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CORRELATION AND PATH COEFFICIENT ANALYSIS IN LINSEED (*LINUM USITATISSIMUM* L.)

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ABSTRACT
The present study was conducted on variability, correlation and path coefficient analysis for yield and yield contributing characters in linseed. The highest genotypic coefficient of variation was observed for 1000 seed weight (29.48) and high heritability coupled with high genetic advance was observed for 1000 seed weight (0.99 and 60.45) and seed yield (0.85 and 35.40). The results of phenotypic and genotypic correlation analysis revealed that number of capsules plant^{-1} (0.797 and 0.704), was significantly and positively correlated with seed yield and plant height (0.2 and 0.192) and technical plant height (0.204 and 0.198) was positively correlated with seed yield in present material. Path analysis indicated that number of capsules plant^{-1} (0.7615) exhibited high direct positive effect on seed yield signifying the importance of this trait while selecting for improvement of seed yield of linseed.

INTRODUCTION

For increase the genetic potentialities of any crop, heritable variability in parents is of primary importance for a successful breeding programme. The heritability is one of the most important selection parameter for measuring genetic relationship between per cent and progeny, has been widely used in determining the degree to which a character may be transmitted from parent to off springs. However, heritability alone is not enough for making efficient selection in advanced generations unless accompanied by substantial amount of genetic advance. According to Hanson *et al* (1956), heritability and genetic advance are complementary aspects.

Correlation coefficient estimates degree of association of different component characters of yield among themselves and with the yield. The correlation studies between various yield attributes with yield, provides a basis for further breeding programmes. Path analysis measures direct and indirect contribution of individual attributes towards seed yield. Genotypic and phenotypic correlation was worked out according to Miller *et al*. (1958) and path analysis as per Dewey and Lu (1959).

Both correlation and path coefficient analysis form a basis for selection and also helps in understanding those yield components affecting yield improvement through the study of their direct and indirect effects.

MATERIALS AND METHODS

Ten linseed genotypes *viz.,* PCL-45, LCK-1101, RLC-133, BAU-13-09, SLS-87, RL-10193, NDL-2010-1-27, PKDL-133, LMS-2010-1-27 AND NL-97-26 and four checks *viz.,* Padmini (Zonal check), T-397 (National check) and Two local checks (NL-115 and S-36) were studied in randomized complete block design with three replications, at Main Agricultural Research station, UAS, Raichur. The above ten linseed genotypes were obtained from Project coordinating Unit, Kanpur, through AICRP network. Data were recorded on plant height (cm), technical plant height (cm), days to 50 per cent flowering, days to maturity, number of capsules plant^{-1}, number of seeds capsule^{-1}, 1000 seed weight (g) and seed yield plant^{-1} at the time of maturity, 10 plants taken at randomly from each entry in each replication and their averages were computed. The genotypic and phenotypic coefficients of variation were computed by formula suggested by Burton (1952). Heritability in broad sense calculated by formula suggested by Hanson *et al*. (1956). Coefficients of correlation were estimated by using formula suggested by Miller *et al*. (1958) and path coefficient analysis was made (Dewy & Lu, 1959).

Estimation of genetic parameters

Coefficient of variation

The genotypic and phenotypic coefficients of variation were calculated using the formula by Burton (1952).

a) Genotypic coefficient of variation (GCV)

$$GCV = \frac{\sigma_g}{\bar{x}} \times 100$$

b) Phenotypic coefficient of variation (PCV)

$$PCV = \frac{\sigma_p}{\bar{x}} \times 100$$

Where σ_g = Genotypic standard deviation

σ_p = Phenotypic standard deviation

$\bar{x}$ = General mean

Heritability

Heritability in broad sense

It has been estimated as per the formula given by Hanson *et al.* (1956).

$$h^2(b) = \frac{\text{Genotypic variance } (\sigma_g^2)}{\text{Phenotypic variance } (\sigma_p^2)} \times 100$$

Genetic advance (GAM)

Genetic advance was estimated as per cent of mean (GAM) of the population.

$$GAM = \frac{GA}{\bar{x}} \times 100$$

Where GA = Genetic advance

$\bar{x}$ = Grand mean

Correlation studies

Phenotypic and genotypic correlations were worked out by using the formula suggested by Miller *et al.* (1958).

Phenotypic coefficients of correlation (r_p) =

$$r(x_i x_j)_p = \frac{cov(x_i x_j)_p}{\sqrt{v(x_i)_p . v(x_j)_p}}$$

Genotypic coefficients of correlation (r_g) =

$$r(x_i x_j)_g = \frac{cov(x_i x_j)_g}{\sqrt{v(x_i)_g . v(x_j)_g}}$$

Path coefficient analysis

The following set of simultaneous equations was formed and solved for estimating various direct and indirect effects.

$r_{1y} = P_{1y} + r_{12}P_{2y} + P_{13}P_{3y} + ... + r_{1k}P_{ky}$

$r_{2y} = r_{21}P_{1y} + P_{2y} + r_{23}P_{3y} + ... + r_{2k}P_{ky}$

$r_{iy} = r_{i1}P_{1y} + r_{i2}P_{2y} + r_{i3}P_{3y} + ... + r_{ik}P_{ky}$

$r_{ky} = r_{k1}P_{1y} + r_{k2}P_{2y} + r_{k3}P_{ky} + ... + r_{kk}P_{ky}$

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes for all the traits studied. Genetic parameters of variation, heritability and genetic advance as per cent of mean for yield and yield contributing characters in Linseed are presented in (Table 1).

Variability and heritability analysis

The highest genotypic coefficient of variation was observed for 1000 seed weight (g) (29.48%), followed by Seed yield (kg/ha) (18.64%) and Number of capsules plant^{-1} (14.01%). The high genotypic coefficient of variation for seed yield plant^{-1} and number of capsules plant^{-1} was also observed by Bhateria *et al.* (2011), Vikas and Nandan (2013) and Yared and Misteru (2013) for number of capsules plant^{-1} which indicates environmental influence on the performance of these traits was less. High heritability coupled with high genetic advance was observed for 1000 seed weight, seed yield and number of capsules plant^{-1} indicating that heritability is due to additive gene action the direct selection based on these traits may be effective. This is in conformity to the findings of Mishra and Yadav (1999) and Vikas and Nandan (2013) for seed yield and number of capsules per plant.

High heritability coupled with moderate genetic advance was recorded for days to 50% flowering, plant height and technical plant height. This finding is in agreement with the findings of Vikas and Nandan (2013) for days to flowering indicating that these characters seems to be more heritable and can be improved through indirect selection as evidenced by Singh (2001).

Characters Association analysis

The results of present research showed that the number of capsule per plant (0.797**) had highly significant with seed yield at both genotypic and phenotypic levels (Table 2).

Both the genotypic and phenotypic correlations were in the similar direction, although the levels of genotypic correlation coefficients were superior in extent than the corresponding phenotypic correlation coefficient. This low degree of phenotypic correlation may be due to effect of the environment on the phenotype of the plants. The current investigation presented that selection strategy based on number of capsules plant-1 could give a superior solution for the enhancement of

Table 1: Genetic variability parameters for yield and yield components in linseed

Character	Mean	Range		Coefficient of variation		Heritability	Genetic advance
		Minimum	Maximum	GCV (%)	PCV (%)	(%)	as percent of mean
Days to 50% flowering	76	65	84	7.00	7.04	0.99	14.35
Plant height (cm)	43	39	52	7.49	8.09	0.86	14.27
Technical plant height (cm)	22	18	26	8.15	11.79	0.48	11.61
Number of capsules plant^{-1}	35	28	45	14.01	15.74	0.79	25.67
Days to maturity	119	110	127	4.02	4.16	0.93	7.98
Number of seeds capsule^{-1}	6.8	6	7	5.88	9.05	0.42	7.85
1000 seed weight (g)	6.1	3.6	9	29.48	29.61	0.99	60.45
Seed yield (kg/ha)	699	527	961	18.64	20.22	0.85	35.40

PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation

Table 2: Phenotypic (P) and genotypic (G) correlation coefficients for yield and its components in linseed

Characters		Plant height (cm)	Technical plant height (cm)	Number of capsules plant^{-1}	Days to maturity	Number of seeds capsule^{-1}	1000 seed weight (g)	Seed yield (kg/ha)
Days to 50% flowering	P	0.013	-0.122	0.057	0.95**	0.31	-0.211	0.121
	G	0.02	-0.16	0.057	0.999**	0.507	-0.213	0.145
Plant height (cm)	P		0.725**	0.073	0.079	-0.215	0.091	0.2
	G		0.976**	0.076	0.143	-0.43	0.094	0.192
Technical Plant height (cm)	P			0.106	-0.056	-0.052	0.259	0.204
	G			0.074	-0.018	-0.488	0.378	0.198
Number of capsules plant^{-1}	P				-0.022	-0.028	0.329	0.704**
	G				0.006	0.011	0.369	0.797**
Days to maturity	P					0.32	-0.132	0.07
	G					0.554*	-0.129	0.113
Number of seeds capsule^{-1}	P						0.122	0.076
	G						0.237	0.016
1000 seed weight (g)	P							0.306
	G							0.331

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

Table 3: Estimates of path coefficients based on phenotypic correlation coefficients

Character	Days to 50% flowering	Plant height (cm)	Technical Plant height (cm)	Number of capsules^{-1} plant	Days to maturity	Number of seeds capsule^{-1}	1000 seed weight (g)	Correlation with Seed yield
Days to 50% flowering	-0.1241	0.0028	0.0152	0.0438	0.2779	-0.0485	-0.0225	0.121
Plant height (cm)	-0.0025	0.1387	-0.0928	0.0581	0.0397	0.0412	0.0099	0.2
Technical plant height (cm)	0.0198	0.1354	-0.0951	0.0563	-0.0051	0.0467	0.0398	0.204
Number of capsules plant^{-1}	-0.0071	0.0106	-0.0070	0.7615	0.0017	-0.0011	0.0389	0.704**
Days to maturity	-0.1240	0.0198	0.0018	0.0045	0.2781	-0.0531	-0.0137	0.07
Number of seeds capsule^{-1}	-0.0629	-0.0597	0.0464	0.0085	0.1541	-0.0957	0.0250	0.076
1000 seed weight (g)	0.0264	0.0131	-0.0359	0.2810	-0.0360	-0.0227	0.1055	0.306

*Significant at 5% level, **Significant at 1% level Diagonal values represent direct effect

seed yield in linseed. The similar finding was also reported by Muhammad *et al* (2014), Vikas and Nandan (2013), Yared and Misteru (2013), Deepak and Rao (2011). On the basis of association analysis studies, it can be concluded that the selection criteria based on number of capsules per plant provide better results for improvement of seed yield in Linseed.

Path coefficient analysis

Path coefficients for yield and its components are presented in (Table 3). Number of capsules plant^{-1} had exhibited highest positive direct effect (0.7615) followed by days to maturity (0.2781), plant height (0.1387) and 1000 seed weight (0.1055). These results are in accordance with the reports of Muhammad *et al* (2014), Vikas and Nandan (2013) and Deepak and Rao (2011). The high magnitude of association of number of capsules plant^{-1} with seed yield is the result of their direct effects on seed yield. Whereas, plant height, days to maturity and 1000 seed weight exerted low direct effects towards seed yield. Path coefficient analysis revealed that importance of number of capsules plant^{-1} as major yield contributing character in Linseed. Hence direct selection for number of capsules plant^{-1} may ultimately leads to the development of high yielding genotypes in Linseed from segregating populations.

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