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Linseed Improvement Through Genetic Variability, Correlation and Path Coefficient Analysis

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ABSTRACT

Extent of genetic variability and interrelationship among agronomic traits were estimated in a set of eight linseed genotypes. Heritability was 82 to 89% for plant height, number of capsules plant^{-1}, 1000 seed weight and seed yield plant^{-1}. Except plant height all the traits were positively and significantly associated with seed yield. Seed yield plant^{-1} had highly significant positive correlation with number of branches plant^{-1}, number of capsules plant^{-1}, significant with 1000 seed weight and non-significant negative correlation with plant height. Path coefficient analysis revealed highest direct effect of number of capsules plant^{-1} followed by plant height, 1000 seed weight and number of branches plant^{-1} on seed yield. Hybridization programme involving genotypes of higher mean values *viz*; LS-77, LS-83 and LS-72 may generate desirable recombinants provided single plants would be selected on the basis of number of capsules plant^{-1} and seed yield plant^{-1} in early segregating generations.

Key Words: *Linum usitatissimum* L.; Genotype; Agronomic traits; Correlations; Path coefficients analysis

INTRODUCTION

Linseed is used in treatment of some inflammatory human and animal diseases in Pakistan and its oil is mainly utilized in the preparation of paint, printing ink and several innumerable by-products. Keeping in view of increasing demand of linseed, there is consistent need to increase genetic seed yield potential. One way to increase seed yield potential and related traits is recombination of favorable genes. To achieve this goal, knowledge about extent of genetic variability of different traits and their correlation is very important, as the success of breeding program mostly hinge on the presence of genetic variability in the breeding material. Higher the genetic variability more will be the opportunities for improvement through appropriate selection procedure.

Genetic traits such as genotypic coefficient of variability, heritability and genetic advance provide precise estimate of genetic variation of quantitative traits (Yadav & Dalal, 1972; Vejay *et al*., 1975; Khorgade & Pillai, 1994; Khan *et al*., 1998; Khan *et al*., 2000). Seed yield of a crop is an outcome of intricate relationships of several traits. Therefore, it is imperative to identify interrelationship of traits and their direct and indirect contribution towards seed yield. Equipped with such information, a linseed breeder can devise more precise breeding scheme. Considerable research on this aspect has already been reported and their researchers emphasized importance of different traits for seed yield improvement.

The present study was aimed at development of useful selection scheme on the basis of extent of genetic variability of seed yield and its components in a set of eight local genotypes and its manipulation in an appropriate hybridization programme.

MATERIALS AND METHODS

Eight linseed genotypes *viz.,* LS-95, LS-99, LS-72, LS-77, LS-77, LS-83, LS -85, LS-49 and Chandni were studied in randomized complete block design with four replications, at Oilseeds Research Institute, Faisalabad. For each genotype plot size was six rows of 5 m row length and the distance between the rows and plants were 30 and 5 cm, respectively. The experiment was planted on a properly leveled water soil. Three more irrigations were applied from germination to maturity. Fertilizer was applied at the time of sowing at the rate of 23:23 NP kg acre^{-1}. Data were recorded on plant height, number of branches plant^{-1}, number of capsules plant^{-1}, 1000-seed weight and seed yield plant^{-1} at the time of maturity on 10 plants taken at random from each entry and their averages were computed. Data recorded were subjected to analysis of variance (Steel & Torrie, 1980). Statistical measures of variability such as genotypic and phenotypic variances, genotypic coefficient of variability (GCV) and phenotypic coefficient of variability (PCV), heritability (h^2), genetic advance (GA) as per cent of mean, genotypic and phenotypic correlations (r_g & r_p) were computed (Kwon & Torrie, 1964) and path coefficient analysis was made (Dewy & Lu, 1959).

RESULTS AND DISCUSSION

There were highly significant differences among mean values of all the genotypes for all the traits studied (Table I). Highest seed yield plant $^{-1}$ was obtained by LS-77 followed by LS-83 while the lowest by LS-85. LS-77 topped in number of branches plant^{-1}, number of capsules plant^{-1}, 1000-seed weight with minimum plant height. LS-83 followed LS-77 in number of capsules plant^{-1} and 1000-seed weight expressed maximum plant height and optimum

Table I. Mean performance and statistical measures of variability of eight linseed genotypes for five agronomic traits

Genotypes	Plant height (cm)	Branches plant^{-1}	Capsules plant^{-1}	1000-seed weight (g)	Seed yield plant^{-1}
LS-95	72.95	3.15	33.55	5.80	2.28
LS99	79.00	3.10	34.20	6.45	2.76
LS72	71.60	3.45	38.45	6.09	2.83
LS77	54.00	3.80	54.60	7.85	3.51
LS83	79.68	3.40	45.00	7.04	3.28
LS85	41.45	3.00	31.20	6.88	2.23
LS49	77.05	3.10	36.95	6.04	2.73
CHANDNI	71.15	3.10	36.30	6.40	2.72
MEAN	72.11	2.81	38.78	6.57	2.72
S.E - +	1.88	0.14	1.34	0.15	0.07
VMS	262.51**	0.29**	231.06**	1.77**	0.77**
F-Ratio	18.63**	3.68**	32.01**	20.72**	34.62**
Genotypic variance	62.11	0.05	55.96	0.42	0.19
Phenotypic variance	76.19	0.13	63.18	0.51	0.21
GCV	10.93	7.08	19.29	9.89	15.46
PCV	12.11	10.96	20.50	10.85	16.35
h^{2}%age	81.50	41.70	88.60	83.10	89.40
GA as% of mean	20.31	11.03	37.39	12.80	28.80

VMS=Variety mean square; GCV=Genotypic coefficient of variability; PCV=Phenotypic coefficient of variability; h^2=Heritability; GA=Genetic advance

Table II. Genotypic and phenotypic correlation coefficients for seed yield components with seed yield of linseed advanced lines

Trait		Plant height (cm)	Number of branches plant^{-1}	Number of capsules plant^{-1}	1000- seed weight (g)
Number of branches plant^{-1}	r_g	0.811*	-	-	-
	r_p	0.500ns			
Number of capsules plant^{-1}	r_g	-0.679ns	1.089**	-	-
	r_p	-0.550ns	0.692ns		
1000 seed weight (g)	r_g	-0.677ns	0.773*	0.796*	-
	r_p	-0.488ns	0.431ns	0.672ns	
Seed yield plant^{-1}(g)	r_g	-0.396ns	0.978**	0.962**	0.731*
	r_p	-0.388ns	0.628ns	0.851**	0.570**

Table III. Path coefficient analysis of 8 advanced lines of linseed

Trait	Plant height (cm)	Number of branches plant^{-1}	Number of capsules plant^{-1}	1000 seed weight (g)	Seed yield plant^{-1} (g)
Plant height (cm)	(0.525)	-0.090	-0.743	-0.088	-0..396ns
Number of branches plant^{-1}	-0.426	(0.111)	1.192	0.100	0.978**
Number of siliquas plant^{-1}	-0.356	0.121	(1.094)	0.103	0.962**
1000 seed weight (g)	-0.356	0.086	0.870	(0.130)	0.731*

number of branches plant^{-1}. Mean, statistical measures of variability such as genotypic and phenotypic variances, GCV, PCV, h^2, GA as per cent of mean indicated that differences between PCV and GCV were less than 1.85 for all the traits .except number of branches plant^{-1} (Table I). This showed less environmental influence in phenotypic variance development. The values of $r_g > r_p$ depicted negative influence of environment in the development of an association (Akbar *et al.*, 2001).

Plant height. Plant height showed comparatively moderate PCV, GCV, High h^2 and moderate GA as percent of mean indicating majority of the variance was due to genetic causes. It also had non significant negative correlation (r_g and r_p) with the other traits except with number of branches plant^{-1} (Table II). Although it had positive direct effect but through negative indirect effects of other traits resulted in overall non significant contribution on seed yield (Table III). Akbar *et al.* (2001) and Khan *et al.* (1998) concluded partially similar results in their study.

Number of branches plant^{-1}. It showed low genotypic and phenotypic variances, low GCV and PCV, higher differences between them, moderate h^2 and low genetic GA as per cent of mean indicated non additive genes involvement and more environmental influence in the development of this trait. It had highly significant positive genotypic association (r_g) with seed yield, 1000-seed weight and number of capsules plant^{-1} but non significant positive phenotypic correlation (r_p) with others traits depicted negative environmental effects (Table II). However, its direct effect on seed yield was slightly positive but very strong and positive through number of capsules plant^{-1} which was strengthened by 1000 seed weight and reduced by plant height at some extent (Table III). Akbar *et al.* (2001), Khan *et al*. (1998) and Mishra *et al*. (1992) reached to more or less similar findings. It is concluded that this is not a suitable trait for seed yield improvement for breeding material in hand. On considering it selection must be done in late segregating generations when utilizing it in hybridization programme.

Number of capsules plant^{-1}. It exhibited high genotypic and phenotypic variances, moderate PCV, GCV and high h^2 and GA as percentage of mean (Table I) for this trait which indicated that it is under additive genes control and very less difference between PCV and GCV showed less environmental influence on this trait. Simple selection of the plants bearing higher number of capsules plant^{-1} may lead to success in improving the trait up to 37.39%. Moreover, it had highly significant and positive correlation (r^g) with seed yield plant^{-1} and significant genotypic correlation with 1000-seed weight also (Table II).It exerted maximum direct effect on seed yield which was slightly strengthened by number of branches plant^{-1} and 1000 for seed weight (Table III). These results were in support of previous studies (Mishra *et al*., 1992; Khorgade & Pillai, 1994; Singh & Kumar, 1995; Stapathi *et al.*, 1987; Khan *et al*., 1998; Khan *et al*., 2000; Akbar *et al.*, 2001). Thus strong emphasis may be given to this trait for selecting desirable plants for seed yield improvement as maximum success might be achieved through this trait.

1000-Seed weight. This trait depicted low variances moderate PCV, GCV, high h^2 and low GA as per cent of mean (Table I) indicating non additive genes control on this trait and higher difference between PCV and GCV depicted more environmental influence. It had significant positive correlation with seed yield (Table II). Its direct effect for the development of seed yield was less but it was strengthened by strong indirect effect of number of capsules plant^{-1}. However, it was reduced through plant height (Table III) Khan *et al.* (1998). Thus this trait is not suitable for effective selection of desirable plants due to less variances and predominantly non additive genes control due to high heritability and low genetic advance for the breeding material in hand.

Seed yield plant^{-1}. This trait depicted low variances, optimum GCV and PCV and less difference between them imposed least environmental influence on this trait, higher h^2 and comparatively higher GA as percentage of mean which showed that this trait was predominantly under additive genes control due to higher heritability and higher genetic advance as a percentage of mean and 28.8% success in seed yield improvement may be achieved through this trait.

Thus, present study concluded that hybridization programme involving genotypes with higher number of capsules plant^{-1} and higher seed yield *viz.*, LS-77, LS-83 and LS-72 could generate transgressive segregates possessing higher seed yield potential provided that selection would be done on the basis of medium height plants bearing higher number of capsules plant^{-1} and higher seed yield plant^{-1} in early segregating generations.

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