The Pharma Innovation Journal 2023; 12(10): 206-210

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 206-210

www.thepharmajournal.com
Received: 08-07-2023
Accepted: 12-08-2023

Kanchan Pradhan
Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

PK Joshi
Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Nandan Mehta
Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Gautam Kumar Jatav
Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Kanchan Pradhan
Department of Genetics and Plant Breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Diversity analysis in flax (*Linum usitatissimum* L.)

Kanchan Pradhan, PK Joshi, Nandan Mehta and Gautam Kumar Jatav

Abstract
Genetic divergence analysis of sixteen flax genotypes, including three check varieties (RLC-148, RLC-153, JRF-5). The experiment was carried out at the Department of Genetics and Plant Breeding, College of Agriculture IGKV, Raipur (C.G) in RCBD with three replications. The D^2 statistic of Mahalanobis (1936) and Tocher's approach for cluster formation, as described by Rao (1952), were used to analyze divergence. A diversity analysis was carried out among sixteen flax accession of linseed. Genotypes were classified into V clusters. The highest number of genotypes appeared in cluster-I, followed by cluster-II and cluster-IV. Maximum intra-cluster distances were observed at cluster-III and cluster-V. The maximum inter-cluster distance was observed between cluster IV&V, followed by between cluster III & IV.

Keywords: Genetic divergence, genotype, cluster, flaxseed

Introduction

Since ancient times, flax (*Linum usitatissimum* L.) has been grown for its seed oil and stem fibre all throughout the world. The top six producers worldwide are Canada, Kazakhstan, Russia, China, the United States, and India (FAO, 2022) [1]. In terms of textile crops, flax is currently the second-largest fibre crop, while linseed is the fifth-largest oil crop globally. Linseed/flax stem, seeds and seed oil have a wide range of uses in the creation of food, nutritional supplements and industrial items, living up to the species name "*usitatissimum*," which means very useful. Because of the oil's special drying capabilities caused by its peculiar fatty acid makeup, it has extensive industrial usage in paints and varnishes (Przbylski *et al.* 2005) [4]. Linseed oil is also used to make hardboard, brake linings, printing ink, linoleum and soaps, among many other interesting things. Due to its natural fibres distinctive lustre and tensile strength, flax fibre is utilized in handloom, textiles, and polymeric composites (Foulk *et al.* 2010 and Yan *et al.* 2013) [2, 7]. Recently a thorough evaluation of the use of linseed plants for food, feed, fibre and value-added products has been conducted (Kaur *et al.* 2018 and Zuk *et al.* 2015) [3, 8]. Because of its high omega-3 fatty acid (linolenic acid; ALA) concentration, dietary fibre, high-quality protein and lignans content, linseed has been known as a nutrient-rich food (Rabetfik *et al.* (2010) [5] and Rubilar *et al.* 2015) [5], linseed is one of the richest plant-based sources of omega-3 fatty acids and contains about 55% ALA of the total fatty acids. Additionally, it boasts a remarkable omega 6 to omega 3 fatty acid ratio of 0.3:1. Nutritionists advise increasing intake of the vital omega 3 fats found in food because they have enormous health benefits and the modern diet tends to be heavy in omega 6 fats. Linseed has a high protein level (18.29%) and a high fibre content (27.4%) (Kaur *et al.* 2018) [3]. Genetic divergence has been crucial in the evolution of crop plants. For a breeding effort targeted at crop improvement on good and rational foundation, knowledge of the current genetic diversity in the crop species is required. The choice of suitable diverse parents is crucial when breeding cultivars for diverse agro-climatic zones because hybridising genetically diverse parents for a particular character may be helpful in unleashing a wide spectrum of variability in segregating generations, adding new gene pools to the population and extending the range of variation.

Materials and Methods

The research work was conducted at the Research cum Instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during *Rabi* 2020-21. The experimental materials consists of thirteen and three checks lines of flax genotypes of linseed from AICRP, Department on Genetics and Plant Breeding. The experiment was carried out in a Randomized complete block design with three replications. All the flax type linseed genotypes were sown on 24 November, 2022 in plots of five rows each of 5 m length with row to row spacing of

30 cm and plant to plant spacing approximately 10 cm. In present study, observations on different quantitative characters related to seed yield and it components, fibre yield and it components and morphological traits based on “National guidelines for the conduct of tests for Distinctness, Uniformity and Stability in linseed, India” were recorded to accomplish the objectives of the study based on Catalogue on linseed germplasm, Project Coordinating Unit (Linseed), C.S.A.U.A. & T. campus, Kanpur, 2010. Five random plants were tagged and taken for recording data of different characters at optimum plant growth stage from each genotypes. Mean values of the data from the sampled plants with respect to different characters were used for various statistical analysis presented in table 1, 2 and 3.A diversity analysis was done by using the D^2 statistic of Mahalanobis (1936) [9].

Table 1: Quantitative traits of linseed for yield and yield related charters.

S. No.	Traits	S. No.	Traits
1.	Day to 50% flowering	7.	No. of seed per capsule
2.	Day to maturity	8.	No. of seed per plant
3.	Plant height (cm)	9.	1000 seed weight (g)
4.	No. of primary branches	10.	Seed yield per plant (g)
5.	No. of secondary branches	11.	Seed yield per plot (g)
6.	No. of capsules per plant	12.	Seed yield kg/ ha.

Table 2: Quantitative traits of linseed for flax fibre

S. No.	Traits	S. No.	Traits
1.	Technical plant height (cm)	5.	Fibre yield per plant (g)
2.	Stem diameter (mm)	6.	Fibre yield per plot (g)
3.	No. of fibre per plant	7.	Impurity percentage (%)
4	Length of fibre (cm)		

Table 3: Qualitative traits in linseed

S. No.	Traits	S. No.	Traits
1.	Plant type	7.	Filament colour
2.	Flower color	8.	Patat venation colour
3.	Flower size	9.	Seed size
4	Flower shape	10.	Capsule size
5.	Anther colour	11.	Capsule dehiscence
6.	Stigma color	12.	Plant height

Results and Discussion

A total of 16 genotypes were grouped into five clusters (Table 4) showing sufficient variability for selecting the genotypes as parent for future breeding programmes.

Table 4: Grouping of linseed genotypes in different clusters

Cluster Group	Number. of Genotypes	List of Genotypes
Cluster I	9	FLAX-4, FLAX-9, FLAX-2, FLAX-3, FLAX-5, FLAX-1, FLAX-8, FLAX-7 & FLAX-6
Cluster II	3	RLC-204, RLC-203 & FLAX-11
Cluster III	1	FLAX-10
Cluster IV	2	RLC-153A©, RLC-148A©
Cluster V	1	JRF-2A©

Cluster I contained highest number of genotypes (9) followed by cluster II (3), cluster IV (2), cluster-III (1), cluster-V (1).
The intra cluster distances were measured in such a manner that the genotypes within the cluster have smaller average distance (intra cluster distance) than the inter cluster distance. The different combinations of different cluster distances are presented in (Table 5 and Fig. 1). Maximum inter-cluster distance was observed between cluster IV-V (592.11), followed by between cluster III-IV (378.9), cluster II-V (256.07), cluster I-IV (209.01), cluster I-VI (205.87), cluster II, IV (138.62), cluster II-III (118.90), cluster III- V (99.89), cluster I-II (82.11), cluster I-III (68.89). The highest intra-cluster distances were observed between cluster I-I (45.17), followed by between cluster IV-IV (39.04), cluster II-II (35.38), whereas lowest intra-cluster between cluster III-III and V-V cluster distance was observed (0.00).

Table 5: Estimates of intra (diagonal and bold) and inter cluster distances among five clusters

	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V
Cluster I	45.17	82.11	68.89	209.01	205.87
Cluster II		35.38	118.90	138.62	256.07
Cluster III			0.00	378.90	99.89
Cluster IV				39.04	592.11
Cluster V					0.00

*In given figure intra-cluster are diagonals bold$\sqrt{D^2}$ values

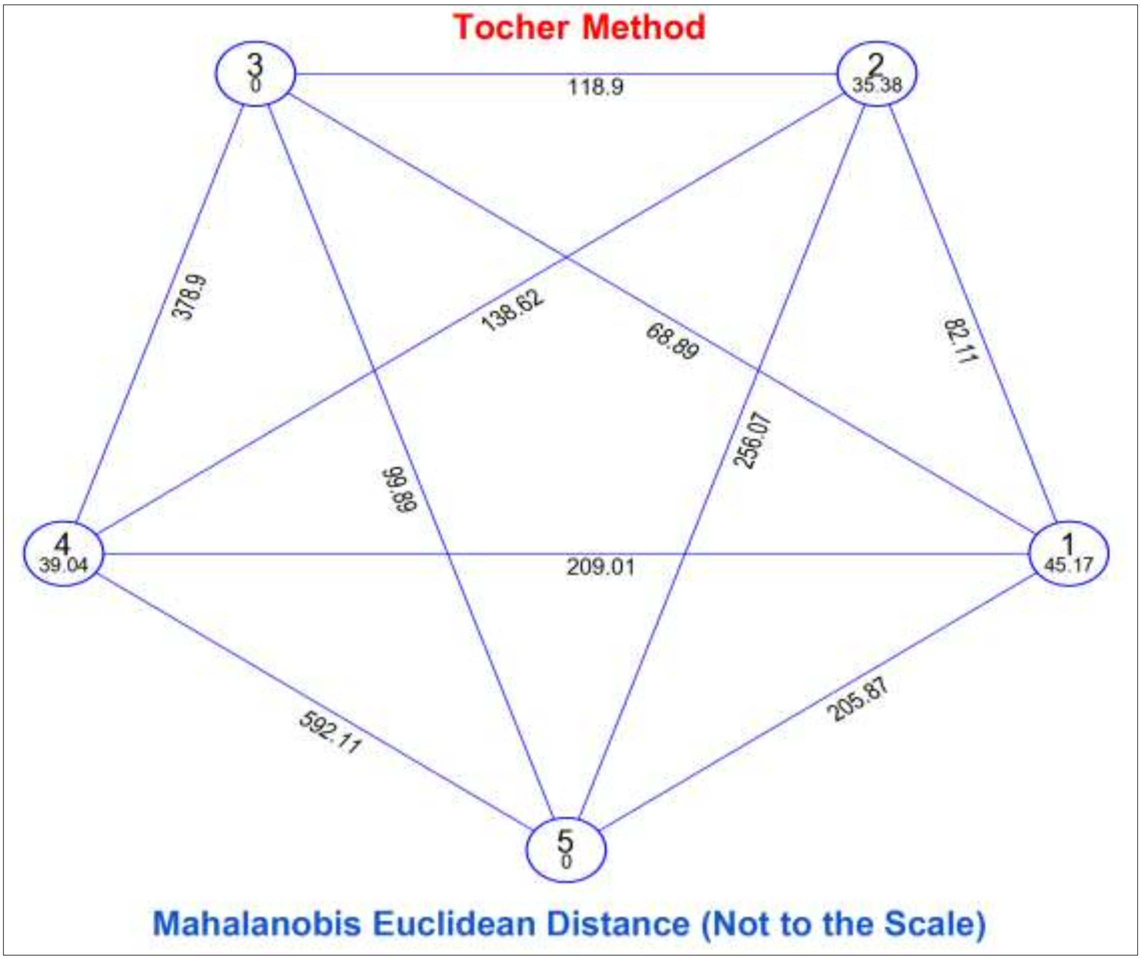

Fig 1: Intra cluster distance and inter cluster relation (within cluster) in flax accession of linseed 2022-23

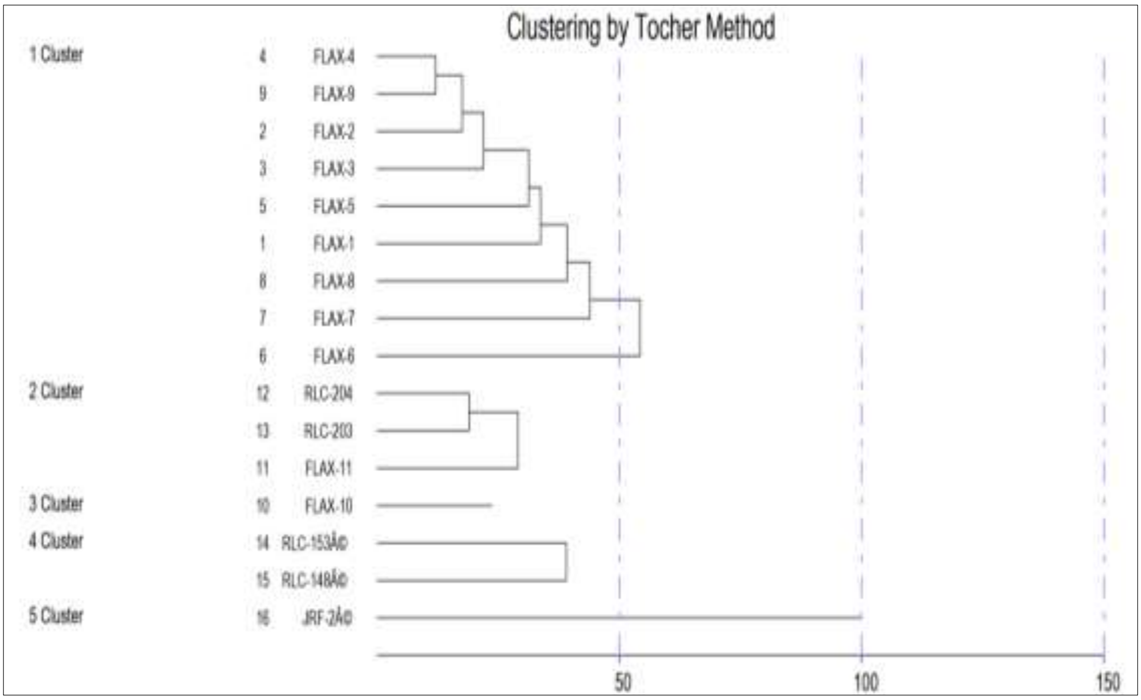

Fig 2: Dendrogram for five clusters with sixteen flax accession of linseed 2022-23

Components of inter-cluster D^2 values

1. **Days to 50% flowering:** Cluster-I recorded maximum mean value (73.22) for days to 50% flowering followed by, cluster-III (71), cluster-V (68.67), cluster-II (62.11) and cluster-IV (59.33).
2. **Days to maturity:** Cluster-II recorded maximum mean value (119.89) for days to maturity followed by, cluster-III (114.33), cluster-I (113.63), cluster-IV (109) and cluster-V (105)
3. **Stem diameter (mm):** Cluster-I recorded maximum mean value (114.53) for plant height followed by, Cluster-III (2.69), cluster-V (2.51), cluster-II (2.11) and cluster-IV (1.90).
4. **Plant height (cm):** Cluster-V recorded maximum mean value (114.53) for plant height followed by, Cluster-III (97.93), cluster-I (88.79), cluster-II (88.67) and cluster-IV (66.33).
5. **Technical plant height (cm):** Cluster-V recorded maximum mean value (85.93) for technical plant height followed by, cluster-III (63.07), cluster-I (57.69), cluster-II (53.58) and cluster-IV (42.63)
6. **Number of primary branches per plant:** Cluster-II recorded maximum mean value (3.87) for number of primary branches per plant followed by, cluster-V (3.67), cluster-I (3.55), cluster-IV (3.50) and cluster-III (3.47).
7. **Number of secondary branches per plant:** Cluster-V recorded maximum mean value (22.60) for number of secondary branches per plant followed by, cluster-IV (19.30), cluster-II (17.38), cluster-III (16.47) and cluster-I (15.72).
8. **Number of capsules per plant:** Cluster-V recorded maximum mean value (50.93) for number of capsules per plant followed by, cluster-I (45.24), cluster-IV (42.43), cluster-III (42) and cluster-II (40.62).
9. **Number of seeds per capsule:** Cluster-II recorded maximum mean value (7.69) for number of seeds per capsule followed by, cluster-III (7.67), cluster-IV (7.67), cluster-V (7.60) and cluster-I (7.57).
10. **No. of seeds per plant:** Cluster-Vrecorded maximum mean value (385.07) for capsule length (cm) followed by cluster-I (342.01), cluster-IV (324.50), cluster-III (316.60) and cluster-II (315.44).
11. **1000 seed weight (g):** Cluster-III recorded maximum mean value (6.30) for 1000 seed weight (g) followed by cluster-I (5.82), cluster-II (5.57), cluster-IV (5.36) and cluster-V (5.30).
12. **Seed yield per plant (g):** Cluster-IV recorded maximum mean value (1.44) for seed yield per plant (g) followed by cluster-V (1.37), cluster-I (1.34), cluster-II (1.33) and cluster-III (1.27).
13. **No. of fiber per plant:** Cluster-IV recorded maximum mean value (24.37) for number of seeds per capsule followed by, cluster-I (24.01), cluster-III (23.87), cluster-II (23.69), cluster-V (23.66).
14. **Length of fiber (cm):** Cluster-V recorded maximum mean value (59.20) for 1000 seed weight (g) followed by cluster-III (54.27), cluster-II (51.13), cluster-I (50.01) and cluster-IV (45.60).
15. **Fiber yield per plant (mg);** Cluster-IV recorded maximum mean value (90) for seed yield per plant (g) followed by cluster-I (80.74), cluster-III (80), cluster-II (72.22), cluster-IV (58.33).
16. **Fiber yield per plot (mg):** Cluster-V recorded maximum mean value (1120) for seed yield per plant (g) followed by cluster-III (980), cluster-I (960.74), cluster-II (874.44) and cluster-IV (715).
17. **Impurity percentage (%):** Cluster-III recorded maximum mean value (25.83) for impurity percentage (%) followed by cluster-V (25.57), cluster-I (24.53), cluster-IV (22.47) and cluster-II (17.56).

Table 6: Mean performance of different clusters for yield and its component traits.

Characters	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V
Days to 50% flowering	73.22	62.11	71.00	59.33	68.67
Days to maturity	113.63	119.89	114.33	109.83	105.00
Stem diameter (mm)	2.75	2.11	2.69	1.90	2.51
Plant height (cm)	88.79	88.67	97.93	66.33	114.53
Technical plant height (cm)	57.69	53.58	63.07	42.63	85.93
No. of primary branches per plant	3.55	3.87	3.47	3.50	3.67
No. of secondary branches per plant	15.72	17.38	16.47	19.30	22.60
No. of capsules per plant	45.24	40.62	42.00	42.43	50.93
No. of seed per capsule	7.57	7.69	7.67	7.67	7.60
No. of seeds per plant	342.01	315.44	316.60	324.50	385.07
1000 seed weight (g)	5.82	5.57	6.30	5.36	5.30
Seed yield per plant (g)	1.34	1.33	1.27	1.44	1.37
No. of fiber per plant	24.01	23.69	23.87	24.37	23.66
Length of fiber (cm)	50.01	51.13	54.27	45.60	59.20
Fiber yield per plant (mg)	80.74	72.22	80.00	58.33	90.00
Fiber yield per plot (mg)	960.74	874.44	980.00	715.00	1120.00
Impurity percentage (%)	24.53	17.56	25.83	22.47	25.57

Conclusion

Diversity analysis through D^2 analysis carried out among 16 flax genotypes of linseed. Genotypes were classified into V clusters. The highest number of genotypes appeared in cluster I which possess 9 flax genotypes of linseed. The second highest number of genotypes was found in cluster II appeared of 3 genotypes. The lowest genotypes were found in cluster IV (2), III (1) and V (1) flax genotypes of linseed. The maximum inter-cluster distance was observed between cluster IV-V, followed by between cluster III-IV, cluster II-V, cluster I-IV, cluster I-VI, cluster II-IV, cluster II-III, cluster III- V, cluster I-II and cluster I-III. The highest intra-cluster distances were observed between cluster I-I, followed by between cluster IV-IV, cluster II-II, whereas lowest intra-cluster between cluster III- III and V-V cluster distance was observed. As a result, it would be wise to select parents from these clusters as they are predicted to produce superior segregates or attractive combinations for the development of valuable genetic stock, gene pools or varieties with enhanced genotypes through a hybridization programme.

References

1. FAO; c2022 https://www.fao.org/faostat/en/#data/QCL [Accessed 5 June, 2022].
2. Foulk JA, Fuqua MA, Ulven CA, Alcock MM. Flax fiber quality and influence on interfacial properties of composites. Int J Sustain Eng. 2010;3(1):17-24. Doi: 10.1080/19397030903348710.
3. Kaur V, Kumar S, Yadav R, Wankhede DP, Aravind J, Radhamani J, *et al*. Analysis of genetic diversity in Indian and exotic linseed germplasm and identification of trait specific superior accessions. J Environ Biol. 2018;39(5):702-709. Doi: 10.22438/jeb/39/5/ MRN-849.
4. Przybylski R. Flax oil and high linolenic oils In: Bailey's industrial oil and fat products; c2005. p. 281-301. Doi: 10.1002/047167849x.bio010.
5. Rabetafika HN, Van Remoortel V, Danthine S, Paquot M, Blecker C. Flaxseed proteins: food uses and health benefits. Int J Food Sci Technol. 2011;46(2):221-228. Doi: 10.1111/j.1365-2621.2010.02477.x.
6. Rubilar M, Gutiérrez C, Verdugo M, Shene C, Sineiro J. Flaxseed as a source of functional ingredients. J Plant Nutr Soil Sci. 2010;10(3):373-377. Doi: 10.4067/ S0718-95162010000100010.
7. Yan L, Chow N, Jayaraman K. Flax fiber and its composites- a review. Compos Part B Eng. 2014;56:296-317. Doi: 10.1016/j.compositesb.2013.08.014.
8. Zuk M, Richter D, Matuła J, Szopa J. Linseed, the multipurpose plant. Ind Crop Prod. 2015;75:165-177. Doi: 10.1016/j.indcrop.2015.05.005.
9. Mahalanobis PC. Mahalanobis distance. In Proceedings National Institute of Science of India. 1936;49(2):234-256.