Biological Forum – An International Journal **16(8): 232-235(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Genetic Variability, Heritability and Genetic Advance Related to Seed Yield in Linseed (*Linum usitatissimum* L.) Genotypes

Ashok Kumar Meena[1*], Sandhya Kulhari[2] and Manoj Kumar[2]
[1]M.Sc. Scholar, Department of Genetics and Plant Breeding,
COA, Agriculture University, Kota (Rajasthan), India.
[2]Assistant Professor, Department of Genetics and Plant Breeding,
COA, Ummedganj, Agriculture University, Kota (Rajasthan), India.

(Corresponding author: Ashok Kumar Meena)*
(Received: 27 May 2024; Revised: 25 June 2024; Accepted: 18 July 2024; Published: 14 August 2024)
(Published by Research Trend)

ABSTRACT: Thirty-six linseed genotypes were tested to assess the genetic variability, among studied genotypes using randomized block design (RBD) at department of genetics and plant breeding, AU Kota in 2019-20. Substantial amount of genetic variations were observed with low influence of environment indicated consistence performance of the genotypes. Analysis of variance exhibit that there were statistically significant differences among all the genotypes using in the investigation for most of the traits. A wide range of variability was observed for yield and yield components *viz.*, Days to 50% flowering, Days to maturity, Plant height (cm), Number of primary branches per plant, Number of capsules per plant, Number of seeds per capsule, 1000-Seed weight (g), Harvest Index (%), Protein content (%), Oil content (%), Seed yield per Plant (g). GCV and PCV were highest for number of capsules per plant followed by number of primary branches per plant. Greater magnitude of heritability coupled with high to moderate genetic advance as per cent of mean was observed for number of capsules per plant, number of primary branches per plant, plant height, seed yield per plant and 1000-seed weight.

Keywords: Genetic variability, heritability, genetic advance, analysis of variance.

INTRODUCTION

Linseed (*Linum usitatissimum* L.) is one of the most important *Rabi* oilseed crop after rapeseed and mustard. It originated in Mediterranean and the south-west Asian regions (Vavilov, 1935). Linseed is an annual herbaceous self-pollinated crop but insects cause 1-2 per cent of natural crossing. It belongs to the order Malpighiales, genus Linum and family Linaceae having chromosome no. 2n=30. Among different species of Linaceae family *Linum usitatissimum* is the only species which has economic values. Every part of the linseed plant is utilized either directly or after processing. It is used as food (dietary fibres and micronutrients), feed (oil cakes) and contains medicinal properties like antioxidant, phytoestrogen and anti-cancerous (Toure and Xueming 2010). It is the richest source of vegetarian Omega-3 fatty acid and good source of protein, dietary fiber, lignin, flax-fiber and essential micronutrients. Linseed contains 33-45% oil, and its major important use in agro-based industries in the manufacturing of paint and varnish and other products. It has high unsaturated fatty acids, especially linoleic acid (Khan *et al*., 2010). Due to the presence of mucilage fibres, linseed is also ingested for laxative properties. Also its high linolenic acid content has made it an important ingredient for manufacture of paints, varnish, oil- cloth, printing ink, stains, polymer linoleum (Rowland, 1998). Although India ranks third in the world, productivity is low as the crop is generally grown as rainfed and area under linseed cultivation is continuously declining in the country. In India it occupies an area of 0.17 mha with a production of 0.12 mt and productivity of 671 Kg/ha (Ministry of Agriculture, GOI, 2020). Whereas in Rajasthan it is cultivated on 0.48 mha area with production of 0.04 mt production and productivity 964 Kg/ha (Annual Report of AICRP on Linseed, 2019-20). In Kota region it occupied an area (940 ha) with production (940 t) and productivity (1000 kg/ha).

The linseed crop has maintained its increasing trend in productivity while the area registered shows the declining trend resulting in stagnant production. Poor yield of linseed crop is attributed to non-availability of improved cultivars to suit the diverse agro climatic conditions. Hence, development of high yielding cultivars becomes the top most priority to overcome the poor yield levels (Leelavathi and Mogali 2018).

Therefore, knowledge of the extent and pattern of variability, particularly of genetic variability present in a population of a given crop is essential for further improvement of the crop. Similarly, information on the extent and nature of interrelationship among characters help in formulating efficient scheme of multiple trait selection. Besides this, knowledge of the naturally occurring diversity in a population helps to identify diverse groups of genotypes that can be used for hybridization program. In India, the information on these aspects in linseed is very limited. Therefore, there is a need to gain information on phenotypic and genotypic variances as well as heritability and interrelationships of yield and yield related traits among linseed genotypes.

Genetic variability studies offer better scope for selection and help in development of high yielding varieties. The magnitude of heritable variation in the traits studied has immense value in understanding the potential of the genotype for further breeding programme. Assessment of variability for yield and its component characters becomes absolutely essential before planning for an appropriate breeding strategy for genetic improvement.

MATERIALS AND METHODS

The present investigation was undertaken at Department of Genetics and Plant Breeding, College of Agriculture, Kota during *Rabi* 2019-2020. The site of experiment is at an elevation of about 271 meter (889 ft) above mean sea level with 25.18°N latitude and 75.83°E longitude. The standard week wise meteorological data for the period of this investigation recorded at the Meteorological Observatory, ARS, Kota. In this experiment out of thirty-six, each genotype was grown in 3 m long plot with plant to plant distance was maintained at 10 cm in Randomized Complete Block Design (RBD) with three replications during *Rabi* season, 2019-20. The analysis of variance for individual characters and for the character pairs respectively, were carried out using the mean values of each plot following the method given by Panse and Sukhatme (1985). The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were computed, following Burton and Devane (1952) method. Heritability in broad sense h^2 (broad sense) was calculated as a ratio of genotypic variance to phenotypic variance (Allard, 1960). The expected genetic advance under selection for the different characters was estimated as suggested by Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The ultimate objective of most of the plant breeding programmes is to develop high yielding genotypes better than existing ones through the manipulation of genetic constellation. Linseed (*Linum usitatissimum* L.) is an important *Rabi* oilseed crop grown in India and in other developing countries of the world. Looking to the above aspects, the present investigation was undertaken subject to different genetical studies *viz*., genetic variability, heritability and genetic advance. The results obtained from the present investigation are discussed below.

The analysis of variance indicated that the highly significant mean differences were observed for all the eleven characters under study *viz*., days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of capsules per plant, number of seeds per capsule, 1000 seed weight (g), harvest index (%), protein content (%), oil content (%), seed yield per plant (g) (Table 1), these studies supported by Bindra *et al.* (2016); Ashok *et al.* (2017). This indicates that substantial variability was present in the linseed accessions selected for study and were suitable for further genetic and selection parameters.

Results of genetic variability parameters indicated that the estimates of PCV value were higher than GCV value. All the traits studied indicating that the apparent variation is not only due to genotypes but, also due to the influence of environment. High values of PCV and GCV were obtained for traits *viz*., number of primary branches per plant, number of capsules per plant. Moderate PCV and GCV (10–20%) values for plant height (cm), number of seeds per capsule, 1000 seed weight (g), seed yield per Plant (g).Low PCV and GCV (<10) observed for days to 50 per cent flowering, days to maturity, harvest index (%), protein content (%) and oil (%) (Table 2). Earlier worker Ahmad (2017); Ashok *et al.* (2017); Kaur and Kumar (2018) were supported above findings.

High heritability observed for 1000 seed weight, number of primary branches per plant, capsules per plant, plant height, days to 50 per cent flowering, oil content, harvest index and days to maturity. Similar result was observed by Akbar *et al.* (2003); Dandigadasar *et al*. (2011); Ashok *et al*. (2017); Ahmed (2017); Vipin *et al*. (2019). In the present investigation high estimate of heritability coupled with high to moderate genetic advance as per cent of mean was recorded for number of capsules per plant followed by number of primary branches per plant, 1000-seed weight and plant height. This indicates that these characters might be governed by additive gene effects. It was reported by Kanwar *et al*. (2014); Tyagi *et al*. (2014); Singh *et al*. (2015); Chandrawati *et al*. (2016); Ashok *et al*. (2017); Ahmed (2017). High heritability with low genetic advance as per cent of mean was found for days to maturity.

Table 1: Analysis of variance for yield and its attributing traits in Linseed genotypes.

Source of Variation	D. f.	Mean Sum Of Squares										
		Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of capsules per plant	Number of seeds per capsule	1000 Seed weight (g)	Harvest index (%)	Protein content (%)	Oil content (%)	Seed yield per Plant (g)
Replication	**2**	0.287	0.176	8.413	0.170	81.788	0.420	0.043	1.056	0.067	0.562	0.901
Genotypes	**35**	39.628**	17.920**	159.470**	5.390**	3061.367**	2.085**	1.891**	26.745**	1.944**	13.189**	2.228**
Error	**70**	1.611	1.938	9.326	0.089	68.129	0.476	0.016	2.378	0.565	0.605	0.336

***,** Significant at 5 % and 1 % level, respectively.**

Table 2: Genetic variability parameters for seed yield and its contributing characters in linseed genotypes.

Sr. No.	Characters	Genetic parameters							
		Mean	Range		PCV (%)	GCV (%)	$h^2_{(bs)}$ (%)	Genetic advance	Genetic advance as per cent of mean
			Minimum	Maximum					
1.	Days to 50% flowering	68.16	61.67	77.33	5.55	5.22	88.70	6.90	10.13
2.	Days to maturity	129.23	124	134	2.09	1.79	73.30	4.07	3.16
3.	Plant height (cm)	58.56	42.53	76.30	13.16	12.08	84.30	13.40	22.86
4.	Number of primary branches per plant	5.08	3.27	8.67	26.80	26.14	95.20	2.67	52.54
5.	Number of capsules per plant	101.94	46.67	174.67	32.03	30.99	93.60	62.96	61.76
6.	Number of seeds per capsule	7.48	6.30	10.00	13.45	9.79	53.00	1.10	14.68
7.	1000 Seed weight (g)	7.35	5.80	8.77	10.90	10.76	97.40	1.61	21.89
8.	Harvest Index (%)	33.68	28.56	39.97	9.62	8.46	77.40	5.16	15.33
9.	Protein content (%)	20.32	18.16	21.42	4.98	3.34	44.80	0.94	4.60
10.	Oil content (%)	38.66	34.40	43.14	5.67	5.30	87.40	3.94	10.20
11.	Seed yield per Plant (g)	6.13	4.50	7.97	16.19	13.14	65.90	1.35	21.97

CONCLUSIONS

From the above study, the analysis of variance for various traits in the investigation revealed statistically significant differences among all the genotypes, indicating substantial genetic variability. A wide range of variability was particularly observed in important yield and yield-related traits such as Days to 50% flowering, Days to maturity, Plant height, Number of primary branches per plant, Number of capsules per plant, Number of seeds per capsule, 1000 Seed weight, Harvest Index, Protein content, Oil content, and Seed yield per Plant.

FUTURE SCOPE

The study highlights the existence of significant genetic diversity in the evaluated linseed genotypes for key agronomic traits, especially those related to seed yield. This information is valuable for future breeding efforts aimed at enhancing linseed varieties with improved yield and other desirable characteristics.

Acknowledgement. I extend my sincere appreciation and gratitude to all the authors who contributed to this study. Each individual brought unique expertise, dedication, and perspective, enriching the collaborative process.
Conflict of Interest. None.

REFERENCES

Agriculture statistics at a glance, ministry of agriculture govt. of India, (2020).

Ahmed, E. (2017). Genetic studies of yield and yield component of Linseed (*Linum usitatissimum* L.). *Journal of Pharmacognosy and Phytochemistry*, *1*, 872-875.

Allard, R. W. (1960). Principles of plant breeding. John Willy and Sons, Inc., New York.

Annual Report AIRCP Linseed, (2019-2020).

Bindra, S. and Paul, S. (2016). Genetic variability and association studies in linseed (*Linum usitatissimum* L.). *The Bioscan*, *11*(3), 1855-1859.

Burton, G. M. (1952). Quantitative inheritance in grasses.Grassland Congress, *1*, 277-185.

Chandrawati, S. N., Yadav, V.K., Kumar, R., Kumar, S. and Yadav, H. K. (2016). Genetic variability and interrelationship among morphological and yield traits in Linseed (*Linum usitatissimum* L.). *Genetika*, *48*(3), 881-892.

Choudhary, A. K., Marker. S. and Rizwi, F. S. (2017). Genetic variability and character association for seed yield in linseed (*Linum usitatissimum* L.) under rainfed condition. *Journal of Pharmacognosy and Phytochemistry*, *6*(*5*), 457-460.

Dandigadasar, B., Tattirnani, M., Danaraddi, C. S. Shilpa, B. B. and Mohan, R. D. (2011).Genetic variability, correlation and path analysis in linseed.*Asian Journal of Biological Sciences*, *6*, 218-222.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955). Estimate of genetic and environmental variability in soybean. *Agronomy Journal*, *47*(7), 314-318.

Kanwar, R. R., Saxena, R. R. and Ruth, E.E. (2014). Variability, heritability and genetic advance for yield and some yield related traits in linseed (*Linum usitatissimum* L.). *Agricultural Science Digest*, *34*(*2*), 154-156.

Kaur, V., Kumar.S., Yadav. R., Wankhede. D. P., Arvind. J., Radhamani. J., Rana, J. C. and Kumar, A. (2018). Genetic diversity in Indian and exotic linseed germplasm and identification of traits specific superior accessions. *Journal of Environment Biology*, *39*, 702-709.

Khan, M. L., Sharif, M., Sarwar, M. and Ameen, M. (2010). Chemical Composition of Different Varieties of Linseed. *Pakistan veterinary journal*, *30*(2), 79-82.

Leelaathi, T. M. and Mogli, S. (2018). Genetic variability, character association and path analysis for yield and yield components in mutant population of linseed. *Journal of farm sciences*, *31*(1), 17-20.

Panse, V. G. and Sukhatme, P. V. (1985). Statistical methods for agricultural workers, ICAR Publications. New Delhi, 270-274.

Rowland, G. G. (1998). Growing flax: Production, management and diagnostic guide. Flax Council of Canada and Saskatchewan Flax Development Commission, 56.

Singh, A., Prashant, K. R., Arvind, K., Shailesh, M. and Yadav, P. K. (2015). Study on variability, heritability and correlation coefficient among linseed (*Linum usitatissimum* L.) genotypes. *Pelagia Research Library Advances in Applied Science Research*, *6*(10), 14-17.

Singh, V. K., Kerkhi, S. A., Singh, S. P. and Tomar, P. (2019). Genetic variability, heritability and genetic advance for grain yield and yield component traits (*Linum usitatissimum* L.). *Journal of Pharmacognosy and Phytochemistry*, *8*(2), 761-765.

Toure, A. and Xueming, X. (2010). Flaxseed lignans: source, biosynthesis, metabolism, antioxidant activity, bio-active components, and health benefits. *Comprehensive reviews in food science and food safety*, *9*(3), 261-269.

Tyagi, A. K., Sharma, M. K., Mishra, S. K., Kerkhi, S. A. and Chand, P. (2014). Estimates of genetic variability, heritability and genetic advance in linseed (*Linum usitatissinum* L.) germplasm. *Progressive Agriculture*, *14*(*1*), 37-48.

Vavilov, N. I. (1935). Studies on the origin of cultivated plants. *Bulletin of Botany and Plant Breeding*, *16*, 39-145.

How to cite this article: Ashok Kumar Meena, Sandhya Kulhari and Manoj Kumar (2024). Genetic Variability, Heritability and Genetic Advance Related to Seed Yield in Linseed (*Linum usitatissimum* L.) Genotypes. *Biological Forum – An International Journal, 16*(8): 232-235.