Himachal Journal of Agricultural Research Vol. 32(1) : 31-36, 2006

Genetic variation and character association of seed yield, its components and economic characters in some cultivars of Indian mustard (*Brassica juncea L.*)

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Abstract

Estimates of variability, heritability, genetic advance, correlation and path coefficient analysis for seed yield, its components and some economic traits were worked out in Indian mustard (*Brassica Juncea* L). Heritability and genetic advance were high for plant height, days to maturity, number of siliqua per plant and seed yield per plant indicating scope of selection for these characters. High heritability along with low genetic advance was exhibited for number of primary branches, number of secondary branches, 1000-seed weight, oil content, protein content and number of seeds per siliqua indicating limited scope of selection of these traits. Number of siliqua per plant was positively associated with seed yield per plant and 1000-seed weight. Path coefficient analysis at genotypic as well as phenotypic levels showed that number of siliqua per plant, plant height, oil content and protein content made maximum direct contribution towards seed yield. The highest positive direct effect on grain yield was exhibited by number of siliqua per plant (0.77%) and lowest by number of primary branches (-0.05%).

Introduction

Rapeseed and mustard are important oleiferous seed crops and constitute major source of edible oil for the human consumption and cake for animals. They contribute around 13.9% of the world vegetable oil production and supply more than 12.5% of the edible oil in the world. India has largest area under rapeseed and mustard but production wise, it has second place after China. In India, Rajasthan ranks first in terms of area and production with an average productivity level of around 986kg/ha. Indian mustard (*Brassica juncea* L.) occupied a quite large acreage of total rapeseed and mustard growing area of northern India. It has almost replaced yellow sarson on account of its greater resistance to aphids. The success of breeding programme depends upon the genetic variability, heritability, genetic advance, correlation and path analysis. The observed phenotypic variation is the result of interaction of genotype and environment in which individual grows. However, it is the only genetic variation which is heritable and hence important in any selection programme. Character association study is vital with the view that it serves the purpose of understanding the yield and the relationship of its contributing traits. Further, this type of study remains worthile since they also provide the means of finding out the component of traits of economic product and provide a vital help to the breeder in various breeding programmes.

Material and Methods

Fifteen genotypes of Indian mustard including Pusa bold as a check were grown in a Randomized Block Design with three replications at the Experimental Farm of Department of Plant Breeding and Genetics, Raja Balwant Singh College of Agriculture Bichpuri, Agra during Rabi 1999-2000. The distance between row to row and plant to plant were 45cm and 25cm, respectively. Data were recorded on five randomly selected plants from each plot for the characters like plant height, number of primary branches, number of secondary branches, days to maturity, siliqua per plant, yield per plant, 1000- seed weight, oil content percent and protein content percent. Phenotypic coefficient of variation, genotypic coefficient of variation and heritability were calculated following the formula of Burton (1952). Genetic advance was estimated as per Allard (1960). The phenotypic and genotypic coefficients of correlation were estimated as per method, suggested

by Al-JibUri *et al.* (1958). The path analysis was carried out as per procedure prescribed by Dewey and Lu (1959).

Results and Discussion

The analysis of variance (Table1) exhibited the highly significant variability for all the characters. The phenotypic coefficient of variation in general was higher than genotypic coefficient of variation (Table2) for all the characters indicating the extent of environmental influence on the manifestation of these characters. The high magnitude of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded for seed yield per plant (43.73%, 42.56%), number per siliqua per plant (30.17%, 29.17%), number of secondary branches per plant (25.01%, 25.99%), number of primary branches (22.73%, 22.42%) and 1000-seed weight (20.81% only PCV) suggesting large variability and thus scope of genetic improvement through selection for these traits. The level of genotypic and phenotypic variation for plant height was moderate (10.26%, 10.31%), whereas variability for days to maturity (6.63%, 6.71%), number of seeds per siliqua (8.84%, 9.98%), oil content (2.38%, 2.50%) and protein content (3.39%, 3.50%) were low (Table 2). Similar results were also reported by Kumar *et al.* (1985) and Lekh-Raj *et al.* (1998). The heritability estimates were high for all the characters. The heritability estimates ranged from 78.40 % for number of seeds per siliqua to 99.10% for plant height. The genetic advance varied from 1.45% for protein content to plant height (37.83%). High heritability associated with high genetic advance for plant height (99.10%, 37.83%), yield per plant (94.70%, 37.71%) and number of siliqua per plant (93.50%, 37.59%) suggested the importance of additive genetic variance. The high heritability along with moderate genetic advance for days to maturity (97.50%, 19.62%) indicated the existence of non-additive genetic variance. Low phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) for days to maturity (6.71%, 6.63%), number of seeds per siliqua (9.98%, 8.84%), oil content (2.50%, 2.38%) and protein content (3.50%, 3.39%) would restrict the success of selection. Genotypic correlations in general were higher in magnitude as compared to respective phenotypic levels for all the traits under study. It suggested that a strong inherent

Table 1. Mean squares for various characters in Indian mustard (*Brassica juncea* L.)

Character	Mean sum of square due to		
Source	Replication	Treatment	Error
df	2	14	28
Number of primary branches	0.16**	3.03**	0.02
Number of secondary branches	0.44	49.90**	1.29
Days to maturity	3.78	281.45**	2.39
Plant height (cm)	3.00	1024.02**	3.10
Number of siliqua / plant	1866.00	110264.90**	2488.54
Number of seeds / siliqua	0.73	4.21**	0.35
Yield / plant	25.89	1081.06**	19.47
1000-seed weight	0.007	3.33**	0.14
Oil content (%)	0.015	3.00**	0.10
Protein content (%)	0.03	1.63**	0.03

**Significant at 1% level of significance

Table 2. Estimate of genotypic coefficient of variation, phenotypic coefficient of variation, heritability (bs) and genetic advance (%) for different characters in Indian mustard (*Brassica juncea* L.)

Characters	Range	GM	GCV %	PCV %	h^2 (bs)	GA % of mean	CV %	SE ±
Plant height	149.07-10.17	179.80	10.26	10.31	99.10	37.83	0.97	1.43
Days to maturity	132.33-63.00	145.58	6.63	6.71	97.50	19.62	1.06	1.26
Number of primary branches	2.6-6.60	4.46	22.42	22.73	97.30	2.03	3.72	0.13
Number of secondary branches	9.20-22.87	16.09	25.01	25.99	92.06	7.98	7.06	0.92
Number of siliqua per plant	386.93-69.64	649.69	29.17	30.17	93.50	37.59	7.67	40.73
Number of seeds per siliqua	10.99-14.20	12.83	8.84	9.98	78.40	2.07	4.63	0.48
Yield per plant	17.84-97.76	44.19	42.56	43.73	94.70	37.71	10.06	3.63
1000-seed weight	3.30-7.03	5.27	19.54	20.81	88.20	1.99	7.14	0.30
Oil content (%)	40.12-43.47	41.38	2.38	2.50	90.30	1.93	0.77	0.26
Protein content (%)	20.33-22.70	21.50	3.39	3.50	93.6	1.45	0.88	0.15

GCV= Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, h^2 (bs) = Heritability in broad sense, GA=Genetic Advance, CV= Coefficient of variation SE= Standard error and GM= General mean

association exists for these traits and phenotypic selection may be rewarding. Similar results were also reported by Sheikh *et al.* (1999).

Correlation coefficient revealed that the traits like number of siliqua per plant (r=0.81*) and 1000-seed weight (r=0.74*) showed positive association with seed yield (Table3). It means a slight increase in any one of the above traits may directly contribute towards seed yield. Similar results were also reported by Rakesh *et al.* (1999) and Kumar *et al.* (1999). Yield per plant was positively correlated with siliqua per plant and 1000-seed weight. Path analysis revealed that direct contribution of siliqua per plant was maximum (0.77%) on seed yield followed by number of seeds per siliqua, 1000-seed weight, plant height, oil content and protein content. It would suggest that the need to consider siliqua per plant, number of seeds per siliqua and 1000-seed weight as selection criteria for improvement of seed yield. Number of primary branches, number of secondary branches and days to maturity had no significant association with seed yield but had negative direct effect on seed yield (Table 4).

Table 3. Correlation coefficients for seed yield, its components and some quality traits in Indian mustard (*Brassica juncea* L.)

Characters	Number of secondary branches	Days to maturity	Plant height	Number of siliqua per plant	Number of seeds per siliqua	Seed yield per plant	1000-Seed weight	Oil Content %	Protein Content %
Number of primary branches	P 0.51*	-0.22	0.17	0.04	-0.40	0.01	0.17	0.64*	0.50
Number of secondary branches	-	0.36	0.20	0.00	-0.09	-0.14	-0.08	0.18	-0.38
Days to maturity	-	-	0.45	0.12	-0.002	0.004	-0.21	-0.20	0.06
Plant height	-	-	-	0.04	-0.06	0.17	0.22	-0.10	0.21
Number of siliqua per plant	-	-	-	-	-0.26	0.81*	0.44	0.12	-0.43
Number of seeds per siliqua	-	-	-	-	-	0.08	-0.12	-0.42	0.47
Seed yield per plant	-	-	-	-	-	-	0.74*	0.12	-0.14
1000-Seed weight								0.27	0.09
Oil content									0.48*
Protein content									-

*Significant at 5% level of significance

Table 4. Estimates of direct and indirect effects of seed yield, its components and some quality traits in Indian mustard *(Brassica juncea* L.*)*

Characters	Number of primary branches	Number of secondary branches	Days to maturity	Plant height	Number of siliqua per plant	Number of seeds per siliqua	1000-Seed weight	Oil content	Protein content	Correlation coefficient
Number of primary branches	**-0.05P**	-0.03	0.03	0.03	0.03	-0.12	0.06	0.08	-0.01	0.01
Number of secondary branches	-0.03	**-0.06**	-0.00	0.03	0.00	-0.03	-0.03	0.02	-0.00	-0.14
Days to maturity	0.01	-0.02	**-0.21** **-0.31**	0.11 0.07	0.18 0.17	-0.001 -0.001	-0.05 -0.07	-0.05 0.03	0.002 -0.0	0.004
Plant height	-0.009	-0.01	-0.06	**0.16**	0.04	-0.02	0.08	-0.01	0.005	0.17
Number of siliqua per plant	-0.002	0.00	-0.05	0.01 0.007	**0.85** **0.77**	-0.13 -0.09	0.12 0.16	0.03 0.02	-0.01 -0.01	0.81*
Number of seeds per siliqua	0.02	0.005	0.00	0.009	-0.20	**0.36**	-0.04	-0.05	0.01	0.08
1000 -seed weight	-0.009	0.005	0.03	0.04	0.34	-0.04	**0.36**	0.04	0.002	0.74*
Oil content	-0.03	-0.01	0.03	-0.02	0.09	-0.15	0.10	**0.13**	-0.01	0.12

Residual (G) = 0.01 and P=0.03

Plant height, number of seeds per siliqua, oil content and protein content had no significant association with seed yield but had positive direct effect on seed yield. 1000-seed weight recorded maximum positive indirect effect on seed yield followed by days to maturity and number of siliqua per plant. The residual effect in the present study was (0.03%).The low residual effect in the present study indicated that the characters chosen for path analysis were adequate and appropriate. The direct and indirect effects among the component viz., number of siliqua per plant and 1000-seed weight was maximum and positive. Thus, the improvement of any of these traits would simultaneously improve seed yield because of correlated response of seed yield by applying strong selection on these traits. Thus, the present study indicated that selection based on number of siliqua per plant and 1000-seed weight would result in improvement of seed yield.

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