–0.60**	–0.37	4.79**	–0.42**	0.31**	–1.82**	–0.99**	0.39
BJ-17	0.43*	0.67	0.25*	0.97**	–3.67**	–0.07	0.09	–0.37	–0.15**	–0.37
BJ-38	–0.19	0.41	0.22*	0.02	–0.31	–0.24**	–0.21	0.33	–0.30**	–0.44*
S.E. $(g_i)\pm$	0.19	0.72	0.01	0.34	0.74	0.04	0.11	0.39	0.04	0.21
S.E. $(g_i\text{-}g_j)\pm$	0.29	1.07	0.15	0.51	1.11	0.06	0.17	0.58	0.05	0.31

*,** : Significant at 5% and 1% level, respectively

Table 3. Crosses showing significant sca effects for seed yield and oil content alongwith other characters in *Brassica juncea*

Crosses	Days to 50% flowering	Plant height	No. of primary branches	No. of secondary branches	Length of main axis	Length of siliqua	No. of seeds/ siliqua	Seed yield/ plant	1000 seed weight	Oil content %
Pusa Bold × RH-30	–0.60	1.04	–0.51	–3.35**	–1.27	–0.06	–0.55	–1.07	0.32**	1.25*
Varuna × PR-1108	–0.66	0.92	–0.49	4.73**	3.02	–0.01	0.12	2.50	0.18	1.54*
Pusa Bahar × PR-1108	–0.30	1.72	0.63*	3.56**	2.80	0.26*	0.94**	2.87*	–0.69**	1.05
Pusa Barani × Glossy mutant	0.50	9.01**	0.88**	1.58	10.87**	–0.18	0.13	2.53*	–0.36**	1.70**
Poorbijaya × BJ-38	0.09	–4.08	0.20	–1.67	–0.42	0.03	1.10*	–1.70	0.34**	1.80**

*,** Significant at 5% and 1% level, respectively

was interesting to note that the parent Pusa Barani was good and gloosy mutant poor general combiner for above three characters. Pusa Bold and RH-30, on the other hand, were good general combiners for 1000 seed weight and oil content, and 1000 seed weight and seed yield, respectively. Thus, the above crosses showed mostly high × low gca effects for superior specific combinations except Poorbijaya × BJ-38 which showed low × low general combining parents. The above results indicated that the crosses with superior sca effects involving high × low gca parents could be expected to yield positive heterosis in higher frequencies.

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