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GENETIC VARIABILITY AND CORRELATION STUDIES IN *BRASSICA JUNCEA*

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Abstract

Sixteen strains were selected from a diverse mustard germplasm and the studies were carried out for the estimation of variability, heritability, genetic advance and correlations in 6 quantitative characters. The strains differed significantly for all the characters. High genotypic and phenotypic variances were recorded for pods per plant and plant height. Maximum genotypic and phenotypic coefficient of variability was found for 1000 seed weight. The heritability estimates ranged from 0.51 – 0.95 and was highest in 1000 seed weight. High heritability combined with high genetic advance for 1000 seed weight and pods per plant indicated additive gene effect for these traits which offers scope for their improvement through mass selection. Significantly positive correlations of seed yield with plant height, number of branches per plant and pods per plant, and pods per plant with number of branches per plant have been found.

Introduction

Among the oilseed crops grown in Pakistan, mustard *(Brassica juncea)* has special importance due to wider adaptability and higher yield potential. There is a greater scope to achieve yield potential through selection and breeding of local varieties and collections having wide range of variability. Olsson (1960), Banerjee *et. al.*, (1968), Gupta (1972), Yadava (1973), Singh & Singh (1974), Katiyar Singh (1974), Paul *et. al.*, (1976) and Labana *et. al.*, (1980) studied genetic variation and interrelationship among different quantitative characteristics in rape and mustard and found that number of branches per plant, pods per plant and number of seeds per pod were the good selection criteria for isolating the high yielding strains. The present studies were carried out to seek information on heritable variation and association of characters with yield in local collections and breeding material for effective selection and use in mustard breeding programme.

Materials and Methods

Sixteen local collections selected from germplasm of mustard including a commercial variety Raya L-18 were planted in a randomized complete block design with four replications during 1979-80 at the National Agricultural Research Centre, Islamabad. The plot size was 5 x 2.4 m in 4 rows with row and plant spacing of 60 and 20 cm respectively. Data were recorded on five randomly selected plants from each strain in each replication. Observations were made on seed yield per plant, plant height, pods per plant, branches per plant, seeds per pod and 1000 seed weight.

The mean values were used for statistical analysis. Genetic parameters like genotypic and phenotypic variance, their coefficient of variability, heritability (broad sense) and expected genetic advance for the said characters were computed according to the following formulas given by Burton & Devane (1953).

i) Genotypic variance $\sigma^2 g = \frac{VMS - EMS}{R}$

Where

VMS = Varieties mean square.
EMS = Error mean square.
R = Number of Replications.

ii) Phenotypic Variance $\sigma^2 p = \sigma^2 g + \sigma^2 e$

Where

$\sigma^2 g$ = Genotypic Variance
$\sigma^2 e$ = Environmental Variance

iii) Genotypic Coefficient of Variability (G.C.V.)

$$GCV = \frac{\sqrt{\sigma^2 g}}{\bar{X}} \times 100$$

Where

$\sigma^2 g$ = Genotypic variance
$\bar{X}$ = Grand mean

iv) Phenotypic Coefficient of Variability (PCV)

$$PCV = \frac{\sqrt{\sigma^2 p}}{\bar{X}} \times 100$$

Where

$\sigma^2 p$ = Phenotypic Variance
$\bar{X}$ = Grand mean

v) Heritability (h^2)

$$h^2 = \frac{\sigma^2 g}{\sigma^2 p}$$

Where

$\sigma^2 g$ = Genotypic Variance
$\sigma^2 p$ = Phenotypic Variance

vi) Genetic Advance ($\triangle G$)

$$\triangle G = K h^2 \times \sigma p$$

Where

K = Selection differential at 5% selection intensity, the value is equal to 2.06.

h^2 = Heritability

σp = Phenotypic standard deviation

Genotypic and Phenotypic Correlations were calculated according to the formula of Singh & Chaudhry (1979).

i) Genotypic Correlation

$$= \frac{\text{G. Cov. (XY)}}{\sqrt{\text{GV (X) GV (Y)}}}$$

Where

G. Cov. (XY) = Genotypic Convariance of X and Y.

GV (X) = Genotypic Variance of X

GV (Y) = Genotypic Variance of Y

ii) Phenotypic Correlation

$$= \frac{\text{P. Cov. (XY)}}{\sqrt{\text{PV (X) PV (Y)}}}$$

Where

P. COV. (XY) = Phenotypic Covariance of X and Y

PV (X) = Phenotypic Variance of X

PV (Y) = Phenotypic Variance of Y

Results and Discussion

Analysis of variance (Table 1) revealed that the strains differed significantly for all the characters under study indicating the prevalence of genetic variation and providing scope to identify the superior genotypes through selection.

Maximum plant height (196.65 cm) was obtained in Raya L-18 (Local Check) and all the other strains gained significantly less height than Raya L-18 except K-410 (191 cm) and K-100 (187.30 cm). Highest seed yield per plant was expressed by K-697 associated with maximum number of branches per plant (10.40). Significantly higher number of pods per plant (820.90), seeds per pod (12.50) and 1000 seed weight (3.65 g.) were recorded in the strains K-306, K-370 and K-166 respectively (Table 2).

Table 1. Range, mean, mean squares and standard error of means for 6 quantitative characters of 16 mustard strains.

Character	Range	Mean	Mean Squares	Standard Error of mean
Plant height (cm)	155.75–196.65	176.48	372.834**	5.99
Branches/Plant	8.85–10.40	9.63	0.819**	0.23
Pods/Plant	504.85–820.90	621.02	25250.552**	19.19
Seeds/pod	10.15–12.50	11.35	1.034**	0.26
1000 seed weight (gms)	1.70–3.65	2.71	0.994**	0.08
Yield/Plant (gms)	10.20–12.60	11.32	1.757**	0.20

** Highly Significant.

The genotypic and phenotypic variances were high for pods per plant (6128.33 and 6865.54) and plant height (75.27 and 147.00). Whereas the genotypic coefficient of variability was maximum for 1000 seed weight (18.27) followed by pods per plant (12.61) and yield per plant (5.71) and almost similar trend was observed with phenotypic coefficient of variability (Table 3). Low coefficient of variability for plant height was due to wide range between genotypic and phenotypic variances (75.27 and 147.0). Labana *et. al.*, (1980) confirm the present findings by reporting high genotypic and phenotypic variance for plant height in Indian mustard with high estimates of coefficient of variability for seed yield per plant and seeds per pod. Gupta (1972) also reported similar results in *Brassica juncea.*

Heritability estimates (broad sense) of the characters varied from 0.51 to 0.95 (Table 3). Maximum heritability was found in 1000 seed weight (0.95) followed by pods per plant (0.89), yield per plant (0.84) and branches per plant (0.64) indicating relatively greater magnitude of genetic variation for these characters. Plant height was comparatively less heritable (0.51) showing more environmental influence on this character. The heritability estimates in itself provide no indication of the amount of genetic progress that will result from selecting the best individuals. Johnson *et. al.*, (1955) reported that the heritability estimates accompanied with genetic advance is more useful than the heritability alone in predicting the resultant effect for selecting the best individuals. In the present studies high heritability values for 1000 seed weight (0.95) and pods per plant (0.89) were associated with high genetic advance of 36.90 and 24.46 respectively. It indicates that additive gene effects are more important in determining these characters and the improvement can be done through mass selection based on phenotypic values. Moderately high heritability for yield per plant (0.84), branches per plant (0.64) and seeds per pod (0.63) coupled with low genetic advance indicates non additive (dominance and epistasis) gene effects. Labana *et. al.*, (1980) are in agreement with the present

Table 2. Mean values of different characteristics in mustard.

Name of Variety	Plant height (cm)	Branches/ plant	Pods/ plant	Seeds/ pod	1000 grain weight (grams)	Yield/plant (grams)
K-4	169.75	9.55	580.15	11.93	2.725	10.75
K-76	177.80	9.30	528.50	11.50	2.425	10.80
K-100	187.30	9.40	643.00	11.45	3.175	11.60
K-166	177.65	9.60	602.35	10.90	3.650	11.00
K-197	178.15	10.05	613.55	10.15	2.700	10.90
K-306	166.65	10.30	820.90	11.80	2.175	11.65
K-314	155.75	9.70	605.10	10.55	2.575	10.65
K-318	172.15	9.45	548.80	11.60	3.075	11.33
K-348	175.90	9.05	594.05	11.25	3.150	10.70
K-351	173.65	9.90	661.05	11.55	2.525	11.75
K-362	172.40	9.15	575.55	11.00	2.625	11.40
K-370	171.05	8.85	586.40	12.50	2.700	10.55
K-383	178.35	10.25	743.30	11.70	1.700	12.45
K-410	191.00	9.50	504.85	11.55	2.625	10.85
K-697	179.50	10.40	677.50	11.55	3.400	12.60
R.L. 18	196.65	9.65	651.30	11.20	2.100	10.20
L.S.D-5% =	12.067	0.454	38.686	0.517	0.168	0.406
1% =	16.080	0.606	51.549	0.689	0.224	0.541

findings showing less heritability with low genetic advance for secondary branches and siliqua length and moderate heritability associated with moderate genetic advance for yield per plant.

The seed yield per plant showed positive correlation with all the characters except 1000 seed weight. Significantly positive genotypic correlation was found with plant height (0.4086), branches per plant (0.6549) and pods per plant (0.6451), whereas seeds per pod showed positive but non-significant correlation (0.1618) with seed yield per plant. Significant negative association was found between seed yield per plant and 1000 seed weight (phenotypic). Yadava (1973), Singh & Singh (1974) and Paul *et. al.*, (1976) also reported positive and significant correlations of seed yield with branches per plant, pods per plant and seeds per pod in *Brassica juncea.* Katiyar & Singh (1974) also found positive association of seed yield and plant height in mustard. Negative correlations were observed between 1000 seed weight and all the other characters under study. Significant negative correlations were found in 1000 seed weight with branches per plant and pods per plant. These results are supported by Olsson (1960) who found that there

Table 3. Genetic parameters of various yield components of mustard.

Characters	Genotypic variance	Phenotypic variance	Genotypic coefficient of variability	Phenotypic coefficient of variability	Heritability	Genetic advance expressed as % age of mean
Yield/plant	0.4189	0.5002	5.71	6.24	0.84	10.78
Plant height	75.2749	147.0097	4.92	6.87	0.51	7.22
Branches/plant	0.1795	0.2814	4.40	5.51	0.64	7.17
Pods/plant	6128.3300	6865.5470	12.61	13.34	0.89	24.46
Seeds/pod	0.2257	0.3577	4.19	5.27	0.63	6.87
1000 seed weight	0.2452	0.2592	18.27	18.79	0.95	36.90

is no correlation between seed yield per plant and 1000 seed weight. He also reported negative correlation between 1000 seed weight and seeds per pod in white mustard. Singh *et. al.*, (1977) also found negative association of seed weight with branches per plant and pods per plant in chickpea.

Seeds per pod showed positive correlation with plant height (0.1034) and pods per plant (0.1301) but negative correlation with branches per plant. Significant and posi-

Table 4. Genotypic and phenotypic correlation coefficients among different quantitative characters in mustard.

Characters		Branches/plant	Pods/plant	Seeds/pod	1000 seed weight	Yield/plant
Plant height	G.	−0.0656	−0.1566	0.1034	−0.0197	0.4086**
	P.	0.0623	−0.0450	0.1008	0.0184	0.3053*
Branches/plant	G.		0.7157**	−0.2147	−0.3023*	0.6549**
	P.		0.6988**	0.1257	0.1184	0.6693**
Pods/plant	G.			0.1301	−0.3976**	0.6451**
	P.			0.2251	−0.2997*	0.6547**
Seeds/pod	G.				−0.2053	0.1618
	P.				−0.0785	0.2760
1000 Seed weight	G.					−0.2162
	P.					−0.3241*

* Significant at 5% level.
** Significant at 1% level.

tive correlation was noted between pods per plant and branches per plant (0.7157) but negative correlation with plant height. Branches per plant also expressed negative correlation with plant height. Significant positive correlations of seed yield per plant with plant height, branches per plant and pods per plant and pods per plant with branches per plant both at genotypic and phenotypic levels showed less environmental effect on these associations. The present findings are similar to Singh & Singh (1974) who found significant positive association between pods per plant and branches per plant in Indian Colza. Banerjee *et. al.*, (1968) also found similar results in yellow sarson. The results suggest that associations of seed yield with plant height, branches per plant and pods per plant are useful criteria for selecting high yielding strains of mustard.

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