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Research Note

Assessment of genetic variability of rapeseed-mustard germplasm under Terairegion of West Bengal

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Abstract
An experiment was conducted at Uttar BangaKrishiViswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2010-11 by using 50 genotypes of rapeseed-mustard germplasm to study the variability in seed yield and its attributing traits. Significant variation among all the genotypes was recorded for all the characters. Most of the characters had higher genotypic and phenotypic coefficient of variation which indicated that the expression of the characters in this germplasm had a genetic basis and can be exploited in breeding programs. The genotypes also exhibited varying degree of heritability and genetic advance. Characters such as days to 50% flowering, siliqua per plant and seed yield per plant had high broad sense heritability and high genetic advance. Seed yield per plant were significantly associated with days to 50% flowering and seeds per siliqua. Seeds per siliqua had significant positive correlation with height up to first fruiting branch and days to 50% flowering. The path coefficient analysis indicated high direct effect of siliqua per plant, seeds per siliqua and 100 seed weight on seed yield per plant.

Keywords
Rapeseed, mustard, genetic variability, correlation, heritability

India is one of the largest rapeseed-mustard growing countries in the world, occupying the first position in Area and second position in Production after China. The world production of rapeseed-mustard has been increasing at a rapid rate in several countries largely in response to the continuing increase in demand for edible oils and its products. *Brassica* (rapeseed-mustard) is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country. When compared to other edible oils, the rapeseed-mustard oil has the lowest amount of harmful saturated fatty acids. It also contains adequate amounts of the two essential fatty acids, *viz.*, linoleic and linolenic, which are not present in many of the other edible oils.

The study of relationship among quantitative traits is important for assessing the feasibility of joint selection of two or more traits and hence for evaluating the effect of selection for secondary traits on genetic gain for the primary trait under consideration. The correlation analysis measures the existence of relationship between various plant characters and determines the component on which selection can be based for improvement in seed yield. The most important components are: the number of branches, siliquaper plant and 100-seed weight. Kumar*et al*. (1984) suggested that selection of component characters rather than yield itself can help substantially to increase seed yield in *brassicas*.

A study was undertaken at the Instructional Farm of Uttar BangaKrishiViswavidyalaya, Pundibari, Cooch Behar, West Bengal during *Rabi* 2010-11. The experimental material in the present study consisted of 50 genotypes of rapeseed–mustard which were sown in RBD with three replications having inter-row spacing of 30 cm and intra row spacing of 10 cm between plant to plant. Detailed observations were recorded for eleven biometrical characters, *viz*. plant height (cm), height upto first fruiting branch (cm), days to 50% flowering, days to physiological maturity, primary branches per plant, secondary branches per plant, siliqua per plant, seeds per siliqua, total chlorophyll content (SPAD), 100 seed weight (g) and seed yield per plant (g). The data were statistically analyzed for each character by analysis of variance from which different variance components were estimated. Heritability estimates (broad sense) were computed as suggested by Hanson *et al.* (1956) and expected genetic advance as percentage of mean was estimated by the method suggested by Johnson *et al*. (1955). The coefficient of genetic variation was estimated by the method described by Burton (1952), while path analysis was carried out using the genotypic correlation coefficients to know the direct and indirect effects of the components on yield as suggested by Wright (1921) and illustrated by Dewey and Lu (1959).

The analysis of variance showed significant differences among the genotypes for all the eleven traits. The high estimates (>15%) GCV recorded for height up to first fruiting branch, days to 50%

flowering, primary branches per plant, secondary branches per plant, siliqua per plant, seeds per siliqua and seed yield per plant, indicated the presence of adequate genetic variation among the genotypes and suitability of their attributes for further improvement by selection, which is in confirmation with the findings of Rai*et al*., (2005). The heritability estimates were high for all the traits except height up to first fruiting branch, secondary branches per plant and total chlorophyll content (Table 1). As days to 50% flowering, siliqua per plant and seed yield per plant showed high heritability coupled with high genetic advance, which indicated that these traits are under the control of additive gene action and phenotypic selection for their improvement will be effective which corroborates with the findings of Mahala*et al*. (2003).

The association of the character and the magnitude of their relationship with other characters at both genotypic and phenotypic levels (Table 2), revealed that seed yield per plant is significantly associated with days to 50% flowering and seeds per siliqua at both phenotypic and genotypic levels (Kardam and Singh, 2005 and Belete, 2011) and height up to first fruiting branch at phenotypic level only. Seeds per siliqua had significant positive correlation with height up to first fruiting branch and days to 50% flowering at both genotypic and phenotypic levels and with primary branches per plant and secondary branches per plant at phenotypic level. Plant height was negatively associated with seed yield per plant at phenotypic level but showed positive significant correlation with siliqua/plant at genotypic level and total chlorophyll content at phenotypic level. Thus, it may be inferred that the selection based on these traits either in combination or alone would be beneficial to identify the genotype having better yield potential.

Path analysis carried out to estimate the direct and indirect contribution of various component traits for recommending a reliable selection criterion, revealed that siliqua per plant (2.841) followed by seeds per siliqua (1.425) and 100 seed weight (1.009) had high direct effect on seed yield per plant (Table 3) and similar result was also reported by Tusar*et al*. (2006). Patel *et al*. (2000) reported that siliqua per plant had highest direct effect on seed yield. Siliqua per plant also showed indirect contribution *via* secondary branches per plant (1.953), plant height (1.014) and primary branches per plant (0.558) and seeds per siliqua showed indirect contribution *via* all the characters except plant height, height up to first fruiting branch, siliqua per plant, seeds per siliqua and 100 seed weight was the major contributor towards seed yield/plant.

It is concluded that during selection due weightage should be paid to siliqua per plant, seeds per siliqua, 100 seed weight, days to 50% flowering, primary branches per plant, secondary branches per plant and height up to first fruiting branch for the development of high yielding cultivars of rapeseed-mustard.

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Table 1. Genetic variability parameters for seed yield and its component traits in 50 genotypes of rapeseed-mustard

Characters	Mean	Range	Mean Square	CD (P=0.05)	PCV	GCV	Heritability	GA as percentage of Mean
Plant height (cm)	115.80	94.80 - 167.00	554.35**	19.23	14.41	10.14	0.49	14.69
Height up to first fruiting branch (cm)	29.00	13.67 - 49.53	229.67*	18.84	44.52	19.35	0.19	17.33
Days to 50% flowering	47.79	39.00 - 90.33	182.13**	3.77	16.78	16.06	0.92	31.67
Days to physiological maturity	105.55	93.00 - 128.33	362.10**	8.75	11.22	9.98	0.79	18.30
Primary branches/plant	4.95	3.40 - 7.67	2.97**	1.48	25.10	17.07	0.46	23.92
Secondary branches/plant	4.93	1.20 -11.33	16.04*	5.29	71.48	27.19	0.14	21.30
Siliqua/plant	128.36	39.60 - 170.40	4052.23*	55.50	35.98	24.13	0.45	33.35
Seeds/siliqua	15.29	11.13 - 25.60	18.76**	4.32	21.69	12.89	0.35	15.78
Total Chlorophyll content (SPAD)	38.84	31.10 - 46.37	32.07*	7.48	12.85	4.88	0.14	3.81
100 seed weight (g)	0.30	0.23 - 0.41	0.01**	0.06	16.56	12.17	0.54	18.43
Seed yield/plant (g)	10.54	4.71 - 16.95	26.59**	3.41	32.62	25.80	0.63	42.05

*Significant at 5% probability level, ** Significant at 1% probability level

Table 2. Genotypic (G) and phenotypic (P) correlations between yield and its attributing traits in 50 genotypes of rapeseed-mustard

Characters		Height upto first fruiting branch (cm)	Days to 50% flowering	Days to physiological maturity	Primary branches/plant	Secondary branches/plant	Siliqua/ plant	Seeds/ siliqua	Total Chlorophyll content (SPAD)	100 seed weight (g)	Seed yield/plant (g)
Plant height (cm)	G	0.153	-0.027	-0.117	-0.624**	-0.617**	0.357**	-0.447**	0.021	-0.052	-0.231
	P	0.492**	0.072	0.062	-0.002	-0.664**	-0.051	-0.240*	0.559**	-0.006	-0.431**
Height upto first fruiting branch (cm)	G		-0.024	0.481**	-0.058	0.226	-0.116	0.449**	0.590**	0.319*	0.156
	P		0.061	-0.076	0.172	0.209	-0.117	0.452**	0.633**	0.414**	0.293*
Days to 50% flowering	G			-0.034	-0.362**	0.979**	0.196	0.475**	-0.584**	0.218	0.393**
	P			0.408**	-0.623**	-0.211	0.688**	0.609**	0.125	0.158	0.530**
Days to physiological maturity	G				-0.052	-0.479**	0.178	-0.376**	-0.232*	-0.385**	0.224
	P				0.085	0.032	-0.079	-0.247*	-0.038	0.526**	0.119
Primary branches/plant	G					0.067	-0.089	-0.207	-0.042	0.176	-0.367**
	P					0.533**	-0.057	0.264*	0.011	-0.051	0.014
Secondary branches/plant	G						0.230	0.230	0.220	-0.077	-0.069
	P						0.226	0.312*	0.208	0.235*	-0.189
Siliqua/plant	G							0.147	-0.093	0.292*	0.121
	P							-0.124	-0.070	0.076	0.219
Seeds/siliqua	G								0.012	0.105	0.312*
	P								0.155	-0.179	0.268*
Total Chlorophyll content (SPAD)	G									0.201	0.140
	P									0.016	0.091
100 seed weight (g)	G										0.016
	P										0.062

*Significant at 5% probability level, ** Significant at 1% probability level, G=Genotypic level, P=Phenotypic level

Table 3. Direct (diagonal) and indirect (off-diagonal) effects of yield components on seed yield in 50 genotypes of rapeseed-mustard

Characters	Plant height (cm)	Height upto first fruiting branch (cm)	Days to 50% flowering	Days to physiological maturity	Primary branches /plant	Secondary branches/ plant	Siliqua/ plant	Seeds/ siliqua	Total Chlorophyll content (SPAD)	100 seed weight (g)	Correlation coefficient with seed yield/Plant (g)
Plant height (cm)	-1.477	-1.703	0.000	-0.113	2.046	0.719	1.014	-0.637	-0.028	-0.053	-0.231
Height upto first fruiting branch (cm)	-1.703	-1.476	-0.001	-0.060	3.287	0.773	-0.146	-0.342	-0.756	-0.006	0.156
Days to 50% flowering	0.040	-0.107	-0.007	0.464	0.192	-0.263	-0.328	0.640	-0.798	0.322	0.393**
Days to physiological maturity	0.173	0.092	0.965	-0.565	-0.003	-0.243	-0.331	0.644	-0.856	0.418	0.224
Primary branches/plant	0.921	1.479	0.000	0.166	-3.280	-1.139	0.558	0.678	0.790	0.219	-0.367**
Secondary branches/plant	0.912	0.980	-0.002	0.202	-3.211	-1.164	1.953	0.868	-0.168	0.159	-0.069
Siliqua/plant	-0.527	0.009	0.001	-0.113	-0.644	-0.800	2.841	-0.535	0.314	-0.388	0.121
Seeds/siliqua	0.660	0.355	-0.003	0.437	-1.559	-0.709	-1.067	1.425	0.051	0.530	0.312*
Total Chlorophyll content (SPAD)	0.077	-0.825	-0.004	0.611	1.916	-0.145	-0.660	-0.054	-1.352	0.177	0.14
100 seed weight (g)	-0.030	0.076	-0.002	0.400	-0.714	-0.184	-1.093	0.749	-0.238	1.009	0.016

*Significant at 5% probability level, ** Significant at 1% probability level, G=Genotypic level, P=Phenotypic level