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Genetic parameters and character association studies in Indian mustard

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Abstract

Genetic parameters and character association studies among the various traits of Indian mustard [*Brassica juncea* (L) Czern & Coss] was carried out. High GCV coupled with high heritability was observed for length of main shoot, seed yield and days to maturity. High magnitude of heritability and moderate genetic advance for days to 50 % flowering indicated that improvement in this trait could be done through selection feasible. Seed yield had significant positive association with days to 50 % flowering, days to maturity, plant height, length of main shoot, number of siliquae on main shoot and 1000-seed weight both at genotypic and phenotypic levels. Seed yield also exhibited positive and significant correlation with percent oil content only at genotypic level indicating that these are the major yield attributing traits.

Key words: *Brassica juncea, correlation, genetic variability, genetic gain and heritability*

Introduction

Indian mustard [*Brassica juncea* (L) Czern & Coss] is an important oilseed crop, accounting more than 70% of the total area under rapeseed and mustard. The breeding strategy to derive high yielding cultivar depends upon the nature and magnitude of variation for different yield components, the assessment of genetic parameters like phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h^2) and genetic advance (GA%) is a pre-requisite for making effective selection. Yield is a complex trait, polygenic in inheritance, more prone to environmental fluctuations than ancillary traits such as branches/plant, seeds/siliquae, main shoot length and 1000-seed weight. Thus, comprehensive selection based on seed yield vis-à-vis component traits is more effective. The correlations and path analysis based on correlations coefficients further unravels the contribution of different traits towards seed yield. However some information related to these aspects is available in this crop, but it is known that genetic variability and correlation coefficient vary from material to material. Hence, the present investigation is carried out to assess the nature and magnitude of genetic variability, their inter-relationships and contribution towards seed yield to generate high yielding recombinants for the development of high yielding cultivar(s) in Indian mustard adapted to this region for the benefit of farmers.

Materials and methods

Experimental material comprised of parents, F_1s, F_2s and F_3s generations derived from a 10 parent diallel mating design excluding reciprocals. Ten diverse parents viz., Varuna, Durgamani, RH-30, NDR-8501, RLM-198, Kranti, Pusa Bold, Pusa Basant, Sej-2 and RK-9807 were crossed in diallel design. Total 145 treatments (10 parents + 45F_1s + 45F_2s + 45F_3s) comprising parents and their combinations of three generations were grown in a complete randomized block design with three replications in single row of 5 meter length during *Rabi* 2008-09 at Oilseeds Research Farm of C.S.A. University of Agriculture and Technology, Kanpur

(U.P.).Intra and inter row spacing were kept at 15 and 45-cm. apart, respectively. Recommended agronomic practices were followed for raising a good crop. The observations on 10 quantitative characters were recorded in each plot from randomly selected 10 plants in parents and F_1 whereas 25 plants in F_2 and F_3 generations in each replication. Genetic parameters were estimated as per standard procedure. Correlation coefficient (Johnson *et al.*, 1955) and path coefficient analysis were analysied (Dewey and Lu, 1959).

Results and discussion

Analysis of variance revealed significant differences among the genotypes for all the characters, indicating presence of wide spectrum of variability (table 1). Estimates of genotypic coefficient of variation varied from percent oil content (3.2) to length of main shoot (13.5) and PCV estimates also showed similar trend for the respective traits. Maximum and minimum differences between GCV and PCV were observed for days to maturity and number of primary branches indicating the influence of environment for these traits, respectively. GCV along with heritability estimate gave the precise picture of genetic gain to be exploited through selection as suggested by Burton (1952). High values of GCV coupled with heritability were observed for length of main shoot, seed yield and days to maturity suggesting that additive gene action might play major role in the expression of these characters and selection would be rewarding in further improvement of these characters. High value of heritability and moderate genetic advance for days to 50% flowering indicated that improvement in this trait could be done through selection to some extent. In rest of the characters improvement is not possible through selection might be due to non-additive gene action which matched with the findings of Prasad *et al*. (2001), Swarnkar *et al.* (2002) and Singh *et al.* (2002).

Table 1: Estimate of mean, range, phenotypic and genotypic coefficient of variation, heritability and genetic advance for ten characters in Indian mustard

Characters	Mean	Range	PCV	GCV	Herita-bility	Genetic advance	% Genetic advance
Days to 50% flowering	75.7	61.7 - 87.0	8.1	7.2	77.6	9.8	13.1
Days to maturity	139.1	121.0 - 169.7	9.4	9.2	95.8	25.9	18.6
Plant height	152.6	126.8 - 167.4	4.6	3.7	65.3	9.5	6.2
No. of primary branches	7.6	6.3 - 10.1	11.3	6.4	32.1	0.6	7.5
No. of secondary branches	18.7	13.5 - 26.3	15.5	10.4	44.9	2.7	14.3
Length of main shoot	44.6	16.9 - 62.9	16.4	13.5	67.3	10.1	22.7
No. of siliquae on main shoot	42.5	22.4 - 54.4	13.5	9.5	49.7	5.9	13.8
Seed yield per plant	25.1	17.1 - 35.7	14.3	10.6	54.8	4.1	16.1
1000-seed weight	4.3	2.4 - 5.7	15.9	8.8	30.6	0.4	10.1
Percent oil content	39.2	35.5 - 42.6	4.2	3.2	58.3	1.9	5.1

Correlation coefficient analysis (table 2) revealed that seed yield had significant positive association with days to 50% flowering, days to maturity, plant height, length of main shoot, number of siliquae on main shoot and 1000-seed weight at genotypic and phenotypic levels. Seed yield also exhibited positive and significant correlation with oil content only at genotypic level and at phenotypic level. Seed yield per plant had positively and significant correlation for days to 50% flowering, days to maturity, plant height, length of main shoot and number of siliquae on main shoot indicating that these are the major yield attributing traits. Selection would be helpful in simultaneous improvement in these traits for yield

Table 2: Phenotypic and genotypic correlation coefficient for ten characters in Indian mustard

Characters		Days to 50% flowering	Days to maturity	Plant height branches	No. of primary branches	No. of secondary shoot	Length of main	No. of siliquae on main per shoot	Seed yield	1000-seed plant	Oil content weight
Days to	P	0.136	0.295**	-0.014	-0.037	0.151	0.212**	0.166*	0.076	0.085	
50% flowering	G	0.150	0.407**	-0.047	-0.024	0.227**	0.359**	0.289**	0.129	0.143	
Days to		P	0.207**	0.065	0.198**	0.599**	0.461**	0.259**	0.321**	0.234**	
maturity		G	0.259**	0.131	0.300**	0.742**	0.664**	0.364**	0.586**	0.312**	
Plant			P	-0.040	-0.051	0.164**	0.240**	0.164*	0.019	0.146	
height			G	-0.069	-0.098	0.291**	0.386**	0.301**	0.060	0.269**	
No. of Primary				P	0.112	0.040	0.017	-0.025	0.133	0.142	
branches				G	0.373**	0.151	0.101	0.048	0.440**	0.319	
No. of secondary					P	0.065	0.053	0.042	0.177**	0.106	
crunches					G	0.163**	0.082	0.079	0.161*	0.123	
Length of						P	0.501**	0.226**	0.222**	0.127	
main shoot						G	0.788**	0.336**	0.407**	0.238**	
No. of siliquae							P	0.194**	0.244**	0.159	
on main shoot							G	0.428**	0.420**	0.183**	
Seed yield								P	0.104	0.083	
per plant								G	0.325**	0.167*	
1000-seed									P	0.120	
weight									G	0.102	
Oil										P	
content										G	

*, ** Significant 5 and 1 per cent levels, respectively

Table 3: Path coefficient analysis for ten characters towards seed yield in Indian mustard

Characters	Direction	Days to 50% flowering	Days to maturity	Plant height	No. of primary branches	No. of secondary branches	Length of main shoot	No. of siliquae on main shoot	1000-seed weight	Oil content	Seed yield as correlated
Days to	P	0.100	0.021	0.023	0.001	0.000	0.013	0.007	0.002	0.001	0.166*
50% flowering	G	0.102	-0.001	0.054	0.006	-0.002	-0.011	0.097	0.032	0.012	0.289**
Days to	P	0.014	0.155	0.016	-0.003	0.002	0.050	0.016	0.007	0.003	0.259**
maturity	G	0.015	-0.004	0.034	-0.016	0.023	-0.037	0.179	0.143	0.026	0.364**
Plant height	P	0.029	0.032	0.077	0.002	-0.001	0.014	0.008	0.000	0.002	0.164*
	G	0.041	-0.001	0.133	0.008	-0.008	-0.015	0.104	0.015	0.023	0.301**
No. of primary	P	-0.001	0.010	-0.003	-0.041	0.001	0.003	0.001	0.003	0.002	-0.025
branches	G	-0.005	-0.001	-0.009	-0.120	0.029	-0.008	0.027	0.108	0.027	0.048
No. of secondary	P	-0.004	0.031	-0.004	-0.005	0.011	0.005	0.002	0.004	0.001	0.042
branches	G	-0.002	-0.001	-0.013	-0.045	0.077	-0.008	0.022	0.039	0.010	0.079
Length of	P	0.015	0.093	0.013	-0.002	0.001	0.083	0.017	0.005	0.002	0.226**
main shoot	G	0.023	-0.003	0.039	-0.018	0.013	-0.050	0.213	0.100	0.020	0.336**
No. of siliquae	P	0.021	0.071	0.018	-0.001	0.001	0.042	0.034	0.005	0.002	0.194**
on main shoot	G	0.037	-0.003	0.051	-0.012	0.006	-0.040	0.270	0.103	0.015	0.428**
1000-seed weight	P	0.008	0.050	-0.001	-0.005	0.002	0.019	0.008	0.020	0.002	0.104
	G	0.013	-0.003	0.008	-0.053	0.012	-0.020	0.114	0.245	0.009	0.325**
Oil content	P	0.009	0.036	0.011	-0.006	0.001	0.011	0.005	0.002	0.013	0.083
	G	0.015	-0.001	0.036	-0.038	0.009	-0.012	0.050	0.025	0.084	0.107**

Residual P = 0.9006, G = 0.7394, *, ** Significant 5 and 1 per cent levels, respectively

improvement of Indian mustard. Rest of the characters with non significant correlation could be improved independently with out affecting others. It is clear from the association that when maturity duration increases number of primary branches, plant height and length of main shoot would also increase possessing higher number of siliquae with bolder and more seeds/plant resulting in higher yield.

Path coefficient analysis (table 3) revealed that number of siliquae on main shoot had maximum direct effect on seed yield at genotypic level. This is also supported by the fact that indirect effects of days to 50% flowering, days to maturity, plant height, number of siliquae on main shoot, length of main shoot, 1000-seed weight and percent oil content, these character were found highly significant at genotypic level. Character, 1000-seed weight was second best in its direct effect due to indirect effects of number of siliquae on main shoot, number of secondary branches, plant height and oil content. Characters, days to maturity, number of primary branches and length of main shoot had negative direct effects on seed yield. Considering the results of path analysis it can be inferred that 1000-seed weight, number of siliquae on main shoot, plant height, number of secondary branches and oil content directly increase the seed yield of Indian mustard. At phenotypic level seed yield / plant had found positive and highly significant correlation for days to 50% flowering, days to maturity, plant height, length of main shoot, number of siliquae on main shoot. Similar findings were reported earlier by Singh *et al.* (2003a), Singh *et al.* (2003b) and Singh *et al.* (2009).

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