



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(8): 2203-2206
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www.thepharmajournal.com

Received: 21-06-2023

Accepted: 23-07-2023

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Characterization & morphological distinction of IGKV released varieties of linseed (*Linum usitatissimum* L.)

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Abstract

The present study was conducted at the Research-cum- Instructional farm, Department of Genetics and Plant Breeding, College of Agriculture, IGKV, Raipur, C.G, during *Rabi* 2022-23. The research work utilized a set of experimental materials comprising of twenty-three linseed varieties that were released from All India Coordinated Research Project (AICRP) on Linseed, IGKV, Raipur, C.G. The material were grown in Randomized Complete Block Design (RCBD) with three replications. The data were recorded on 13 morphological traits. DUS testing of morphological characters of linseed showed significant amount of distinctiveness for characters *viz.*, flower colour, anther colour, flower heart shape, petal venation colour, petal shape, peal margin, leaf shape, organ position, and seed shape. The characters like petal shape, flower size, plant growth habit and plant height (cm), style and stigma colour exhibited lesser classes of distinctiveness suggesting that these traits are useful in distinguishing varieties in broad level.

Keywords: DUS characterization, descriptors, morphological traits, distinctiveness

1. Introduction

Linseed also known as flax or common flax is a flowering plant belonging to family Linaceae. It's an annual herb bearing blue or white colored flower. One of the first field crops to be farmed was linseed (*Linum usitatissimum* L.), often known as flax in North America. Linseed cultivated for fibers have an average height of 0.9 to 1.2 m with slender stalks of diameter 2.5 to 4 mm and branches concentrated at the plant top. Whereas linseed cultivated for seeds are comparatively shorter and have many branches. Flax is farmed for its seeds which can be used to produce oil, which is used as a food supplement and as an ingredient in many wood-finishing products or can be pulverized into meal. Linseed meal obtained after crushing linseed seeds to obtain linseed oil is a protein rich feed for ruminants, rabbits and fishes. Flax seed produces edible oil known as linseed oil which is oldest commercial oil. A 100g portion of ground flax seed provides 534 kilocalories and contains 18% protein, 29% carbohydrates and 42% fat (USDA Food Data Central, 2018) ^[6].

Linseed occupies an area of 32.23 lakh ha yielding 30.68 lakh tones with an average productivity of about 952 kg/ha in the world whereas in India, it occupies an area of 2.01 lakh ha with production of 1.37 lakh tones and yield of 659 kg/ha (Director's report, AGM, 2021-22). Diversity in germplasm was required to meet different purposes of crop such as increased yield, wider adaptation, desirable quality, disease and pest resistance. In general, a majority of Linseed germplasm plant have blue flowers and almost similar agronomic and morphological traits up to flowering stage. From flowering onwards there is a very narrow range of distinction available which has to be identified among the varieties released. Since 1967 a large number of linseed varieties have been released from IGKV, AICRP on Linseed. These varieties generally have blue colored flowers and in recent years white colored flower varieties have been developed which have other overlapping traits. For differentiating these varieties from one another it becomes mandatory to distinguish and characterize these varieties according to the DUS descriptors which are important for seed certification program of Linseed.

2. Materials and Methods

The research work was conducted at the Research *cum* Instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during *Rabi* 2022-23 and observations recorded were verified at Department of Genetics and Plant Breeding, College of Agriculture, IGKV, Raipur.

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The research was conducted using a Randomized Complete Block Design with three replications. On November 23, 2022, all twenty-three varieties of linseed were sown in plots of three rows each measuring 4 meters in length, with a row to row spacing of 30 cm and a plant to plant spacing of 10 cm. At the center of each plot, five plants were chosen at random for observation.

3. Results and Discussion

The observations on morphological traits were based on National guidelines for the conduct of tests for Distinctness, Uniformity and Stability (DUS) in linseed, published Catalogue on linseed germplasm by Project Coordinating Unit (Linseed), Kanpur, (2010) in collaboration with NBPGR, the International Union for the Protection of New Varieties of Plants (UPOV), Geneva, Switzerland (2011) guidelines and descriptor of International Flax Database (IFDB). In the context of DUS classification presented in table 1, the morphological traits of linseed were evaluated among the twenty-three genotypes:

- As per DUS descriptors out of twenty-three varieties, ten varieties had tinge blue colored flowers, six varieties had blue colored flowers, five had white colored flowers, one had violet colored flowers and only one had violet-blue colored flowers.
- On the basis of flower shape, seventeen varieties were grouped under funnel shapes flowers, four varieties had disc shape and only two varieties had star shape flowers.
- On the basis of flower size, eighteen varieties were grouped under medium size flower, three were grouped under large size flower and two varieties were grouped under small size flowers.
- On the basis of anther colour, fourteen varieties had blue colored anther, five had grey colored anther and four varieties had cream colored anthers.
- On the basis of filament colour, twenty-two varieties had white colored filament and only one variety had white filament with blue colour just below anthers.
- On the basis of stigma and style colour, seventeen varieties had white stigma and white style while six varieties had blue style and white stigma.

- On the basis of flower heart shape, ten varieties had circular to pentagonal heart shape, seven varieties had circular heart shape and five varieties had pentagonal heart shape.
- On the basis of petal venation colour, fifteen varieties had blue colored veins, five had white veins and only three varieties had violet colored veins.
- On the basis of petal shape, ten had circular petal shape, eight varieties had elliptical shape and five had narrow petal shape.
- On the basis of petal margin, fourteen varieties had crenate margin, five varieties had coarsely crenate margin and four varieties had even margin.
- On the basis of leaf shape, nine varieties were grouped under lanceolate shape leaves, nine varieties were grouped under linear shape and five were grouped under oval leaf shape.
- On the basis of organ position, eight varieties had anthers closely surrounding the stigma, five varieties had anthers surrounding stigma openly and five varieties had stigma below anthers.
- On the basis of plant growth habit, fifteen had semi-erect growth habit, seven had erect growth habit and only one had bushy growth habit.
- On the basis of plant height, fifteen were of medium height, five were of tall height and three were of short height.
- On the basis of seed colour, eighteen varieties had brown colored seeds, three varieties had dark brown seeds and only two varieties had light brown colored seeds.
- On the basis of seed shape, ten varieties had elongate shaped seeds, ten varieties had medium shaped seeds and only three varieties had round shaped seeds.

The result shows similarity with Kerkhi *et al.* (2002) ^[4] who studied diverse linseed genotypes and categorized them by taking various specifying quantitative and morphological characters. Similarly, Dhirhi *et al.* (2016) ^[3] studied 150 linseed genotypes for DUS testing using morphological and yield contributing traits.

Table 1: DUS (Distinctness, Uniformity and Stability) descriptors for linseed genotypes under study. As per Catalogue on linseed germplasm, Project Coordinating Unit (Linseed), Kanpur, (2010).

Trait	Descriptors	Name of variety	No. of variety	Frequency
Flower colour	Blue	R-7, R-17, Kartika, RLC-143, RLC-171, RLC-187	6	26.08%
	Tinge blue	Deepika, RLC-92, RLC-133, RLC-148, RLC-153, RLC-161, RLC-164, RLC-167, RLC-197, RLC-199	10	43.47%
	Violet blue	R-552	1	4.34%
	Violet	Kiran	1	4.34%
	White	RLC-133, RLC-201, RLC-202, RLC-203, RLC-204	5	21.73%
Flower shape	Disc	Kartika, RLC-92, RLC-138, RLC-148	4	17.39%
	Funnel	R-7, R-17, Kiran, R-552, Deepika, RLC-143, RLC-153, RLC-161, RLC-164, RLC-167, RLC-171, RLC-187, RLC-197, RLC-199, RLC-201, RLC-203, RLC-204	17	73.91%
	Star	RLC-133, RLC-202	2	8.69%
Flower size (mm)	Small	RLC-203, RLC-204	2	8.69%
	Medium	R-7, R-17, Kiran, R-552, Deepika, RLC-133, RLC-138, RLC-143, RLC-148, RLC-153, RLC-161, RLC-164, RLC-167, RLC-187, RLC-197, RLC-199, RLC-201	18	78.26%
	Large	Kartika, RLC-92, RLC-171	3	13.04%
Anther colour	Blue	R-7, R-17, Kiran, R-552, RLC-138, RLC-143, RLC-153, RLC-161, RLC-164, RLC-167, RLC-171, RLC-187, RLC-199, RLC-204	14	60.86%
	Grey	Kartika, Deepika, RLC-92, RLC-148, RLC-197	5	21.73%
	Cream	RLC-133, RLC-201, RLC-202, RLC-203	4	17.39%
Filament	White	R-7, R-17, R-552, Kartika, Deepika, RLC-92, RLC-133, RLC-138, RLC-143, RLC-148,	22	95.6%

colour		RLC-153, RLC-161, RLC-164, RLC-171, RLC-187, RLC-197, RLC-199, RLC-201, RLC-2-2, RLC-203, RLC-204		
	White filament with blue at distal end	Kiran	1	4.34%
Stigma and Style	Blue stigma and white style	R-7, RLC-153, RLC-161, RLC-164, RLC-167, RLC-187	6	26%
	White stigma and white style	R-17, Kiran, R-552, Kartika, Deepika, RLC-92, RLC-133, RLC-138, RLC-143, RLC-148, RLC, 171, RLC-197, RLC-199, RLC-201, RLC-202, RLC-203, RLC-204	17	74%
Flower heart shape	Circular to pentagonal	R-17, Kiran, Kartika, Deepika, RLC-148, RLC-153, RLC-161, RLC-164, RLC-197, RLC-199	10	43.47%
	Circular	RLC-92, RLC-133, RLC-138, RLC-171, RLC-201, RLC-202, RLC-203	7	30.43%
	Pentagonal	R-7, R-552, RLC-143, RLC-167, RLC-187	5	21.73%
Petal venation colour	Blue	R-17, Kartika, Deepika, RLC-92, RLC-138, RLC-243, RLC-248, RLC-153, RLC-161, RLC-164, RLC-167, RLC-171, RLC-187, RLC-197, RLC-199	15	65.21%
	White	RLC-133, RLC-201, RLC-202, RLC-203, RLC-204	5	21.73%
	Violet	R-7, Kiran, R-552	3	13.04%
Petal shape	Circular	R-7, R-17, Kiran, Kartika, Deepika, RLC-92, RLC-138, RLC-143, RLC-148, RLC-153	10	43.4%
	Elliptical	R-552, RLC-161, RLC-164, RLC-167, RLC-171, RLC-187, RLC-197, RLC-199	8	34.7%
	Narrow	RLC-133, RLC-202, RLC-202, RLC-203, RLC-204	5	21.74%
Petal margin	Crenate	R-17, Kiran, R-552, RLC-92, RLC-138, RLC-143, RLC-148, RLC-161, RLC-164, RLC-171, RLC-187, RLC-197, RLC-199, RLC-201	14	60.86%
	Coarsely crenate	R-7, RLC-133, RLC-202, RLC-203, RLC-204	5	21.73%
	Even	Kartika, Deepika, RLC-153, RLC-167	4	17.39%
Leaf shape	Lanceolate	R-7, R-17, Deepika, RLC-133, RLC-197, RLC-199, RLC-201, RLC-203, RLC-204	9	39.13%
	Linear	R-552, RLC-92, RLC-143, RLC-153, RLC-161, RLC-164, RLC-167, RLC-202	9	39.13%
	Oval	Kiran, Kartika, RLC-138, RLC-248, RLC-171	5	21.73%
Organ position	Anthers surround stigma closely	R-7, R-17, Kiran, R-552, Kartika, Deepika, RLC-171, RLC-197, RLC-199, RLC-202, RLC-203, RLC-204	8	34.7%
	Anthers surround stigma openly	RLC-92, RLC-133, RLC-138, RLC-167, RLC-187, RLC-201	5	21.73%
	Stigma below anthers	RLC-143, RLC-148, RLC-153, RLC-161, RLC-164	5	21.73%
Plant growth habit	Erect	RLC-92, RLC-133, RLC-161, RLC-164, RLC-167, RLC-203, RLC-204	7	30.43%
	Semi-erect	R-7, R-17, Kiran, R-552, Kartika, Deepika, RLC-138, RLC-143, RLC-153, RLC-171, RLC-187, RLC-197, RLC-199, RLC-201	15	65.21%
	Bushy	RLC-202	1	4.34%
Plant height	Tall	RLC-167, RLC-203, RLC-204, RLC-187, RLC-199	5	21.73%
	Medium	R-7, R-17, R-552, Kartika, Deepika, RLC-92, RLC-133, RLC-138, RLC-143, RLC-148, RLC-153, RLC-161, RLC-164, RLC-171, RLC-197	15	65.21%
	Short	R-17, Kiran, RLC-202	3	13.04%
Seed colour	Brown	R-7, R-17, Kiran, R-552, Kartika, Deepika, RLC-92, RLC-133, RLC-138, RLC-143, RLC-148, RLC-164, RLC-171, RLC-197, RLC-199, RLC-202, RLC-203, RLC-204	18	78.26%
	Dark Brown	RLC-153, RLC-161, RLC-167	3	13.04%
	Light Brown	RLC-187, RLC-201	2	8.69%
Seed shape	Round	R-7, Kartika, RLC-133	3	13.05%
	Medium	R-17, Kiran, R-552, RLC-143, RLC-167, RLC-187, RLC-197, RLC-199, RLC-202, RLC-204	10	43.47%
	Elongated	Deepika, RLC-92, RLC-138, RLC148, RLC-153, RLC-161, RLC-164, RLC-171, RLC-201, RLC-203	10	43.47%

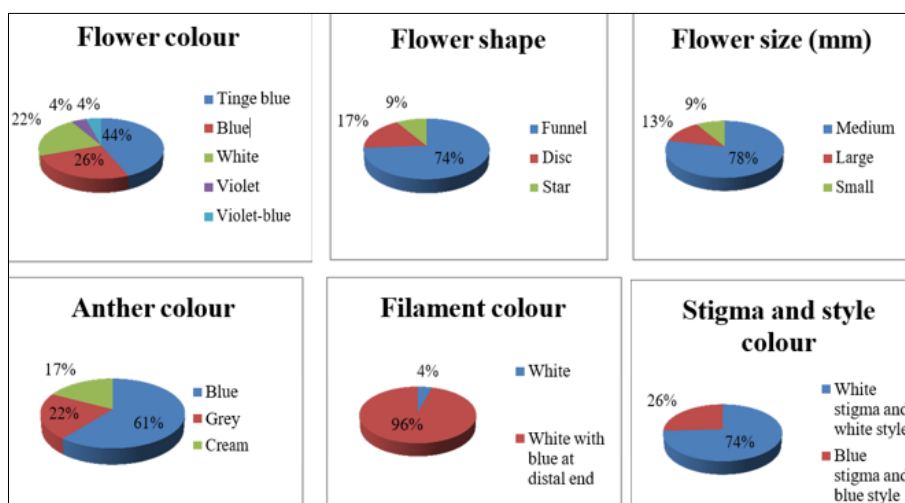


Fig 1: Graphical representation of morphological characters in linseed varieties through pie charts

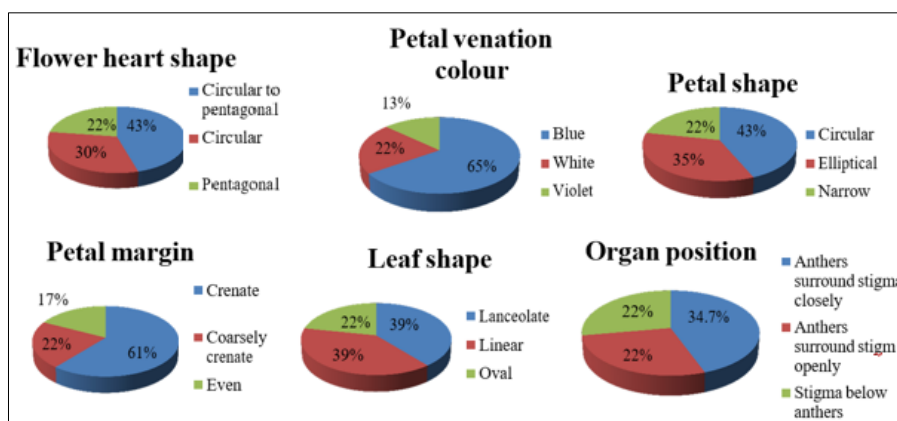


Fig 2: Graphical representation of morphological characters in linseed varieties through pie charts (cont.)

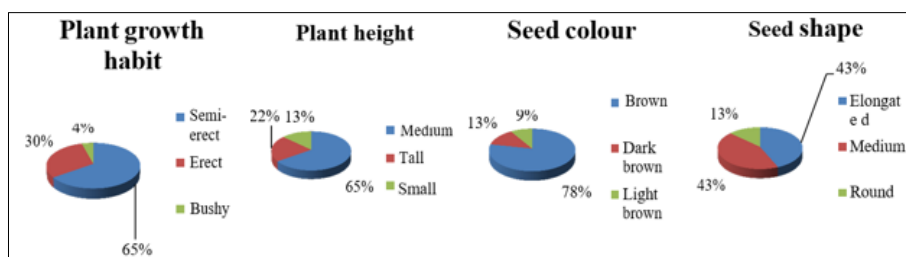


Fig 3: Graphical representation of morphological characters in linseed varieties through pie charts (cont.)

4. Conclusion

- DUS testing of morphological characters of linseed showed significant amount of distinctiveness for characters viz., flower colour, anther colour, flower heart shape, petal venation colour, petal shape, petal margin, leaf shape, organ position, and seed shape.
- The characters like petal shape, flower size, plant growth habit and plant height (cm), style and stigma colour exhibited lesser classes of distinctiveness suggesting that these traits are useful in distinguishing varieties in broad level.
- The characters like filament colour and seed colour were almost uniform of majority of varieties

distinctness, uniformity and stability for Flax/linseed. TG/57/7 Flax UPOV, Geneva; c2011.

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