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Genetic Variability, Heritability and Genetic Advance for Yield & Yield Components in Linseed [*Linum usitatissimum* L.] Genotypes

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ABSTRACT: The experiment was conducted to study the variability, heritability and genetic advance in 75 genotypes of linseed. Analysis of variance indicated highly significant differences for all the characters studied. The range of variation was maximum for number of capsules per plant and seed yield per plant. Seed yield per plant exhibited maximum phenotypic and genotypic coefficient of variation. High heritability was observed for all the characters except number of primary branches per plant and number of seeds per capsule. High heritability coupled with high genetic advance as percent of mean was recorded for seed yield per plant, number of capsules per plant, number of secondary branches per plant, plant height and 1000-seed weight.

KEY WORDS: Genotypic coefficient of variation, genetic advance, linseed, variability,

I. INTRODUCTION

Linseed is an important and ancient oilseed crop being cultivated for its oil, fibres and other manifold uses in different parts of the world. It is a major source of Omega-3 fatty acid which is essential for human beings as it cannot be synthesized in the body, but must be supplemented directly from foods. This plays a role in cholesterol lowering, cardiovascular benefits by affecting prostaglandins and leukotrienes related to blood clotting and inflammatory disorder like rheumatoid arthritis. Linseed requires assessment of various heritable traits. Genetic variability is the most important feature of any population and variability present in the population is the prerequisite in response to selection for any crop improvement programme. Selection of superior varieties will be possible only when adequate variability exists in the gene pool. Hence, the insight into the magnitude of variability of present in a gene pool of a crop species is of utmost importance to plant breeder for initiating a judicious plant breeding programme. The coefficient of variation expressed in phenotypic and genotypic levels are used to compare the variability observed among different characters. A wide range variation has been observed for seed yield (Tewari and Singh, 2018) and other important components of yield (Paul *et al.* 2016). The heritability aid in determining the relative amount of heritable portion in variation and thus help the plant breeder in selecting genotypes from the population. Therefore, the present study was undertaken for assessing the extent of genetic variability, heritability and genetic advance in linseed germplasm.

II. MATERIALS AND METHODS

A. Plant material

Field experiment was carried out during 2018-19 at Oilseed Research Farm, Kalyanpur, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India (Latitude 26°28'N and longitude 80° 24'E). The experiment was laid out in a randomized complete block design with three replications. Seventy-five genetically diverse genotypes were selected from various parts of linseed growing areas of India. Each plot consists of 2 rows of 5.0 m length having row to row distance of 30 cm and plant to plant distance 7 cm. Thinning was done to maintain the optimum population. The recommended agronomical packages of practices were followed to ensure good crop.



B. Data collection

Five competitive randomly selected plants from each plot and each replication were used for various data collection. To gain an understanding of plant growth and development characters like days to 50% flowering and days to maturity were recorded by visual assessment on a single observation of a group of plants during the growing season. Other quantitative characters, i.e. plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight (g) and seed yield per plant (g) were recorded at harvest. Oil content of each genotype was analysed using Nuclear Magnetic Resonance (NMR) technique as per procedure described by Alam and Alam (2005). Oil content results were expressed as a percentage.

C. Statistical Analysis

Analysis of variance (ANOVA) for each character was analysed by adopting the method suggested by Panse and Sukhatme (1967). The phenotypic and genotypic coefficient of variation was calculated as per Burton and Devane (1953). Heritability and genetic advance were estimated according to Johnson *et al.* (1955) and Allard (1960).

III. RESULTS AND DISCUSSION

The analysis of variance revealed high and significant difference for all the characters under studied (Table-1). The range of variation was maximum for the characters viz. number of capsules per plant, seed yield per plant, number of secondary branches per plant, number of primary branches per plant, plant height, 1000-seed weight, oil content and days to 50% flowering while it was least in case of days to maturity and number of seeds per capsule (Table-2). The estimates of phenotypic coefficient of variation (PCV) were little higher than genotypic coefficient of variation (GCV), which is an indicator of additive effect of environment on the expression of these characters. Similar findings were observed by Tewari and Singh (2018) and Ram *et al.* (2010). Seed yield per plant exhibited maximum PCV (36.84 %) and GCV (36.49 %) followed by the characters number of secondary branches per plant, number of capsules per plant, number of primary branches per plant and plant height. Similar results were also observed by Kanwar *et al.* (2014). High phenotypic variation with high genetic variability for these traits showed less influence of environment. It suggested that phenotype alone may be effective for the improvement of these characters. On contrary, moderate PCV and GCV were recorded for 1000-seed weight and oil content. This indicated that little improvement could be expected for these characters. However, low estimates of variability were recorded for days to 50% flowering, number of seeds per capsule and days to maturity. These results are in accordance with Reddy *et al.* (2013).

However, high variance values are not the determining factors of the expected progress that could be made in quantitative characters (Falconer, 1981). It was suggested that the high GCV together with high heritability estimates would give a better picture of the extent of genetic gain to be expected under selection. In the present investigation all the characters expressed high heritability except number of primary branches per plant (68.5%) and number of seeds per capsule (66.3%). High heritability of the characters indicated that the influence of environment on these characters are low or negligible. Similar results have been reported by Tewari and Singh (2018). The estimates of heritability alone, is not very much useful in predicting the resultant effect for selecting the best genotypes because it includes the effect of both additive as well as non-additive gene interactions. High genetic advance only occurs due to additive gene action. So, Heritability coupled with genetic advance would be more useful than heritability alone. On examining the estimate of genetic advance for different characters, it was observed that seed yield per plant had high genetic advance as percent of mean followed by number of capsules per plant, number of secondary branches per plant, plant height, 1000-seed weight and number of primary branches per plant. Similar results were reported by Tewari and Singh (2014) and Singh *et al.* (2019). Moderate magnitude of genetic advance as percent of mean was obtained for days to 50% flowering whereas low magnitude was observed for oil content, number of seeds per capsule and days to maturity. High heritability coupled with high genetic advance as percent of mean was recorded for seed yield per plant, number of capsules per plant, number of secondary branches per plant, plant height and 1000-seed weight.

IV. CONCLUSIONS

In the present study, the characters seed yield per plant, number of capsules per plant, number of secondary branches per plant, plant height and 1000-seed weight represents high values of heritability and genetic advance. Therefore, these characters are the ideal characters for improvement through selection. Since the additive gene action is involved in inheritance of these characters, hence it is suggested that linseed breeder should give more emphasis on the selection process for these characters to accumulate favourable genes to realize high yielding genotypes.



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Table-1: Analysis of Variance [ANOVA] for various characters in linseed.

Source of Variation	d. f.	Days to 50% flowering	No. of primary branches per plant	No. of secondary branches per plant	Plant height (cm)	No. of capsules per plant	No. of seeds per capsule	Days to maturity	Oil content (%)	1000 seed weight (g)	Seed yield per plant (g)
MS (Rep.)	2	3.45	1.89	0.13	2.45	12.72	0.41	2.15	0.18	0.34	1.46
MS (Treat.)	74	137.83*	3.43**	80.65**	512.60**	3023.87**	0.99*	107.47**	59.85*	4.80*	17.93*
MS (Error)	148	4.17	1.08	6.31	4.76	18.89	0.33	4.47	0.72	0.11	0.33

**= Significant at 1% level probability

Table-2: Estimation of genetic parameters for various characters in linseed.

Characters	Mean \pm SE	Range		Coefficient of Variation		Heritability (%)	Genetic Advance	Genetic Advance as percent of mean (%)
		Minimum	Maximum	PCV [%]	GCV [%]			
Days to 50% flowering	70.01 \pm 1.18	52.33	89.0	9.681	9.533	97.0	13.54	19.33
No. of primary branches per plant	4.52 \pm 0.60	2.66	08.0	23.646	19.568	68.5	1.50	33.35
No. of secondary branches per plant	17.77 \pm 1.45	7.66	31.0	29.16	28.00	92.2	9.84	55.37
Plant height (cm)	64.70 \pm 1.26	43.33	118.0	20.20	20.10	99.1	26.67	41.23
No. of capsules per plant	110.04 \pm 2.50	36.00	202.0	28.84	28.75	99.4	64.99	59.05
No. of seeds per capsule	8.70 \pm 0.33	7.33	10.0	6.62	5.39	66.3	0.78	9.05
Days to maturity	132.12 \pm 1.25	119.00	145.0	4.53	4.43	95.6	11.78	8.92
Oil content (%)	36.45 \pm 0.49	24.85	45.50	12.25	12.17	98.8	9.08	9.08
1000 seed weight (g)	7.23 \pm 0.19	4.18	9.70	17.47	17.26	97.6	2.54	35.14
Seed yield per plant (g)	6.63 \pm 0.33	2.53	12.47	36.84	36.49	98.1	4.94	74.46



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