Journal of Oilseed Brassica 1(2) : 75-78, July 2010

Diallel analysis for yield and yield contributing characters in Indian mustard (*Brassica juncea*)

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Abstract

Diallel analysis in mustard involving ten parents and forty five crosses was performed to estimate the general (gca) and specific combining ability (sca) of parents and crosses respectively. The gca and sca effects showed wide variation in the level of significance for various yield contributing characters. The parents Seeta, Varuna and Laxmi were identified as best general combiners for yield and yield contributing characters on the basis of high mean performance and significant gca effects. Among the crosses Varuna x Seeta was identified as best F_1 cross, which can be forwarded to the next generation by single seed descent method with an aim of getting useful segregants in the succeeding generation.

Key words: *Diallel, Combining ability, gca, sca*

Introduction

Indian mustard [*Brassica juncea* (L) Czern & Coss] is an important *rabi* (post-rainy) season oilseed crop in India and occupies a premier position due to its high oil content. It is a minor crop of Vidarbha region of Maharashtra, often grown as mixed crop and hence is one of the reasons for lower productivity. Hence there is a need of developing high yielding genotypes with early maturity and high oil content. The plant breeder uses many biometrical approaches like diallel, line x tester, top cross and poly cross to choose appropriate parents for hybridization programme. Of these, diallel analysis is one of the efficient, convenient and often used biometrical tool that provides information on the selection of parents from the study of F_1 itself.

Materials and methods

The experimental material consisted of ten diverse genotypes crossed in diallel fashion to secure forty five F_1s. These forty five crosses along with their respective parents were sown in Completely Randomized Block Design with three replications at the Shankar Nagar Farm of the Botany Section, College of Agriculture, Nagpur during *rabi* 2008-09. All the package of practices and plant protection measures were taken as per the recommended schedule (NRCRM,1999). Data recorded for days to 50% flowering, days to maturity, number of primary branches, plant height at maturity (cm), number of siliqua plant^{-1}, 1000 seed weight (g), seed yield plant^{-1} (g) and oil content. The data were subjected to Analysis of variance for the experimental design (Fisher, 1938), Analysis of combining ability (Griffings, 1956, Method 2 Model I)

Results and discussion

Analysis of variance for combining ability revealed that mean squares due to gca was of higher magnitude than those due to sca indicating larger diversity among the parents than the crosses for most of the characters (table 1). The mean sum of squares due to gca were significant for days to 50% flowering, number of siliqua plant^{-1} and seed yield plant^{-1}. The mean sum of squares due to specific combining ability was significant for days to 50% flowering, plant height, number of siliqua plant^{-1} and seed yield plant^{-1}. Singh *et al* (2003) also reported highly significant differences among the progenies for seed yield.

The predictability ratio ranged from 0.54 for days to maturity to 0.80 for days to 50% flowering. The ratio of predictability for number of siliqua plant^{-1} and seed yield plant^{-1} were 0.75 and 0.71, respectively. The value of predictability ratio worked

Table 1: Analysis of variance for combining ability

Source	Degree of freedom	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	No. of primary branches plant^{-1}	No. of siliqua plant^{-1}	1000 seed weight (g)	Yield plant^{-1} (g)
GCA	9	5.73**	1.70	85.33	0.17	853.72**	0.04	3.23**
SCA	45	2.86**	2.92	97.64*	0.27	696.43**	0.04	2.18**
Error	108	1.49	1.99	62.75	0.25	127.74	0.06	0.43
Predictability Ratio		0.80	0.54	0.64	0.56	0.71	0.67	0.75

*significant at 5% level; **significant at 1% level

out for these two characters revealed that gca effects of parents involved in the crosses as well as sca effects of crosses should be considered while selecting the parents or crosses for their exploitation to recover transgressive segregates as the value of predictability ratio is greater than 0.50 but not closer to unity.

The estimates of gca effect among parents (table 2) showed that Seeta had highest significant gca effect for seed yield plant^{-1} and higher significant gca effect for the number of siliqua plant^{-1}. Laxmi exhibited highest significant gca effect for the number of siliqua plant^{-1} and positive non-significant gca effect for seed yield plant^{-1}. Varuna exhibited higher significant gca effect for seed yield plant^{-1} and non- significant gca effect for number of siliqua plant^{-1}. Hence, the genotypes Seeta, Varuna and Laxmi would be useful as desirable parents for enhancing yield potential through pooling of favourable genes for desirable yield components. Thakral *et al* (2000) also identified Varuna as a good general combiner.

Top ranking crosses involved high medium and low combiners as parents. Among the 45 crosses studied, eight crosses exhibited significant negative sca effects for number of siliqua plant^{-1} and seed yield plant^{-1}. The cross Varuna x PCR-7 exhibited high negative sca effects for seed yield plant^{-1}, number of siliqua plant^{-1} and plant height at maturity. This cross also had one parent exhibiting significantly high gca effect for seed yield plant^{-1} and number of siliqua plant^{-1} while the other parent exhibited positive non significant gca effect for seed yield plant^{-1} and negative non significant gca effect for number of siliqua plant^{-1}.

Table 2: General combining ability effects of parents

Parents	Days to 50% flowering	Number of siliqua plant^{-1}	Yield plant^{-1} (g)
Pusa bold	0.139	-1.233	0.031
Varuna	0.222	2.239	0.610**
Vardan	0.889**	0.017	-0.121
Seeta	0.500	9.906**	0.909**
Bio-902	0.528	-0.344	0.008
Laxmi	0.250	17.600**	0.202
PCR-7	-0.083	-3.622	0.170
Ashirvad	-1.556**	-8.122**	-0.591**
Kranti	-0.556	-10.622**	-0.762**
ACN-9	-0.333	-5.817	-0.455*
S.E (gi) ±	0.334	3.0952	0.180

*significant at 5% level; **significant at 1% level

Note: GCA effect of parents for days to maturity, plant height, no. of primary branches plant^{-1}, 1000 seed weight were not calculated as their respective mean squares were non-significant

In self-pollinated crops like mustard, the aim of a breeder is to produce homozygous lines, unless commercial exploitation of heterosis becomes feasible. Production of true breeding varieties thus requires identifying crosses with low sca effects and involving parents with high gca effects. Selection of crosses in this manner was also done by Maha (2008). Based on these criteria, promising crosses and their selected *per se* performance as given in table 3.

Table 3: Specific combining ability effects of some selected crosses for different characters

Cross	Days to 50% flowering	Plant height at maturity (cm)	No. of siliqua plant^{-1}	Yield plant^{-1} (g)
Pusa Bold x Bio 902	-1.758	-8.642	-27.950*	-1.502*
Pusa Bold x ACN-9	-0.230	-12.981	-22.811*	-1.959**
Varuna x Seeta	-2.813*	-8.848	-42.338**	-2.554**
Varuna x PCR-7	2.770*	-20.042**	-57.144**	-1.975**
Vardan x Bio-902	0.159	-16.465*	-26.866*	-1.835**
Laxmi x Kranti	-4.119**	-13.759	-55.838**	-1.622*
Ashirvad x Kranti	-1.313	-16.215*	-25.449*	-1.703**
Kranti x ACN-9	1.131	-2.465	-27.088*	-1.452*
S.E. (sij) ±	1.126	7.296	10.410	0.607

Out of the eight crosses which exhibited desirable sca effects, the crosses Varuna x ACN-9, Pusa bold x PCR-7, Bio-902 x Laxmi and Varuna x Seeta were identified as the better crosses for economically important characters. However, out of these crosses the cross Varuna x Seeta was found to be the best cross based on high mean performance, high significant gca effect of parents involved in the cross and negative sca effects (table 4) and hence can be forwarded to the next generation for producing genotype of inherent superiority by following a simple selection method.

Table 4: Selected crosses and their performance for important characters

Cross	Mean	GCA effects		SCA effects
		P_1	P_2	
		Number of siliqua plant^{-1}		
Varuna x Seeta	159	2.239	9.906**	-42.338**
		Seed yield plant^{-1} (g)		
Varuna x Seeta	8.12	0.610**	0.909**	-2.554**
		Number of siliqua plant^{-1}		
Varuna x PCR-7	121	2.239	-3.622	-57.144**
		Seed yield plant^{-1} (g)		
Varuna x PCR-7	5.86	0.610**	0.170	-1.975**

*significant at 5% level; **significant at 1% level

Varuna x Seeta cross exhibited highest significant negative sca effect for seed yield plant^{-1} and high significant sca effect for number of siliqua plant^{-1}. Parents involved in this cross also exhibited highest significant gca effect for seed yield plant^{-1} and number of siliqua plant^{-1}. Another cross Varuna x PCR-7 also exhibited negative significant sca effect for no. of siliqua plant^{-1} and seed yield plant^{-1} along with high mean performance. One of the parents involved in these cross exhibited positive significant gca effects for both number of siliqua plant^{-1} and seed plant^{-1} and negative significant sca effect for seed yield plant^{-1}, number of siliqua plant^{-1} and days to 50% flowering were exhibited by the cross Laxmi x Kranti. The same cross also had one parent with positive significant gca effect for number of siliqua plant^{-1} and positive non-significant gca effect for seed yield plant^{-1}, whereas the other parent exhibited negative significant gca effect for both number of siliqua plant^{-1} and seed yield plant^{-1}, Negative significant sca effects indicated the involvement of additive gene action for yield components which is a general situation observed in self-pollinated crops. Hence, improvement for seed yield can also be sought by using simple selection method or any other method which can capitalize additive gene action. Due to the presence of additive gene action in these crosses, the genotypes of inherent superiority can be produced by using biparental mating in selected progeny and using diallel selective mating, for further selection of segregating generations for improvement of yield and yield components (Singh *et al*, 2003).

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