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An Analysis of Association of Characters of Value in Breeding Linseed (*Linum usitatissimum* L.)

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Phenotypic and genotypic coefficients of variability, heritability in broad sense, genetic advance and correlation coefficients were studied for eight quantitative characters in 92 genotypes of linseed. The estimates of components of variation showed high genetic coefficient of variation, heritability and genetic advance as percentage of mean for 200 seed weight. High heritability in conjunction with low genetic advance as percentage of mean was obtained for all the characters except 200 seed weight. Seed yield per plant showed significant positive association with number of seeds per capsule, number of capsules per plant, 200 seed weight and plant height while negative and sigpificant with number of days of flowering. Seed yield per plant 200 seed weight, number of capsules per plant and seeds per capsule had significant association with each other.

Information on the nature and magnitude of variation in the available germplasm, association of characters with yield and among themselves and the extent of environmental influence on these characters are necessary for a a purposeful programme of breeding. Chaudhary and Prasad (1968) observed high genetic variability for number of secondary branches and least for yield per plant and number of seeds per pod in Indian mustard. Yield per plant also showed low heritability and genetic advance. Shrivastava and Das (1973) in their study with *Brassica compestris* L. var sarson found maximum genetic variability for seed yield per plant. High heritability value with high genetic advance was obsarved for number of siliqua on main shoot. Genotypic correlations were higher than phenotypic correlations In all characters.

Little information on these aspects is available on the quantitative characters in linseed. An attempt was, therefore, made in the present investigation to study the genetic variability, genetic advance, heritability and association of various characters in relation to seed yield in 92 genotypes of linseed.

MATERIAL AND METHODS

Ninety two genotypes of linseed comprising eight parents, 56 F_1s and 28 F_2s were grown in a randomised block design with three replications in rabi 1976. The three metre long plot consisted one row each of parent and F_1 and

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three rows of F_2. The spacing was 45 × 15 cm between and within rows. Observationswere recorded on number of days taken to flowering and maturity, plant height, number of tillers per plant, 200 seed weight, number of capsules per plant, number of seeds per capsule and seed yield per plant. The mean values in each genotype were computed according to the formula of Burton (1951). Heritability in broad sense was estimated based on the formula of Johnson *et. al*. (1955) and genetic advance according to that of Lush (1949). Correlation coefficients were calculated from the variance and covariance components according to the method suggested by Fisher (1954).

RESULTS AND DISCUSSION

Genotypic coefficient of variation ranged from 2.98 (number of days to flowering) to 24.42 (200 seed weight). Characters with low genetic coefficient of variation indicated that they were more influenced by the environment (Table I). Swarup and Chaugale (1962) pointed outt hat genetic coefficient of variation alone is not sufficient for the determination of the amount of heritable variation.

The heritability values in broad sense estimated to ascertain the usefulness of selection based on phenotypic expression were generally high indicating effectiveness of selection. It ranged from 56.36 per cent (tillers per plant) to 99.63 per cent (200 seed weight). Characters such as number of days to flowering and maturity, plant and 200 seed weight had heritability value above 80 per cent. Johnson *et al*. (1955) reported that heritability estimates together with genetic advance as percentage of mean (genetic gain) were more useful than the former alone in predicting the resultant effect for selecting the best individuals. Genetic gain was maximum (29.78) in 200 seed weight followed by number of tillers per plant whereas least in days to flowering. The character "200 seed weight" exhibited high genetic gain along with high heritability value. This indicated that variation is because of additive effects (Panse, 1957) and thus, selection for this character would be effective for yield improvement. High heritability, although, was recorded for most of the characters their genetic gain was not high. This indicated that in these non additive gene action was operative (Liang and Walter, 1968).

Table II indicated the estimates of correlation coefficients among yield and yield components. Genotypic correlations in general were higher than the corresponding phenotypic ones. These correlation coefficients were more than the environmental correlations, which indicated that the expression, of the characters has not been appreciably influenced by environment. Genotypic correlation coefficient values revealed that seed yield per plant was significantly and positively correlated with plant height, 200 seed weight, number of capsules per plant, and

number of seeds per capsule, while the number of tillers per plant had positive but non-significant correlation. Similar results were obtained by Badwal *et al.* (1970). Association of number of days to flowering with seed yield per plant was negatively significant at genotypic level. Number of capsules per plant showed significant positive association with number of seeds per capsule. Significant positive correlation was also observed between plant height and number of tillers per plant, 200 seed weight, number of capsules per plant and seed yield per plant.

The main objective of the study of association of characters was primarily to know the suitability of various characters for indirect selection, as selection for one or more characters results in correlated response for several other characters. In the present study, the associations were in favourable direction between seed yield per plant and number of capsules per plant, number of seeds per capsule, 200 seed weight and plant height. Therefore, selection for yield components may be effective in improving the productivity of linseed.

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TABLE I. Estimates of genetic parameters for eight metric characters in linseed

Characters	Phenotypic coefficient of variation (%)	Genotypic coefficient of variation (%)	Heritability (%)	Genetic advance (%)	Genetic advance as % of mean
Seed yield/plant	5.05	5.35	83.63	0.10	1.39
Days to flowering	3.30	2.98	81.61	0.06	0.07
Days to maturity	11.99	11.13	86.08	0.21	0.15
Plant height	17.95	16.25	82.02		0.59
Tillers/plant	17.86	13.41	56.36	0.21	3.05
200 seed weight	24.07	24.42	99.63	0.49	29.78
Capsules/plant	7.44	6.43	74.62	0.11	0.08
Seeds/capsule	33.73	31.33	86.31	0.60	1.50

TABLE II Estimates of Phenotypic (P), Genotypic (G) and Environmental (E) Correlation coefficients in linseed

Characters	Correlations	Days to maturity	Plant height	Tillers/plant	200 seed/weight	Capsules/plant	seeds/capsules	seed yield/plant
Days to flowering	P	0.5306**	−0.2062*	−0.1646	0.0157	−0.4057**	−0.1178	−0.2198*
	G	0.6302**	−0.2501*	−0.1863	0.0300	−0.4433**	−0.1494	−0.2335*
	E	0.0574	0.0403	−0.0597	−0.0182	−0.0463	0.0011	−0.1431
Days to maturity	P		0.0419	−0.1878	0.0834	−0.2911**	−0.1748	−0.1652
	G		0.0275	−0.2346*	−0.1686	−0.3219**	−0.2143*	−0.1907
	E		0.1176	0.0228	−0.1093	−0.0342	−0.0354	−0.0329
Plant height	P			0.2074*	0.2433*	0.4212**	0.0525	0.3930**
	G			0.2388*	0.3202**	0.4545**	0.0599	0.4517**
	E			0.0424	0.0823	0.0127	0.0240	0.0266
Tillers/plant	P				0.1271	0.1819	−0.0263	0.1460
	G				0.1615	0.2029*	−0.0510	0.1668
	E				0.0615	−0.0575	0.0638	0.0365
200 seed weight	P					0.1633	0.1323	0.4502**
	G					0.2150*	0.2030*	0.6364**
	E					0.0543	0.0020	0.0258
Capsules/plant	P						0.3175**	0.6235**
	G						0.3636**	0.6722**
	E						0.1304	0.0087
Seeds/capsule	P							0.3939**
	G							0.5138**
	E							0.0988

* Significant at 5%
** Significant at 1%