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Diallel analysis for yield contributing traits of Indian mustard (*Brassica juncea* L.)

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ABSTRACT

Eight varieties of Indian mustard (Brassica junce L.) viz. Vardhan, NDR 8501, MCN 20, Rohini, Rh 30, Varuna, Seeta and Kranti were hybridized in all possible combinations excluding the reciprocals. The parents and their 28 F_1s were grown following recommended agronomic packages to study general and specific combining abilities and nature of gene action on different yield contributing characters. Results revealed presence of genetic divergence in respect of the characters under study. Both dominant and recessive alleles indicated to play important role in expression of different characters. Partial dominance type of gene action was observed in case of the characters like plant height, 100 seed weight, number of seeds per pod and weight of 25 pods. While overdominance type of gene action was noticed in case of number of primary branches per plant, number of pods per plant and yield per plant. The nature of gene action suggested early generation selection may be followed for some of the characters that can be used in the future mustard breeding programme. NDR 8501 was found to be good general combiner for plant height, 100 seed weight, yield per plant and weight of 25 pods. Some of the crosses like Vardhan x Seeta, Vardhan x Kranti, MCN 20 x Varuna and Rohini x Rh 30 exhibiting significant positive SCA effects revealed presence of 'I' type of epistasis or dominance x dominance type of gene interaction. Importance of both additive and non-additive gene actions was focused in the improvement of Indian mustard programme.

Key words: Additive gene action, combining ability, epistasis, Indian mustard and *per se* performance

Indian mustard (*Brassica juncea* L. Czern & Coss) commonly known as Banarasi rai or Rai is the principal oil yielding crop in West Bengal. But the overall production of mustard is much below the requirement for the state due to various reasons. One of such reasons has been lack of genetic improvement of the crop keeping pace with the growing demand. Combining ability analysis helps in genetic improvement of crop plants. Information about combining ability analysis in mustard for New Alluvial Zone is still scanty (Ghosh Dastidar and Patra, 2002). Environmental factors play a significant role on the performance of various quantitative traits (Ghosh Dastidar and Sinhamahapatra, 1991 and Ghosh Dastidar and Patra, 2001). Therefore, the present experiment was taken up to generate information about general and specific combining ability of yield contributing characters of mustard under New Alluvial Zone of West Bengal through diallel crossing system.

MATERIALS AND METHODS

Eight varieties of the crop *viz.,* Vardhan, NDR 8501, MCN 20, Rohini, Rh 30, Varuna, Seeta, Kranti were used as parents in a diallel crossing programme without reciprocals. The seeds of the said varieties were sown during 1st week of December, 2005 in the crossing block consisting of ten lines of 5m length against each entry at the Central Research Farm, New Alluvial Zone, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, West Bengal. Normal agronomic practices were followed to raise a good crop. A crossing programme in all, possible combinations (8 × 8) excluding the reciprocals were done at the onset of flowering. During *rabi* (November, 2006 to February, 2007), the set of diallel cross along with the parents were evaluated in a randomized block design with three replications. The crop was sown in a three row plot of 5m length. A distance of 30cm between rows and 10cm between plants was maintained by thinning. All recommended agronomic practices for the region were maintained for growing the crop. Observations were recorded on plant height (cm), number of branches plant^{-1}, number of pod plant^{-1}, 25 pod weight (g), number of seeds 15 pods^{-1}, 100 seed weight (g) and seed yield plant^{-1} (g) , The data were subjected to combining ability analysis following Griffing method 2 Model I (Griffing, 1956).

RESULTS AND DISCUSSION

Estimated mean square due to general(GCA) and specific combining ability (SCA) effects were significant for plant height, 25-pod weight, 100 seed weight and seed number pod^{-1} (Swarnakar *et al*., 2002) while only SCA effects were significant for the remaining characters like number of branches plant^{-1}, number of seeds per 15 pods and seed yield plant^{-1} (Table 1). The results, therefore, indicated that both additive and non-additive genetic variances were important in the inheritance of the afore-mentioned characters. The magnitude of additive variances was higher than those of dominance variances for all the characters except pod number plant^{-1} indicating the importance of additive gene action in the expression of the characters. Ram *et al*. (1976) reported the higher effect of non-additive gene action than additive for yield and most of its component characters. The estimation of GCA effects (Table 2) alone revealed that NDR 8501 possesses more potential as

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Table 1: ANOVA for general (GCA) and specific combining ability (SCA) for different characters.

Source of variation	d.f.	Plant height (cm)	No. of branch / plant	No. of pod / plant	25 pod weight (g)	100 seed weight (g)	No. seed / pod	Seed yield/ plant (g)
GCA	7	661.87 **	0.694	7183.08	0.27**	0.014 **	450.45 **	39.79
SCA	27	183.45 **	0.697 **	10891.03**	0.009 **	0.0018 **	416.92 **	33.18 **
Error	35	41.00	0.444	5991.87	0.003	0.001	127.46	20.49

Table 2: Estimates of GCA effects of parents for different characters.

Parents	Plant height (cm)	No. of branch / plant	No. of pod / plant	25 pod weight (g)	100 seed weight (g)	No. of pod	Seed yield/ plant (g)
Vardhan	- 4.70 *	0.32	4.57	- 0.02	0.00	- 1.02	- 1.49
NDR 8501	5.87**	- 0.08	- 26.54	0.09 **	0.05 **	2.62	3.39
MCN 20	-9.69 **	0.16	43.12	0.03	-0.04 **	7.07	-0.03
Rohini	15.67 **	0.37	-31.04	0.01	0.03 **	-7.93 *	-2.44
Rh 30	0.53	-0.26	-28.21	0.04 **	0.03 **	-6.28 *	-1.10
Varuna	-1.51	0.25	23.22	0.02	-0.02 **	12.12	1.93
Seeta	-7.63 **	-0.26	11.57	-0.09 **	-0.06 **	1.23	-1.39
Kranti	2.54	0.15	3.31	-0.01	0.01	-2.58	1.13
SEm (±)	**1.89**	**0.19**	**22.89**	**0.016**	**0.0996**	**3.33**	**1.13**

Table 3 : Significant SCA effects and their *per se* performance for different characters

Characters	F_1 s	SCA	*Per se* performance
Plant height (cm)	Vardhan X Seeta	21.56 **	209.30
	Rohini X Rh 30	15.93 **	232.16
	MCN 20 X Seeta	15.47 **	189.30
No. of branch/plant	Vardhan X Rohini	1.81 *	7.95
	MCN 20 X Varuna	1.64 *	6.80
	Rohini X Rh 30	1.31 *	7.15
No. of Pod /plant	Vardhan X Kranti	186.84 *	528.3
	Varuna X Kranti	175.70	535.8
	Vardhan X Seeta	141.08	495.8
25 pod weight (g)	Vardhan X Seeta	0.14 *	0.951
	NDR 8501 X MCN 20	0.13 *	0.995
	MCN 20 X Varuna	0.13 *	0.932
100 Seed weight (g)	NDR 8501 X MCN 20	0.08 **	0.508
	Vardhan X Rh 30	0.05 **	0.499
	Varuna X Seeta	0.04 **	0.388
No. of seed /15 pod	NDR 8501 X Seeta	25.87 **	222.50
	Rh 30 X Seeta	24.02 **	217.00
	Vaardhan X Varuna	20.87 **	210.00
Seed yield/plant (g)	Varuna X Kranti	10.67 **	26.55

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

good general combiner for seed yield plant^{-1} 25-pod weight, 100 seed weight and plant height. Rohini showed significant and positive gca effect for latter two characters but significantly negative GCA effect for seed number pod^{-1}. Rh 30 exhibited significantly positive GCAeffects for 25-pod weight, 100 seed weight and seed number pod^{-1}. Varuna was found to be good combiner for the latter character only. Interestingly, Seeta had significantly negative GCA effect for plant height, 25-pod weight and 100 seed weight.

However, on the basis of *per se* performance and general combining ability, NDR 8501 was identified as potential parent for plant height and seed yield plant^{-1} while Rohini for plant height and 100 seed weight. Results of SCA effects (Table 3) revealed that only one cross (Varuna × Kranti) produced positive and significant effect for seed yield. The same cross combination exhibited to be the best combination for pod number plant^{-1}. The crosses like Vardhan × Rohini; Vardhan × RH30 and NDR 8501 × Kranti showed highly significant sca effects in the negative direction for plant height. Therefore, these crosses have potential for producing dwarf plants in the segregating generations to be isolated on the basis of yield performance with special emphasis on the former cross (Vardhan × Rohini) which was found to be good specific combiner for seed number pod^{-1} also. Similarly, Vardhan × RH30 also was found as good specific combiner for 100 seed weight. The parent Vardhan is not a good general combiner but RH 30 had significant positive GCA effect for the same. Therefore, a 'j' type *i.e.* additive × dominance interaction might be expected to control the character. The cross Rohini × RH 30 exhibited significant positive SCA effect for branch number plant^{-1}, 25 pod weight and 100 seed weight. Both the parents appeared good general combiner for 100 seed weight. Therefore, 'i' type epistasis *i.e.* additive × additive type of interaction might be responsible toward controlling the character.

The above results indicate that in Indian mustard, both additive and non-additive gene actions were involved in controlling the seed yield and its related characters. Therefore, recurrent selection for population improvement will be helpful for accumulation of the favourable genes for improvement of Indian mustard.

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