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Characterization of Linseed Varieties Based on Seed Coat Colour

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ABSTRACT Seed coat colour is an important trait for verification and protection of linseed varieties. Due to continuous note it is very difficult to place the varieties in the neighboring notes. By naked eye the varieties were categorized in five states with considerable amount of error. RHS colour chart reduced the error and grouped the varieties in five states, whereas Hunter's colour lab categorized the linseed varieties in eight states with minimum error.

Key words: Seed colour, RHS colour chart, Hunter's colour lab

Linseed (*Linum usitatissimum* L.) is an important oilseed crop of rainfed areas of winter season. Nearly 16 characteristics have bean listed for Distinctness, Uniformity and Stability test of the varieties [1]. Out of 16 distinguishing characteristic only three are at seed level *viz.*, seed size, seed weight and seed colour. Seed size and seed weight are highly influenced by environment.

Seed coat colour is an important trait for verification, establishment of distinctness and testing of genetic purity at seed level. National Test Guidelines categorizes linseed varieties in five states. The allotted note for the expression of the trait is continued (Table 1) therefore it is very difficult to place the varieties in the adjoining note. Considering the complexity in finalizing the seed coat colour with naked eye the present investigation was carried out.

Seed colour has become an important trait in linseed because of high demand of zero linolenic acid in oil. On the other hand high-linolenic cultivars are in demand in health food markets. Low alpha-linolenic acid Omega 3 fatty acid oil is good for cooking. The substances such as omega-3, omega-6, and omega-9 present in flax seed oil are phytoestrogens that regulate the immune system and help to maintain the hormone balance. The unique phytochemical elements have been isolated from the linseed, which once consumed are converted to effective cancer-fighting and cancer-preventative compounds known as mammalian lignans. The flax seeds are the richest source of plant lignans; they contain about 100 times more than the other plant sources. Seed colour is used to classify the varieties with high linolenic acid with brown seed, and low linolenic acid variety with light to yellow-seeds [2].

MATERIALS AND METHODS

Seeds of 72 notified varieties of linseed received from Project Coordinator Linseed, Kanpur, to test the Distinctiveness, Uniformity and Stability of the extant varieties for implementation of PPV and FR act were grown in randomized complete block design with two replications, number of rows 7, row length 5m, row to row distance 30cm and plant to plant distance 10cm. Properly sun-dried, well-developed and healthy seeds (<9% moisture) were scanned for seed coat colour in continuous four years (2003-4 to 2006-7) after one-month storage as per National Test Guidelines [1] by visual assessment, Colour Chart of Royal Horticulture Society [3] and Hunter's Colour lab [4].

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RESULTS AND DISCUSSION

Naked eye observation classified the varieties in five groups. Observations of the seed coat colour of the same variety by naked eye were not stable over the replications (two), years (five) and observed especially for dark, medium and light shade of brown. The naked eye classification placed maximum varieties under light, medium and dark brown shade. The variation was minimum between two note difference *i.e.*, light and dark brown but maximum between light and medium brown and medium and dark brown (Table 1).

To reduce the error the seed coat colour was recorded with the help of Colour Chart of Royal Horticulture Society [3] developed to match nature's own colours with the help of 884 shades of four groups of easy-to-use fans. The RHS Colour Chart is the standard reference for plant colour identification and used by food manufacturers to standardize food colourings, chemical engineering companies and fabric designers.

The RHS colour chart classified all the varieties of linseed under greyed colors of yellow, orange, red, purple, green, brown, grey, black and white *i.e.*, 160 B to 177 D (Table 2) in seven states. Classification was simple and accurate for the colour of different number *i.e.*, 160, 161 and 177. But differentiation between the group 161 A and B and 177 A, B, and D may vary over the replication and year. The accuracy also depends on the light intensity during observations.

To minimize the error the seed coat colour was measured with the help of Hunter's Colour lab colour flex (Table 4) with the geometry of 45°/0 using D 65/10° illumination. Measurement was done in terms of CIE L* (lightness); a* (redness and greenness) and b* (yellowness and blueness). It classified varieties in eight states without any variation over the replication and precision of observer as Brown I, Brown II, Brown III, Brown IV and Brown V, Chocolate, Fawn and Yellow (Table 3). As the Hunter's Colour Lab eliminate human error and increases the number of group therefore may be recommended to classify the varieties of all the crops especially for providing protection.

The varieties under group I PKDL-41 and Rashmi designated as Brown I had least value for white and low for red and yellow; for the group Brown II white was 36.26 to 37.95 redness

Table 1. Classification of linseed varieties based on expression of seed coat colour as per National Test Guideline by naked eye

Colour	Note	Reference	Varieties	Number
Fawn	1	Gaurav	Gaurav	01
Yellow	2	Surabhi	KL 210, KL 221 , LC 185, Surabhi	04
Light brown	3	Sweta	Garima, Jawahar 23, Jeevan, KL 224, LC 2023, LMS-95-4, Meera, Nagarkot, NL 97, NL 126, Padmini, Parvati, PKDL 21, Pusa 2, Rashmi, RL 914, RLC 81, RLC 95, RLC 100, S 36, SLS 27, Sweta	22
Brown	4	Neelum	Chambal, Himalini, Himalsi 1, Himalsi 2, Janki, JLS 9, Kiran, KL 215, LC 54, LC 2063, LCK 4036, LMS-4-27, LMS-9-2k, Mukta, Neela, Neelum, NL 165, OLC 10, Pusa 3, PKDL 41, R 552, RL 2206, RLC 94, RLC 95, RLC 102, RLC 106, RLU 6, Shekhar, Shikha, SLS 66	30
Dark brown	5	Laxmi 27	C 429, Hira, Jawahar 1, Jawahar 7, Jawahar 17, K 2, Kiran, LC 2279-4, Laxmi 27, LMS 153-3, PKDL 42, RLC 92, Sheela, Shubhra, T 397	15

Table 2. Classification of linseed varieties based on expression of seed coat colour with the help of RHS colour chart

	Shade	Colour	Group	Varieties	Number
Greyed colors of yellow, orange, red, purple, green brown, grey, black and white	160 B	Greyed-Yellow	B	LC 185	01
	161 A	Greyed-Yellow	A	Gaurav, KL 210, KL 221	03
	161 B	Greyed-Yellow	B	Surabhi	02
	177 A	Greyed-Orange	A	Himalsi1, NL 126, PKDL 21, Rashmi, RLC 100, RLC 95 C 429, Chambal, Himalini, Himalsi 2, Hira, Janki, Jawahar 23, Jeevan, JL 226, JLS 9, KL 215, KL 224, Laxmi 27, LC 2023	06
	177 B	Greyed-Orange	B	LC 2063, LC 54, LCK 4036, LMS 4-27, LMS 9-2K, LMS 954, Meera, Mukta, Neelum, NL 165, OLC 10, Padmini, Parvati, PKDL 41, Pusa 2 Pusa 3, R 552, RL 2206, RL 914, RLC 102, RLC 106, RLC 81, RLC 92, RLU 6, Shekhar, Shubhra, SLS 27, SLS 66, Sweta, T 397	44
	177 C	Greyed-Orange	C	Garima Jawahar 1, Jawahar 17, K 2, Kiran, LC 2279-4, Nagarkot, Neela, NL 97, PKDL 42, RLC 94, S 36, Sheela, Shikha	14
	177 D	Greyed-Orange	D	Jawahar 7, LMS 1533	02

Table 3. Classification of linseed varieties based on seed coat colour by Hunter's colour chart

Colour	Varieties	
Brown I	PKDL 41, Rashmi	02
Brown II	RLC 100, PKDL 21, RLC 92, NL 165, Laxmi 27, Sweta, Pusa 3, Hira, Himalini, RLC 102, K 2, KL 224,Chambal, Shekhar, RLC 106, RLC 95, T 397, R 552, Jeevan, LMS 9-2K, Nagarkot, Sheela, OLC 10, LMS153-3	02
Brown III	Kiran, NL 126, Janki.KL 226, Jawahar 23, Mukta, LC 54, Himalsi 1, KL 215, Shubhra, LMS4-27, Himalsi 2, PKDL 42, Himani, SLS 66, JLS 9, C429, Pusa 2, RLC 81, RL 2206	20
Brown IV	Meera, S 36, LCK 4036, Padmini, NL 97, SLS 27, RL 914, Jawahar 1, Parvati, Jawahar 7, LC 2279-4, RLC 94, LMS95 4, LC 2063, Neelum, Garima, Neela, RLU 6	18
Brown V	Jawahar 17, Shikha, LC 2023	03
Chocolate	Gaurav	01
Fawn	KL 210, Surabhi	02
Yellow	KL221, LC185	02

Table 4. Comparison of expression of seed coat colour based on RHS colour chart and Hunter's colour lab

S.No.	Varieties	Seed color (RHS chart)	Seed color (Hunter colorimeter)			Remark	
			L*	a*	b*	L*a*b*	Group
1.	PKDL-41	177 B	35.27	7.62	14.67	Least white	Brown I
2.	Rashmi	177 A	35.79	8.53	14.09	Low red and yellow	
3.	RLC-100	177 A	36.26	9.66	16.13		
4.	PKDL-21	177 A	36.32	8.90	15.56		
5.	RLC-92	177 B	36.33	9.64	16.22		
6.	NL-165	177 B	36.53	9.31	16.17		
7.	Laxmi 27	177 B	36.61	9.09	16.18	36.26-37.95	
8.	Sweta	177 B	36.63	8.88	15.13	White	
9.	Pusa-3	177 B	36.87	9.27	15.18		
10.	Hira	177 B	36.97	9.20	16.51	8.08-10.0	
11.	Himalini	177 B	37.08	8.69	16.49	Redness	
12.	RLC-102	177 B	37.15	9.05	15.68		
13.	K-2	177 C	37.17	8.08	15.17	15.13-17.76	Brown II
14.	KL-224	177 B	37.17	8.91	15.79	Yellowness	
15.	Chambal	177 B	37.17	9.24	15.57		
16.	Shekhar	177 B	37.33	8.89	15.20		
17.	RLC-106	177 B	37.46	9.09	16.11		
18.	RLC-95	177A	37.52	8.38	15.31		
19.	T-397	177 B	37.60	8.88	16.08		
20.	R-552	177 B	37.70	8.40	15.81		
21.	Jeevan	177 B	37.71	8.83	15.57		
22.	IMS 9-2K	177 B	37.83	10.0	17.76		
23.	Nagarkot	177 C	37.84	8.89	15.35		
24.	Sheela	177 C	37.86	8.68	15.38		
25.	OLC-10	177 B	37.94	8.71	16.06		
26.	LMS 153-3	177 D	37.95	8.43	15.26		

27.	Kiran	177 C	38.02	9.54	16.46		
28.	NL-126	177 A	38.06	8.88	16.69	38.02-38.84	
29.	Janki	177 B	38.08	8.71	15.20	white	
30.	KL-226	177 B	38.11	8.77	16.05		
31.	Jawahar-23	177 B	38.11	9.01	16.08	8.10-9.54	
32.	Mukta	177 B	38.12	8.10	15.17	redness	
33.	LC-54	177 B	38.15	9.33	17.47		
34.	Himalsil	177 A	38.17	9.45	16.74		
35.	KL-215	177 B	38.22	9.11	16.36	15.17-17.47	
36.	Shubhra	177 B	38.28	8.33	15.49	yellowness	Brown III
37.	IMS 4-27	177 B	38.31	8.15	15.18		
38.	Himalsi2	177 B	38.38	9.11	16.46		
39.	PKDL-42	177 C	38.38	9.53	16.38		
40.	Himani	177 B	38.50	8.97	16.63		
41.	SLS-66	177 B	38.51	9.44	17.46		
42.	JLS-9	177 B	38.60	9.02	16.48		
43.	C429	177 B	38.68	8.82	16.24		
44.	Rjsa-2	177 B	38.68	9.09	17.15		
45.	RLC-81	177 B	38.73	9.30	16.40		
46.	RL-2206	177 B	38.84	8.69	16.47		
47.	Meera	177 B	39.09	8.72	16.66		
48.	S-36	177 C	39.12	8.57	17.30		
49.	LCK-4036	177 B	39.22	7.97	16.10		
50.	Padmini	177 B	39.29	9.25	17.52		
51.	NL-97	177 C	39.30	8.85	16.99	39.09-39.97	
52.	SLS-27	177 B	39.42	7.86	16.27	white	
53.	RL-914	177 B	39.50	8.56	16.43		
54.	Jawahar-1	177 C	39.63	7.50	15.23	7.30- 9.47	
55.	Parvati	177 B	39.67	8.16	15.85	redness	Brown IV
56.	Jawahar-7	177 D	39.69	7.30	14.91		
57.	LC-2279-4	177 C	39.74	8.26	16.48		

58.	RLC-94	177 C	39.76	8.71	18.08	14.91-18.01	
59.	IMS 95-4	177 B	39.77	8.05	15.88	yellowness	
60.	LC-2063	177 B	39.77	8.30	16.46		
61.	Neelum	177 B	39.78	7.51	15.38		
62.	Garima	177 C	39.84	9.47	18.01		
63.	Neela	177 C	39.96	8.77	17.76		
64.	RLU-6	177 B	39.97	8.73	16.82		
65.	Jawahar-17	177 C	40.23	7.30	14.65		Brown V
66.	Shikha	177 C	40.26	8.28	17.15		
67.	LC-2023	177 B	40.67	7.87	16.14		
68.	Gaurav	161 A	50.50	8.13	25.47		Chocolate
69.	KL-210	161 A	55.86	7.24	30.15		Fawn
70.	Surabhi	161 B	57.52	7.20	29.76		
71.	KL-221	161 A	58.27	8.26	30.13	Highest white,	Yellow
72.	LC-185	160 B	59.81	7.02	32.86	low red and high yellow	

*High value of L shows more whiteness; a redness and b yellowness

Direction	Code	Value	Colour
Positive	a	High	Redness
Negative	a	High	Greeneness
Positive	b	High	Yellow
Negative	b	High	Blue
Lightness	L	100	White
Lightness	L	0	Black

8.08 to 10.0 and yellowness 15.13-17.76; Brown III white 38.02 to 38.84 redness 8.10 to 9.54 and yellowness 15.17 to 17.47. For Brown IV group white ranged from 39.09 to 39.97 redness from 7.30 to 9.47 and yellowness from 14.91 to 18.01 and for last group of Brown i.e., V white is near 40 redness from 7.30-8.28 and yellowness 14.65 - 17.15.

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