E-ISSN: 2663-1067
P-ISSN: 2663-1075
IJHFS 2022; 4(1): 18-20
Received: 07-11-2021
Accepted: 09-12-2021

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Genetic variability and selection parameter for yield and its components in linseed (*Linum usitatissimum* L.)

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Abstract
An experiment consisting 60 genotypes of linseed was conducted at Research Farm of P. G. College Ghazipur during two years 2007-8 and 2008-9 in three micro environments results showed high level of variability for pooled data for all the characters. Highest PCV and GCV were recorded for biological yield per plant followed by capsules per plant and seed yield per plant. It was lower for days to maturity and oil content. High heritability in broad sense was recorded for all the characters except days to maturity which showed moderate heritability. Genetic advance was a high for number of capsules per plant. Other characters showed moderate to low genetic advance indicating the role of both additive and non-additive genes. An advancement of 139.6% over base population was expected for biological yield per plant followed by capsule per plant (56.30%). Seed yield had about 50% improvement over mean. Seed yield per plant showed positive and significant correlation with days to flowering, days to maturity, tillers per plant, branches per plant, capsules per plant, number of seeds per capsule and biological yield per plant. Simple selection method would be more appropriate for improving the seed yield.

Keywords: linseed, genetic variability, heritability, genetic advance, correlation

1. Introduction
Genetic improvement of linseed is expected through production breeding, which requires precise information on the nature and degree of genetic variability present in linseed germplasm. Exploration from its principle areas of cultivation which would help in understanding the evolutionary mechanism involved in intraspecific divergence and choice of desirable parents for evolving superior varieties are the major tasks before linseed.
Diverse germplasm is of digital importance and genetic improvement in yield and quality is possible only whenever there exist enough genetic variability which obliviously reflects that the phenotype of the individual will have a sound base for the selection. Apart from it the knowledge of most heritable traits and correlation are also helpful for increasing the yield. The more diverse parent within all limits of fitness, the greater are the chance of heterotic responses in F_1 broad spectrum of variability on segregation. Assessment of genetic divergence also helps in down sizing the breeding materials.
The concept of heritability is important both for the breeder and geneticist for determining an index of transmissibility of a character from parents to there off springs (Lush 1940). Correlation is an important biometrical technique for determining correlation response and selecting superior phenotypes and interrelation among themselves.

2. Material and Methods
Sixty linseed genotypes were evaluated for 12 yield and morphological characters at Research Farm of P.G. College, Ghazipur during the Rabi season of 2008 on 15th October. Each genotype was sown in two rows of 5m length and spaced 30 cm between rows and 10 cm between plants. All the recommended packages of practices were adopted to raise a good crop. The data was recoded on 10 randomly selected plants for days to flowering, days to maturity, plant height (cm), tillers per plant, branches per plant, capsules per plant, seeds per capsule, 1000 seed weight (g), biological yield per plant (g), harvest index (%), oil content (%), and seed yield per plant (g). The data so generated was analyzed for various statistical parameters as usual procedure. The phenotypic and genotypic coefficient of variability according to Burton and de Vane (1953) [3], heritability in broad sense (Burton, 1952) [2], correlation (Al-Jibouri *et al.*, 1958) [1].

3. Results and Discussion

High level of genetic variability was observed for all the traits under study (Table 1). Phenotypic coefficient of variability was higher than genotypic coefficient of variability for all the characters under study. Highest PCV% was observed for biological yield per plant (30.38) followed by capsules per plant (27.55). It was lowest for days to maturity (1.46) followed by oil content (5.75) and days to flowering (6.45). Maximum differences between PCV and GCV for seed yield per plant (1.65%) and tillers per plant (0.84%) indicated that these characters are more influenced by environment while lower differences between these two for remaining characters showed stability of these traits. These results are in accordance with earlier findings of

Heritability in broad sense includes additive and epistatic gene effects and it is realized only when accompanied with genetic advance. It is also assumed that GCV along with heritability estimates would give the best picture of the extent of genetic advance for better selection.

High heritability estimates for all the characters were observed. High heritability and high genetic advance for capsules per plant and plant height revealed the presence of additive gene effect for controlling the characters. High heritability with low genetic advance for remaining characters showed that these characters are under the control of both additive and non-additive gene action.

Seed yield per plant showed positive and significant correlation to days to flowering, days to maturity, tillers per plant, capsules per plant, seeds per capsule, branches per plant and biological yield per plant both at genotypic as well as phenotypic level, In general the genotypic correlations are same in direction but lower in magnitude hence these associations might be due to linkage of genes.

Among characters themselves, positive correlation between maturity characters, namely, days to maturity with 1000 seed weight and biological yield indicated the role of physiological processes which act effectively on development of the characters resulting higher yield.

Among other characters positive and significant contribution of association between days to maturity with 1000 seed weight and biological yield revealed the physiological processes for strong translocation of photosynthates to plant and economic parts resulting higher yield with crop period.

Table 1: Parameters for Variability for yield and maturity characters in linseed

Characters	Mean($\bar{x}$)	(PCV %)	(GCV %)	Heritability (h^2)	Genetic Advance (G.A.)	G.A. over mean
Days to 50% flowering	77.88	6.45	6.39	98.1	10.15	13.03
Days to maturity	28.10	1.46	1.25	73.4	2.83	10.07
Plant height (cm)	67.98	12.36	12.26	98.4	17.04	25.06
Tillers/plant	6.78	17.06	16.22	90.4	2.15	31.71
Branches/plant	4.14	20.59	19.95	93.9	1.65	39.82
Capsules/plant	103.13	27.55	27.46	99.3	58.14	56.30
Seeds/capsule	7.24	12.95	12.45	92.4	1.79	24.72
1000 seed weight	5.77	18.03	17.61	95.4	2.04	35.35
Biological yield	8.00	30.38	30.25	99.1	11.17	139.62
Harvest index	24.14	22.10	21.96	98.7	10.85	44.94
Oil content	39.296	5.75	5.69	98.2	4.57	11.63
Seed yield	4.195	27.43	25.78	88.4	2.09	49.88

Table 2: Genotypic and Phenotypic correlations for yield and maturity characters in linseed

Character	1	2	3	4	5	6	7	8	9	10	11	12
Days to 50% flowering	Rp Rg	0.258*	0.187	0.243	0.248	0.176	0.039	0.066	0.081	0.188	-0.235	0.254*
Days to maturity	0.282*	Rp Rg	-0.081	-0.173	-0.015	0.126	-0.022	0.342**	0.299*	-0.050	-0.110	0.259*
Plant height (cm)	0.200	-0.012	Rp rg	0.113	-0.031	-0.023	0.016	-0.074	0.122	-0.198	-0.042	-0.028
Tillers/plant	0.267*	0.013	0.140	Rp rg	0.226*	0.398**	0.028	-0.134	0.304**	-0.043	0.157	0.350**
Branches/plant	0.269*	0.109	-0.001	0.283*	Rp Rg	0.284*	0.101	0.188	0.274*	0.146	-0.112	0.453**
Capsules/plant	0.185	0.147	-0.013	0.402**	0.294*	Rp rg	0.140	-0.345**	0.594**	0.157	0.032	2.859**
Seeds/capsule	0.058	0.072	0.033	0.085	0.141	0.151	Rp rg	-0.541**	0.075	0.189	0.047	0.274*
1000 seed weight	0.066	0.285**	-0.073	-0.119	0.175	-0.337**	-0.483**	Rp rg	0.032	-0.047	-0.104	0.000
Biological yield	0.083	0.272*	0.122	0.301**	0.290*	0.593**	0.088	0.049	Rp rg	-0.586**	0.086	0.646**
Harvest index	0.188	-0.025	-0.194	-0.028	0.146	0.159	0.196	-0.024	-0.540**	Rp rg	-0.168	0.223
Oil content	-0.226*	-0.070	-0.040	0.165	-0.099	0.036	0.069	0.076	0.097	-0.151	Rp rg	-0.031
Seed yield	-0.251*	0.285*	-0.018	0.367**	0.443**	0.818**	0.308**	0.054	0.636**	0.245*	0.016	Rp r

(Significant at p=0.05. ** Significant at p=0.01.)

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