

STUDY OF COMBINING ABILITY IN INDIAN MUSTARD
[*Brassica juncea* (L.) CZERN & COSS]

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ABSTRACT

An experiment was conducted at Main Castor & Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during Rabi 2009-10 in randomized block design with three replication to evaluate the twenty one genotypes comprising fifteen hybrids derived from six diverse parents (BPR 380-1, RSK 28, RH(OE)0103, SKM 532, GM 3 and GM 1) of Indian mustard following half diallel mating design. The results revealed higher magnitude of sca variance over gca variance for all the traits, which indicated preponderance of non-additive gene action. The parents, BPR 380-1 and RSK 28 were good general combiners for seed yield and its two or more component traits. Out of fifteen hybrids, three hybrids (SKM 532 x GM 3, RSK 28 x RH (OE) 0103 and BPR 380-1 x RSK 28) showed significant positive sca effects for seed yield and its component traits could be commercially exploited by taking advantage of high degree of natural out crossing in Indian mustard.

KEY WORDS: *Combining ability, gca, Indian mustard, sca*

INTRODUCTION

Mustard is the premier winter edible oilseed crop in India. It is second most important edible oilseed crop of the India after groundnut. Mustard seed contains about 38 to 43 per cent oil, which is yellow fragrant and is considered to be the healthiest and nutritious cooking medium. It is a plant of Asiatic origin with major center of diversity in china and it was introduced in India from China. Indian mustard (*Brassica juncea* (L.) Czern and Coss) is a natural amphidiploids (2n=36) of *Brassica campestris* (2n=20) and *Brassica nigra* (2n=16). It is (85 to 90%) self pollinated crop and 4 to 15% cross pollinated by honey bees.

Combining ability studies have significant importance in determining the type of gene action present in controlling a character. Additive type of gene action is indicated by general combining ability variance while non-additive type of gene action is shown by specific combining ability variance, originating mainly from dominance and epistasis deviations (Malik et al., 2004). The overall performance of a genotype in a series of crosses is called general combining ability, while the performance of specific combinations of genotypes in crosses in relation to the average performance of all combinations is known as specific combining ability. Present studies were done to ascertain the presence of

additive and non-additive type of gene action to carry out selection for yield attributes in early or late segregating generations in studied promising Indian mustard genotypes.

MATERIALS AND METHODS

A set of 15 hybrids were developed using 6 parents (BPR 380-1, RSK 28, RH(OE)0103, SKM 532, GM 3 and GM 1) of mustard through diallel mating design excluding reciprocals during *Rabi* 2008-09. The trials consisting of 15 hybrids and their 6 parents were raised in randomized block design with three replications at Main Castor & Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *Rabi* 2009-10. Each entry was sown in a single row plot of 4.0 m length at a spacing of 45 cm x 10 cm. Observations on five randomly selected competitive plants were recorded for days to 50 per cent flowering, days to maturity, plant height, main branch length, number of branches per plant, number of siliquae per plant, number of siliquae on main branch, seed yield per plant, 1000 seed weight, oil content and protein content. The data were analyzed for combining ability as per the method suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

The analysis of variance for combining ability (Table 1) indicated that the mean squares due to general combining ability and specific combining ability were found highly significant for all the traits studied. The variance due to sca was higher than that of due to gca for all the characters, indicated the role of non-additive gene action in the inheritance of these traits. These results were confirmed with the ratio ($\sigma^2_{gca}/\sigma^2_{sca}$), which was less than one for all the traits. These results are in agreement with the results of Rao and Gulati (2001), Patel *et al.* (2003)

and Singh *et al.* (2008). The presence of predominantly non-additive gene action would be necessitating the maintenance of heterozygosity in the population. Breeding methods such as biparental mating followed by reciprocal recurrent selection may increase frequency of genetic recombinations and hasten the rate of genetic improvement.

A close examination of general combining ability effects of the parents revealed that none of the parents was found to be consistently good combiner for all the characters (Table 2). However, the parent BPR 380-1 was good combiner for seed yield, 1000 seed weight and oil content. The parent RSK 28 was good combiner for seed yield per plant, days to 50 per cent flowering, days to maturity, number of branches per plant, total siliquae per plant and protein content. The gca is due to the additive and additive x additive gene effects, which are fixable components of genetic variation (Griffing, 1956). Therefore, it would be worthwhile to use above parental lines in hybridization programme.

The estimates of sca effects revealed that out of fifteen hybrids, three hybrids (SKM 532 x GM 3, RSK 28 x RH (OE) 0103 and BPR 380-1 x RSK 28) showed significant positive sca effects for seed yield per plant. Three best specific combiners with mean performance, gca status and their significant response of sca effects to other traits are presented in Table 3. All these crosses showed significant positive response to total siliquae per plant and number of branches per plant indicating its direct effect for increasing seed yield. However, two crosses showed significant response to number of siliquae on main branch, two for oil content, one for protein content and one for 1000 seed weight.

This may be because of very complex nature of seed yield and its dependence on its components.

Out of three crosses showing high mean and significant positive sca effects for seed yield, one cross (SKM 532 x GM 3) involved average x average gca parents, second cross (RSK 28 x RH(OE)0103) with good x poor and for last cross (BPR 380-1 x RSK 28) with good x good. Better performance of hybrids involving poor x poor or average x poor general combiners indicated dominance x dominance (epitasis) type of gene action (Jinks, 1956). The crosses showing high sca effects involving one good general combiner indicated additive x dominance type gene interaction which could produce desirable transgressive segregants in subsequent generations.

CONCLUSION

The results suggested that the crosses showing high mean performance, positive sca effects for seed yield and their significant response to other related traits had necessarily involved both or at least one parent as good combiner which could be commercially exploited by taking advantage of high degree of natural out crossing in Indian mustard.

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Table 1: Analysis of variance (mean square) for combining ability, estimates of components of variance and their ratio for various characters in Indian mustard

Source of Variation	df	DF	DM	PH	MBL	NSM	TSP	NBP	SY	OC	PC	TSW
GCA	5	29.64**	11.28**	756.64**	23.05**	32.13**	4064.61**	38.85**	39.34**	6.66**	1.7**	0.47**
SCA	15	5.36**	15.81**	143.89**	72.74**	56.81**	4833.01**	109.98**	22.29**	2.91**	0.9**	0.32**
Error	40	0.50	1.27	41.51	1.23	4.59	299.27	2.01	1.74	0.31	0.0	0.02
σ^2_{gca}		3.64	1.25	89.39	2.73	3.44	470.67	4.60	4.70	0.79	0.21	0.06
σ^2_{sca}		4.86	14.54	102.37	71.50	52.22	4533.75	107.97	20.55	2.59	0.90	0.30
$\sigma^2_{gca}/\sigma^2_{sca}$		0.75	0.09	0.87	0.04	0.07	0.10	0.04	0.23	0.31	0.23	0.19

**** Significant at 1 per cent level of significance**

Where,

DF = Days to 50 Per Cent Flowering, DM = Days to Maturity, PH = Plant Height, MBL = Main Branch Length, NSM = Number of Siliquae on Main Branch, TSP = Total Siliquae Per Plant, NBP = Number of Branches Per Plant, SY= Seed Yield Per Plant, OC = Oil Content, PC = Protein Content, and TSW = 1000-Seed Weight

Table 2: The estimates of general combining ability (gca) effects of the parents for various characters in Indian mustard.

Parents	DF	DM	PH	MBL	NSM	TSP	NBP	SY	OC	PC	TSW
BPR 380-1	2.03**	0.13	2.47	0.72	0.94	7.29	0.30	2.97**	0.66**	-0.89**	0.09*
RSK 28	-2.97**	-2.13**	-1.34	-0.04	-0.06	27.73**	3.00**	1.20**	-0.61**	0.45**	-0.20**
RH (OE) 0103	-1.35**	0.42	-18.80**	-2.92**	3.50**	-5.60	1.47**	-2.53**	-0.01	0.20**	-0.40**
SKM 532	-0.39	0.71	3.67	-0.51	-0.94	-34.53**	-2.66**	0.26	1.44**	0.07	0.15**
GM 3	1.24**	-0.42	7.16**	2.19**	-1.99**	-12.96*	-2.42**	-2.69**	-1.05**	-0.02	0.24**
GM 1	1.44**	1.29**	6.84**	0.56	-1.46*	18.08**	0.31	0.79	-0.43*	0.18**	0.12**
S.E.(gi) ±	0.23	0.36	2.08	0.36	0.69	5.58	0.46	0.43	0.18	0.05	0.04

*, ** Significant at 5 per cent and 1 per cent level of significance, respectively.

Where,

DF = Days to 50 Per Cent Flowering, DM = Days to Maturity, PH = Plant Height, MBL = Main Branch Length, NSM = Number of Siliquae on Main Branch, TSP = Total Siliquae Per Plant, NBP = Number of Branches Per Plant, SY= Seed Yield Per Plant, OC = Oil Content, PC = Protein Content, and TSW = 1000-Seed Weight

Table 3: Three best specific combiners for seed yield perplant and their performance for other traits in Indian mustard.

Sr. No.	Hybrids	SCA Effects	Mean Seed Yield Per Plant (g)	GCA Status	Significant Response in Other Traits for sca Effects
1.	SKM 532 x GM 3	9.70**	19.48	A x A	NSM, TSP, NBP
2.	RSK 28 x RH(OE)0103	6.39**	13.96	G x P	MBL, TSP, NBP, OC, TSW
3.	BPR 380-1 x RSK 28	4.66**	21.71	G x G	NSM, TSP, NBP, OC, PC

** Significant at 1 per cent level of significance

Where,

NSM = Number of Siliquae on Main Branch, TSP = Total Siliquae Per Plant, NBP = Number of Branches Per Plant, OC = Oil Content, MBL = Main Branch Length, PC = Protein Content, and TSW = 1000-Seed Weight

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