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ESTIMATION ON GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE AND ITS YIELD ATTRIBUTING CHARACTERS IN LINSEED (*LINUM USITATISSIMUM* L.)

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ABSTRACT

The investigation was comprised of linseed grown in randomized block design with three replications each female and male were crossed at Main Experiment Station Farm of LNCTU, Bhopal, (M.P.) during Rabi 2024-25. High heritability was not present any of them characters, whereas medium heritability was observed in characters like number of primary branches per plant, whereas low heritability was observed in characters like days to 50% flowering, plant height (cm), days to maturity, number of secondary branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight (gm), seed yield per plant (gm), biological yield / Plant. As per result, analyses of variance to the treatment were highly significant for all the characters except days to maturity, number of primary branches per plant. The analysis of variance to the parents were highly significant for all the characters except days to 50 % flowering, days to maturity, number of primary branches per plant, number of seeds per capsule, 1000-seed weight (g), Grain yield per plant (g). The analysis of variance to the F₁s, were highly significant for all the characters except days to maturity, number of seeds per capsule, 1000-seed weight (g). Highly significant difference observed among F₁s, for all the characters except days to maturity, number of seeds per capsule, 1000-seed weight (g).

Keywords : Genetic variability, Heritability and genetic advance.

Introduction

Linseed, commonly known as flax (*Linum usitatissimum* L.), is an important oilseed and fibre crop cultivated worldwide. Its history of use spans thousands of years, reflecting its versatility in agriculture, industry, and human nutrition. The crop is valued both for its nutrient-rich seeds and strong fibre-producing stems. Belonging to the family Linaceae, linseed is an annual herbaceous plant that typically grows up to 100cm tall. It is characterized by slender stems, narrow lance-shaped leaves and attractive flowers that may appear blue, white or violet. The seeds are small, flat and vary in colour from golden to brown depending on the variety. The seeds of linseed are a rich source of omega-3 fatty acids, dietary fiber

and lignans, making them highly beneficial for health. Oil derived from the seeds, often called flaxseed oil, is widely utilized in food products, cosmetics and industrial purposes such as paints and varnishes. Beyond its oil, the plant's fiber is processed into linen fabric, ropes, and specialty papers, highlighting its dual economic importance. Adapted to temperate climates; linseed thrives in cool growing seasons and prefers well-drained loamy soils rich in organic matter. While moderately drought-tolerant, it requires consistent moisture for optimal growth. Proper agronomic practices such as balanced nutrient management and pest control are essential to achieve high yields. The lignans present in flaxseed have antioxidant properties that reduce the risk of chronic diseases. Omega-3 fatty

acid (alpha-linolenic acid) is a substrate for the synthesis of longer chain poly-unsaturated fatty acids mainly eicosapentaenoic and decosahexaenoic acids, which influence the biophysical properties of the cell membrane and are required for normal cell functions (Preethi, 2009).

Globally, countries like Canada, Russia, China and India are leading producers of linseed. Its nutritional profile particularly the presence of alpha-linolenic acid, lignans and polysaccharides contributes to disease prevention and supports cardiovascular, digestive and metabolic health. This makes linseed not only a vital agricultural commodity but also a recognized superfood with wide-ranging benefits.

Material and Method

The investigation evaluated each female and male were grown during Rabi season 2024-25 at Main Experiment Station Farm of LNCTU, Bhopal, (M.P.). Germplasm line of linseed i.e. NPHY-29, NP-121, NPRR271, NPRR-402, RL-28-1, ADHUERA-170, NPHY-39, NPRR-28, NPHY-38, POLF-6, LCK-87312, RR-76, No-8, L-53, SJKO-05, No-3, 141No18, XRR-9, LMHS-397 and SJKO-55 in randomized block design with three replications. The observation was recorded like Days to 50 % flowering, Plant height (cm), Days to maturity, Number of primary branches per plant, Number of secondary branches per plant, Number of capsules per plant, Number of seeds per capsule, 1000-grain weight (g), Biological yield per plant (g), Grain yield per plant (g), Harvest index (%). The nature and magnitude of gene effects responsible for different traits, Estimation of heritability and expected genetic advance in respect of all the characteristics (genetic gain), Heritability, (in narrow sense) in F_1 was calculated following formula suggested by Crumpacker and Allard (1962), which is based on the component analysis: Heritability, (in narrow sense)

$$\hat{h}^2 = \frac{1/4\hat{D}}{1/4\hat{D} + 1/4\hat{H}1 + 1/4\hat{F} + \hat{E}}$$

Heritability, (in narrow sense) in F_2 was calculated following formula suggested by Verhalen and Murray (1969), which is based on the component analysis:

$$\hat{h}^2 = \frac{1/4\hat{D}}{1/4\hat{D} + 1/16\hat{H}1 + 1/8\hat{F} + \hat{E}}$$

Where,

\hat{h}^2 = estimate of heritability coefficient and \hat{D} , \hat{H} , \hat{F} and \hat{E} are the same components as explained earlier.

$$\text{Heritability \% in narrow sense} = \hat{h}^2 \times 100$$

The genetic advance was calculated by the formula given by Robinson *et al.* (1949) as:

$$G.A. = K \times \hat{h}^2 \times \sigma_{ph}^2$$

Genetic advance over means of the character

$$G.A. (\%) = \frac{G.A.}{\bar{X}} \times 100$$

Where,

G. A. = Estimate of genetic advance,

K = Selection differential at 5 per cent selection intensity, i.e. 2.06,

σ_{ph}^2 = phenotypic standard deviation,

\hat{h}^2 = estimate of heritability coefficient,

\bar{X} = mean of the character concern

Result and Discussion

In table-1 analysis of variance to the treatment were highly significant for all the characters except days to maturity, number of primary branches per plant. The analysis of variance to the parents were highly significant for all the characters except days to 50 % flowering, days to maturity, number of primary branches per plant, number of seeds per capsule, 1000-seed weight (g), Grain yield per plant (g). The analysis of variance to the F_1 s, were highly significant for all the characters except days to maturity, number of seeds per capsule, 1000-seed weight (g).

In table-2 and table-3, high heritability was not present any of them characters, whereas medium heritability was observed in characters like number of primary branches per plant, whereas low heritability was observed in characters like days to 50% flowering, plant height (cm), days to maturity, number of secondary branches per plant, number of capsules per plant, number of seeds per capsule, 1000-seed weight (gm), seed yield per plant (gm), biological yield/Plant. In the table, value of zero indicates that none of the phenotypic variance resulted from differences in genotype and all the differences in phenotypes results from environment variance. In the table, value of one indicates that all of the phenotypic variance results from differences in genotype. In the table-2 and table-3, a heritability value between zero and one indicates that both genetic and environmental factors influence the phenotypic variance. Similar observation reported heritability and genetic advance for seed yield and other quantitative characters in linseed genotype. Highest estimate of heritability was recorded for plant height, followed by oil content in both the generations. All the characters exhibited high heritability but differential magnitude of genetic advance followed by Rafiq *et al.* (2014).

In F₁ generation characters likes number of seeds per capsule, exhibited high value of genetic advance, whereas, number of secondary branches per plant, biological yield/Plant, and exhibited moderate value of genetic advance, whereas, days to 50% flowering, plant height (cm), number of primary branches per plant, number of capsules per plant, 1000-seed weight (gm), grain yield per plant (gm) and exhibited low genetic advance.

In F₂ generation characters likes days to maturity, days to 50% flowering and No of capsules per plant exhibited high value of genetic advance, whereas, number of secondary branches per plant, biological yield/plant, and exhibited moderate value of genetic advance, whereas, days to 50% flowering, plant height (cm), number of primary branches per plant, number of capsules per plant, 1000-seed weight (gm), grain yield per plant (gm) and exhibited low genetic advance.

The results of heritability coupled with genetic advance in percent of mean showed that character's No of seeds per capsule and No. of secondary branches/plant had moderate heritability among with high genetic advance, No. of capsules per plant and biological yield/Plant. Rest of the traits had low to high heritability with low to moderate genetic gain in generations.

Conclusion

The study demonstrated significant genetic variability across treatments, parents, and F₁ generations for most traits, confirming the presence of exploitable genetic diversity. However, certain traits such as days to maturity, number of primary branches and seed weight showed limited variation.

Table 1: Analysis of variance for 10 characters in linseed (*Linum usitatissimum* L.)

Source of variation	d.f.	Days to 50% flowering	Plant height (cm)	Days to maturity	No of primary branches /plant	No of secondary branches /plant	No of capsules per plant	No of seeds per capsule	1000- Seed weight(gm)	Seed yield per plant(gm)	Biological Yield/plant
Replication	2	7.2	58.59	4.87	4.45	58.73	699.83	1.98	2.21	0.59	847.72
Treatment	29	17.98**	63.64**	3.76	4.33	43.17**	489.12**	17.23**	3.42**	2.64*	663.49**
Parent	19	8.68	33.05**	2.35	1.52	28.59**	172.38**	1.37	0.42	0.82	262.21**
F ₁ S	9	8.89**	31.3**	1.28	2.45*	15.04**	345.11**	1.48	3.47	1.69*	451.08**
Error	58	7.77	3.89	3.02	3.41	3.33	62.45	1.42	1.62	0.61	89.8

Significance at 5% probability level, ** Significance at 1% probability level.

Table 2: Estimate of heritability and genetic advance in percent of mean for 10 characters in linseed

Characters	Heritability	Population means		Genetic advance (1%)	Genetic advance in percent of mean
		F1	F2		
Days to 50% flowering	-0.73	79.81	78.10	-7.46	-9.45
Plant height (cm)	-0.02	65.58	51.84	-4.06	-6.61
Days to maturity	-0.11	128.16	131.56	-0.76	-0.57
No of primary branches /plant	11.10	5.86	4.22	0.14	3.27
No of secondary branches /plant	2.26	23.79	15.29	3.61	18.02
No of capsules per plant	4.78	110.09	56.86	5.45	6.52
No of seeds per capsule	1.25	7.29	6.82	2.13	31.11
1000- Seed weight	5.52	6.77	7.25	0.20	2.61
Grain yield per plant	0.46	6.88	4.77	0.11	1.48
Biological yield / Plant	7.31	34.79	35.98	5.73	16.29

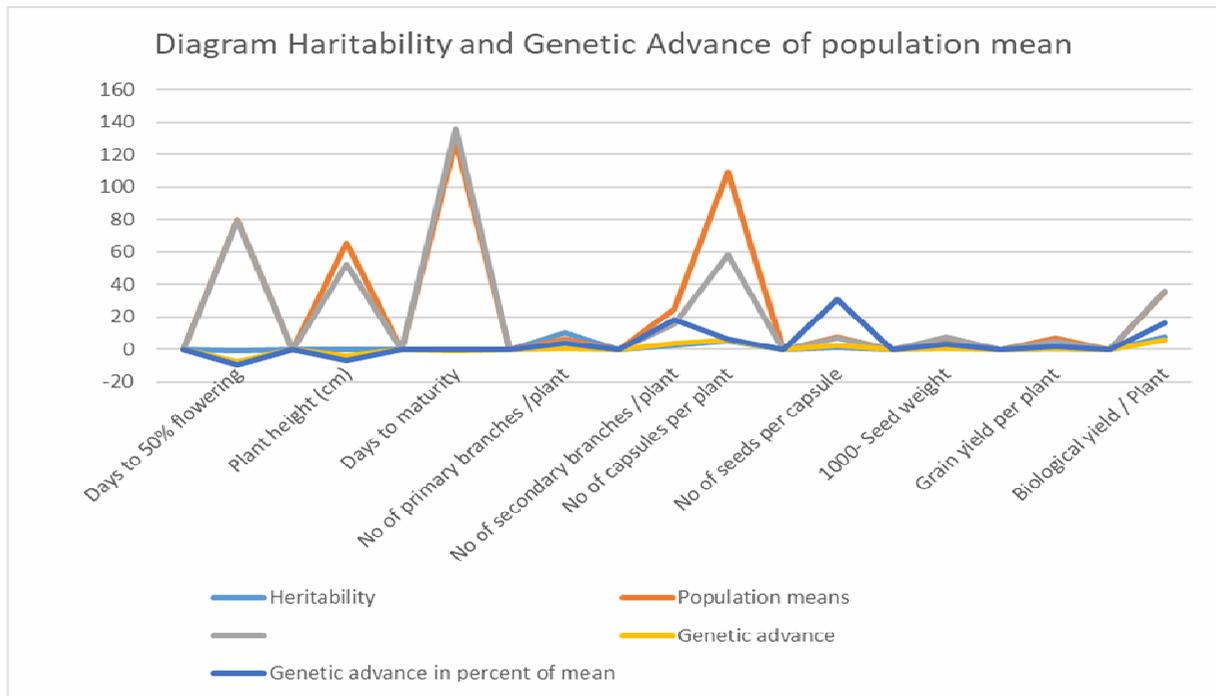


Fig. 1: Graphical representation of heritability and genetic advance in percent of mean for 10 characters in linseed

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