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ASSESSMENT OF GENETIC VARIABILITY PARAMETERS IN SMALL SEEDED GENOTYPES OF LINSEED (*LINUM USITATISSIMUM* L.)

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ABSTRACT

The present investigation has been conducted to determine variability assessment in small seeded genotypes of linseed. The experiment was carried out with three replications and forty linseed genotypes, including three check varieties (RLC-143, RLC-148 and RLC-153). Analysis of variance represented that there was significant variability in all quantitative characters under study for the forty small seeded genotypes of linseed. High PCV and GCV were found in number of capsules plant^{-1} followed by number of primary branches plant^{-1}, number of secondary branches plant^{-1} and number of seeds per capsule attributes. High heritability was found in days to oil content percentage followed by days to 50% flowering, capsule length, number of capsules plant^{-1}, days to maturity, 1000 seed weight, number of primary branches plant^{-1}, plant height, number of secondary branches plant^{-1} and number of seeds per capsule attributes. A high genetic advance as a percentage of the mean was found in number of capsules plant^{-1} followed by number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of seeds per capsule, 1000 seed weight, oil content percentage and plant height. The significant genetic variability in any breeding material is a prerequisite as it does not only provide a basis for selection but also provide some valuable information regarding selection of diverse parents for use in hybridization programme.

Keywords **:** Linseed, Genetic Variability, Genetic advance.

Introduction

Linseed is one of the most significant rabi oilseed crops. It is the only species in the Linaceae family with a commercial value, and there are 300 species in 25 families. Also known as flax or flaxseed. The species name *usitatissimum* is a Latin term that means "most helpful," while the name Linum is derived from Lin, or "thread." It has been grown since the beginning of time for its oil-rich seed and fibre (flax). Linseed is native to the western Mediterranean to India, and it was domesticated for the first time during the Fertile Crescent era. In terms of area and production, rape seed and mustard are the two most important oilseed crops, followed by linseed, also referred to as "Alsi." It is a significant oilseed crop that is well-known in the nation for its varied uses in a range of industries.

About 80 percent of the oil produced goes to industries and is used as a drying oil for the manufacturing of stickers, linoleum, patent leather, paints, varnish, printer ink, enamels, tarpaulins and soaps. The fibre extracted from the stem is utilized to produce strong yarns, linen fabrics, linen threads and the coarser grades are used for making strings, canvas bags, quality papers etc. (Pujar, 2012; Anamika et al., 2022). Linseed oil is a rich source of unsaturated fatty acids i.e. oleic acid (16-24%), linoleic acid (18-24%) and linolenic acid (33-50%) with a relatively low glucosinolate content (Flachowsky *et al.*, 1997; Minz *et al.*, 2022). The knowledge of genetic variability is pre-requisite for proper selection strategies as selection depends on the existence of available genetic variability. Furthermore, selection utilizes the heritable proportion of existing variability. Hence, knowledge of heritability is essential for crop improvement. Genetic parameters like the phenotypic and genotypic coefficients of variation play important for identifying the amount of variability present within the germplasm.

According to (Richharia, 1962), linseed has two primary origins: South West Asia, mainly in India, and the Mediterranean region of Europe. This cultivated species has two unique morphological forms, flax and linseed. When used as fibre, it is known as flax fibre, and when used as an oilseed, it is known as linseed (Vaisey-Genser and Diane, 2003). Only *Linum usitatissimum* L., one of around 290 species in the genus, has any commercial significance. The domesticated species of *L. bienne*, often known as pale flax, originated from a single domestication event (Allaby *et al.*, 2005). The closely similar wild species identified in India go by the names *L. perenne, L. strictrum, L. mysorense, L. angustifolium*, and *L. grandiflorum.* Characters like annual habit non-shattering of capsules are chosen for the initial domestication. Although linseed is more effective at self-fertilization, occasionally there is 2% outcrossing as a result of insect activity (Dilman 1928). It is a self-pollinated, long-day crop that is grown in 34 nations worldwide.

The oil content of seeds varies between 33 and 45% (Gill, 1987). When it comes to the nutritional qualities of linseed, the presence of many omega fatty acids is the first thing that comes to mind. enraged 41 percent fat, 20% protein, and 28% total dietary fibre. Omega-3 and omega-6 fatty acids are the two types of omega fats. Omega-3 fatty acids include linolenic acid, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). Flaxseed is high in both soluble and insoluble fibres, accounting for 28% of total dietary fibre. Plant lignans are found in abundance in flaxseed.

A breeder can create effective selection techniques with the use of genetic variability knowledge since selection is reliant on the presence of genetic variability. Genotypes in the segregating population show a wide range of genetic variability, which offers plenty of room for better selection. Genotypes are mostly responsible for genetic variety in the population. Heritability knowledge is especially crucial for crop development operations since selection makes use of the heritable fraction of already-existing variability. Before deciding on an appropriate breeding strategy for genetic progress, the evaluation of variability for yield and yield-attributing traits becomes absolutely necessary.

Materials and Methods

In the experiment were forty linseed genotypes, including three checks (RLC-143, RLC-148, and RLC-153) gathered from the All India Coordinated Research Project on Linseed, Department of Genetics & Plant Breeding, Research Cum Instructional Farm, College of Agriculture, IGKV, Raipur (C.G.). These forty linseed genotypes were evaluated to identify qualitative data and provide genotypic data. The research was carried out during *rabi* 2021-22 using a Randomized Complete Block Design with three replications.

Geographical situation

The research was carried out at the IGKV Raipur, Chhattisgarh, Research cum Instruction farm during the *rabi* 2021–22. With a 21°16'N latitude, 81°31'E longitude, and an elevation of 289.56m above mean sea level, Raipur is situated in the state's southern region.

Table 1: Experimental material used in the present study

S.no.	Genotypes	S.no.	Genotypes	S.no.	Genotypes	S.no.	Genotypes
1	GP-630	11	GP-2415	21	GP-2750	31	GP-1936
2	GP-761	12	GP-2566	22	GP-2751	32	GP-262
3	GP-1663	13	GP-2638	23	GP-2755	33	GP-1678
4	GP-1716	14	GP-2646	24	GP-2806	34	GP-2232
5	GP-1809	15	GP-2667	25	GP-2808	35	GP-2240
6	GP-2009	16	GP-2741	26	GP-2915	36	GP-2486
7	GP-2053	17	GP-2743	27	GP-2918	37	GP-2608
8	GP-2148	18	GP-2745	28	GP-2936	38	**RLC-143** ©
9	GP-2306	19	GP-2748	29	GP-2937	39	**RLC-148** ©
10	GP-2308	20	GP-2749	30	GP-2938	40	**RLC-153** ©

Methodology

In the current study, phenotypic characteristics are observed based on "National guidelines for distinctness, uniformity, and stability in linseed, India" published in accordance with the catalogue on linseed germplasm, DUS descriptor in accordance with UPOV 2011 (International union for the protection of new varieties of plants) & Flax Council of Canada and descriptor of IFDB-International Flax Database (2006), Project Coordinating Unit (Linseed) Kanpur For the experiment. Observations were recorded on five randomly selected plants from each plot for 11 quantitative characters *viz.* seed coat colour, days to 50% flowering, days to maturity, plant height (cm), number of primary branches/plant, number of secondary branches/plant, number of capsules/plant, capsule length (cm), number of seeds/capsules, 1000 seed weight (g) and oil content (%)

Statistical analysis

The variability parameters were determined as per the methodology suggested by Burton and de Vane (1953) and Johnson *et al.,* (1955)

Results and Discussion

Analysis of variance showed highly significant variation for number of capsules per plant, plant height (cm), days to maturity, oil content percentage, days to 50 (%) flowering, number of secondary branches per plant, number of seeds per capsule, number of primary branches per plant, 1000 seed weight (g) and capsule length (cm) traits used in the present investigation for all he characters studied and provide an opportunity for further analysis and estimation of parameters of variability.

Table 2: Analysis of variance for seed yield and its contributing traits in small seeded linseed

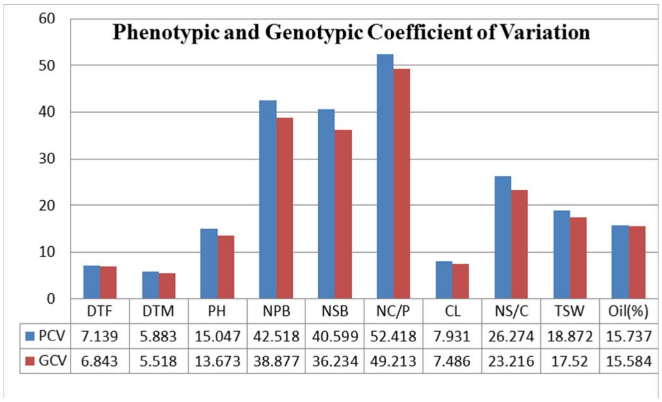
S. No.	Characters	Source of Variation		
		Replication	Treatment	Error
		d.f. (2)	*d.f.* (39)	*d.f.* (78)
	Days to 50 (%) flowering	1	64.62**	1.846
2	Days to maturity	1.508	100.75**	4.389
3	Plant height (cm)	5.329	112.83**	7.418
4	No. of primary branches per plant	0.061	2.36**	0.145
5	No. of secondary branches per plant	0.876	28.11**	2.206
6	Number of capsules per plant	43.785	640.45**	27.48
7	Capsule length (cm)	0.001	0.01**	0
8	Number of seeds per capsule	2.742	18.77**	1.607
9	1000 seed weight (g)	0.009	1.678**	0.085
10	Oil content (%)	0.419	93.08**	0.611

Table 3: Genetic Parameter of variation for seed yield and its contributing traits in small seeded linseed

S.No.	Characters	Mean	Max	Min	PCV (%)	GCV (%)	h^2 (bs)	Genetic Advance	GA as % of mean
1	Days to 50 % flowering	66.84	74.67	52.67	7.14	6.84	91.89	9.04	13.52
2	Days to maturity	103	116.4	86.67	5.88	5.52	87.98	10.95	10.67
3	Plant height (cm)	43.35	63.2	31.47	15.05	13.68	82.57	11.09	25.59
4	Number of primary branches/plant	2.21	4.47	1.00	42.52	38.87	83.61	1.62	73.23
5	No. of secondary branches/plant	8.11	15.2	3.93	40.59	36.24	79.65	5.403	66.62
6	Number of capsules/ plant	29.05	67.53	8.53	52.42	49.22	88.15	27.64	95.18
7	Capsule length (cm)	0.74	0.88	0.63	7.93	7.49	89.09	0.108	14.55
8	Number of seeds/capsule	10.31	17.17	6.33	26.27	23.22	78.08	4.354	42.26
9	1000 seed weight (g)	4.16	5.67	2.47	18.87	17.52	86.19	1.393	33.51
10	Oil content (%)	35.63	41.77	14.63	15.73	15.58	98.06	11.33	31.79

Coefficients of variation were estimated at phenotypic and genotypic levels and classified as low (< 10%), moderate (10-20%) and high (>20%). Phenotypic coefficients of variation were in general, higher in magnitude than that of genotypic coefficients for the entire selected characters (Table). Maximum phenotypic and genotypic coefficients of variation (%) was recorded for number of capsules per plant (52.42, 49.22) followed by, number of primary branches per plant (42.52, 38.87), number of secondary branches per plant (40.59, 36.24) and number of seeds per capsule (26.27, 23.22).

Moderate phenotypic and genotypic coefficients of variation (%) was recorded for 1000 seed weight (g) (18.87, 17.52) followed by, oil content percentage (15.73, 15.58) and plant height (cm) (15.05, 13.68). Low phenotypic and genotypic coefficients of variation (%) was recorded for capsule length (cm) (7.93, 7.49) followed by, days to 50 % flowering (7.14, 6.84) and days to maturity (5.88, 5.52). The findings of the current study are consistent with those of Payasi *et al.* (2000), who found that "PCV values were larger than the GCV value for the features like number of capsule per plant," showing that environmental variation also has an impact on the apparent variation. As a result, given that the environment exhibits unpredictable fluctuations in nature, phenotypes must be prioritised for the successful selection of these qualities.



DTF: Days to 50 (%) flowering, DTM: Days to maturity, PH: Plant height (cm), NPB/PL: No. of primary branches/plant, NSB/PL: Number of secondary branches/plant, NC/PL: Number of capsules/plant, CL: Capsule length (cm), NS/C: Number of seeds/capsule, TSW: 1000 seed weight (g), Oil(%): Oil content (%).

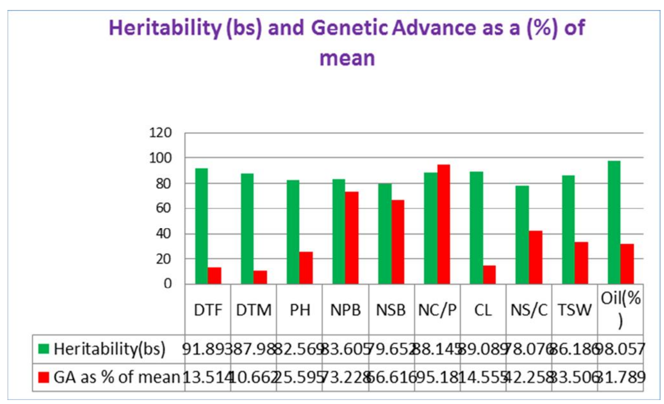
Fig. 1: Graphical representation of comparison between PCV and GCV for seed yield and its contributing trait in small seeded genotypes of linseed

Heritability estimates in broad sense was grouped as high (> 70 %), moderate (50-70 %) and low (< 50 %). Heritability in broad sense was recorded for each of the yield contributing trait under study (Table). The highest heritability was recorded for oil content (98.06%) followed by, days to 50% flowering (91.89%), capsule length (cm) (89.09%), number of capsules per plant (88.15%), days to maturity (87.98%), 1000 seed weight (g) (86.19%), number of primary branches per plant (83.61%), plant height (cm) (82.57%), number of secondary branches per plant (79.65%) and number of seeds per capsule (78.08%).

The highest amount of genetic advance was recorded for number of capsules per plant (27.64) whereas, the moderate amount of genetic advance was recorded for oil content percentage (11.33) followed by, plant height (cm) (11.09) and days to maturity (10.95). The low genetic advance was noticed for days to 50 % flowering (9.04) followed by, number of secondary branches per plant (5.403), number of seeds per capsule (4.354), number of primary branches per plant (1.62), 1000 seed weight (g) (1.39**)** and Capsule length (cm) (0.108).

The high amount of genetic advance as mean percent was observed for number of capsules per plant (95.18%) followed by number of primary branches per plant (73.23%), number of secondary branches per plant (66.62%), number of seeds per capsule (42.26%), 1000 seed weight (g) (33.51%), oil content (31.79%) and plant height (cm) (25.59%) whereas, the moderate amount of genetic advance was recorded for capsule length (cm) (14.55%) followed by days to 50% flowering (13.52%), days to maturity (10.67%). These results fall in line with those of Akber et al. (2003), Ahmad *et al.* (2014) and Upadhyay *et al.* (2019) reported "high heritability for 1000 seed weight, plant height, number of primary branches per plant and number of secondary branches per plant." Similar result also reported by Gauraha *et al.* (2011*)*, Reddy *et al*. (2013), chaudhari *et al.* (2015), Singh *et al.* (2019) and Dabalo *et al* (2020) reported "high heritability and high genetic advance for plant height (cm), number of capsules per plant, number of primary branches per plant, number of secondary branches per plant, 1000 seed weight and oil content (%)."

High Heritability coupled with high genetic advance as percentage of mean were observed for oil content percentage, number of capsules per plant, 1000 seed weight (g), number of primary branches per plant, Plant height (cm), number of secondary branches per plant and number of seeds per capsule. High heritability with moderate genetic advance as percentage of mean was observed for capsule length (cm), days to maturity and days to 50% flowering.



DTF: Days to 50 (%) flowering, DTM: Days to maturity, PH: Plant height (cm), NPB/PL: No. of primary branches/plant, NSB/PL: Number of secondary branches/plant, NC/PL: Number of capsules/plant, CL: Capsule length (cm), NS/C: Number of seeds/capsule, TSW: 1000 seed weight (g), Oil(%): Oil content (%).

Fig. 2: Graphical representation of comparison between heritability and genetic advance as percentage of mean

Conclusion

Analysis of variance shows that variation among treatment is highly significant for all the characters whereas, variation among replication is non-significant for all the characters. It means significant amount of variability present among the genotypes. The value of phenotypic coefficient of variation is higher than genotypic coefficient of variation were observed for character viz: number of capsules/plant, number of primary branches/plant, number of secondary branches/plant, number of seeds/capsule. its mean that apparent variation was caused not just by genotypes but also due to influences of environment. The genotypic and phenotypic coefficient of variation was observed moderate for 1000 seed weight, plant height, oil content. High heritability coupled with high genetic advance as percentage of means were observed for characters viz: Plant height (cm), Number of primary branches/plant, Number of secondary branches/plant, Number of capsules/plant, Number of seeds/plant, 1000 seed weight (g) and Oil content (%). It indicated that heritability is due to additive gene effects and selection may be effective. High heritability with moderate genetic advance were recorded for characters viz: days to 50% flowering, Days to maturity, Capsule length (cm) suggesting control of expression by both additive and non-additive gene action indicating that selection cannot be practiced for improving this traits, thus heterosis breeding can be useful. Positive and significant correlation between the required characters promote improvement in both the traits. Heritability combined with high genetic advance would be a more useful tool for predicting the outcome in selecting the optimal genotypes for yield and its defining traits. It aids in determining how the environment affects how genotypic and reliable features are expressed.

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