

Varietal Performance and Nutrient Effects on Linseed Growth and Yield

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Abstract

Linseed is a valuable but underused oilseed crop worldwide. It has various applications, including use as food and feed, use in industry, textile industry, as raw material for pharmaceuticals, etc. It is a fantastic source of Omega 3 fatty acids and may be used in place of non-fish esters. Research in a variety of disciplines, including plant breeding, agronomy, and food science, can help increase the nutritional value of linseed. At the Research Farm C.S.A. university agriculture and technology Research Centre, Kanpur (U.P), a field experiment was conducted in 2023–2024 to investigate the "Performance of varieties and nutrient levels on growth and yield of linseed (*Linum usitatissimum* L.)". The results demonstrated that variety V1 (RLC-92) had significantly greater values for plant height (70.84 cm), primary (4.11) and secondary branches per plant (22.86), dry matter accumulation (7.44), number of capsule plant-1 (60.78), number of seed capsule-1 (8.33), test weight (7.34 g), seed yield (1483.70 kg/ha), straw yield (3290.58 kg/ha), harvest index (31.07 %), and benefit cost ratio (2.41) when compared to the other varieties, but it was on par with V5 (RLC-148). In terms of nutrient levels, treatment F3 (150% RDF) produced considerably superior growth and yield characteristics compared to F1 (50% RDF), including plant height (62.17 cm), primary (4.09), and secondary branches per plant (21.96), dry matter accumulation (7.81), number of capsule plant-1 (60.24), number of seed capsule-1 (8.39), test weight (7.44 g), seed yield (1409.25 kg/ha), straw yield (3223.11 kg/ha), and harvest index (30.40). However, F3 was on par with 100% RDF (F2) except for the B:C ratio. The highest B:C ratio was obtained by F2 (2.13), but since the difference between F3 and F2 in terms of yield and yield attributes was insignificant, the nutrient level of F2 (100% RDF) is economically viable for the linseed crop.

Key word: Linseed, Nutrient levels, Agronomy, Economics Variety and Yield attributes

Introduction

The oilseed industry is a significant component of the agricultural economy, and India is a major producer of oilseeds worldwide. India is the world's fifth largest producer of flaxseed. Linseed is cultivated in India in an area of 3.31 lakh ha. with a production of 1.72 lakh tonnes and a yield of 523 kg/ha. [anonymous 2017–18]. Linseed grown in U.P. state in an area of 0.45 lakh ha. yields 0.14 lakh tonnes with a productivity of 301 kg/ha [anonymous 2017-18]. Linseed is made up of 4% ash, 6% carbohydrates, 21% protein, 28% dietary fiber, and 40% fat (Vaisey-Genser and Morris, 2010). The linseed plant is a rich source of both edible and nonedible oil. Industrial oil is a crucial component in the production of paint, varnish, and

stain (Matheson, 1976). Edible linseed oil, which is used for human consumption, includes alpha-linolenic acid (ALA), a polyunsaturated fatty acid with health and nutritional advantages (Wood, 1997; Flax Council of Canada, 2004). In Chhattisgarh state, the output of linseed is lower than the national average. In this state, the poor productivity of linseed is caused by a number of reasons, but the most important ones are the selection of better varieties that are appropriate for the environment and the proper use of fertilizer. Depending on a number of physiological processes that are influenced by both genetics and the environment, different kinds have varying yields. The truth is that a given genotype does not display the same phenotypic traits under all environmental circumstances, and various genotypes react differently to a given environment, typically with varying relative rankings (Ebehort and Russel, 1966). Another important factor in boosting productivity is plant nutrition. When cultivated for fiber, flax is referred to as "linseed"; when grown for oil purposes, it is referred to as "linseed"; and when grown for both, it is referred to as "dual purpose flax." The species name usitatissimum means "most useful," while the word *Linum* comes from the Latin word *lin*, which means "thread." In Indian languages, it is also well known by the names *Alsi*, *Tisi*, *Jawas*, and *Aksebijja*. Linseed is now grown in Russia, the United States, Argentina, Uruguay, India, Pakistan, China, Japan, Morocco, and Australia. The nutritional value of linseed is contingent upon a number of variables, including genetics, growth environment, biotic and abiotic stresses, post-harvest handling (processing), and even how the end consumer uses it (Morris, 2007). Linseed is a wonderful source of necessary fatty acids and may be considered a substitute for omega-3 fatty acids for vegetarians. Its oil content, which can fluctuate between 33 and 47% depending on a variety of variables, is between 33 and 47%. Around 20% of the total oil produced in India is used by farmers, while the remaining 80% goes to industries in several forms, including boiled oil, borated oil, eposidized oil, aluminates oil, urethane oil, isomerizes oil, etc. Linseed oil is high in alpha-linolenic acid (ALA), with roughly 55% ALA content, and it also has a high concentration of lignin and dietary fiber. In addition to having a pleasant flavor, it also has an abundance of omega-3 fatty acids and micronutrients. Out of its 36% protein content, 85% is made up of digestive ty acids (Mueller et.al 2010).

Materials and Method

Study Area

The field experiment was carried out at the Research Farm of C.S.A. university Agriculture and technology Research Center, Kanpur (U.P.), at 22.09°N latitude, 82.12°E longitude, and 292 meters above mean sea level during the Rabi season of 2023–24. India's Eastern plateau and hill area (Agro-climatic zone-VII) includes the area. The state of U.P. is divided into three agro-climatic zones, one of which is the state zone of the U.P. plains, where Kanpur is located. The experimental site's soil had a sandy loam texture, a neutral reaction (pH 7.09), a low nitrogen content (237.5 kg ha⁻¹), a moderate phosphorus content (14.34

kg ha⁻¹), a high potassium content (361.09 kg ha⁻¹), and a low organic matter content (0.60%).

Details about treatment

The treatment, which included three nutrient levels—F1 [50% RDF], F2 [100% RDF], and F3 [150% RDF]—and five varieties, namely (V1) RLC-92, (V2) RLC-133, (V3) RLC-138, (V4) RLC-143, and (V5) RLC148.

crop management

On November 9, 2023, the crop was planted, and at maturity of the varieties, it was harvested (RLC-133 on March 2, 2023; RLC-92, RLC138, and RLC-148 on March 7, 2024; and RLC-143 on March 11, 2024).

Statistical Analysis

The information on various growth and yield factors was recorded using conventional methods. The method described by Gomez and Gomez (1984) was used to statistically analyze the collected data.

Result and Discussion

Growth, yield attributing characters and yield of linseed

The ultimate outcome of the interaction of several factors contributing to growth, development, and yield is the seed yield. The data presented in tables 1 and 2 indicated that yield, yield-related traits, and growth were all considerably impacted by nutrient levels and varieties. Compared to the other variety, variety V1 (RLC-92) produced notably higher plant height (70.84 cm), primary branches plant⁻¹ (4.11), secondary branches plant⁻¹ (22.86), dry matter accumulation (7.44), number of capsule plant⁻¹ (60.78), number of seed capsule⁻¹ (8.33), test weight (7.34 g), seed yield (1483.70 kg/ha), straw yield (3290.58 kg/ha), and HI (31.07 %). The number of seeds per capsule, test weight (g), seed yield (kg/ha), straw yield (kg/ha), and harvest index (%), on the other hand, were comparable to V5 (RLC-148). With V3 (RLC-138), the lowest values were seen for the number of main branches per plant (3.49), secondary branches per plant (19.76), dry matter accumulation (6.63g), number of capsules per plant (47.74), number of seeds per capsule (7.67), seed yield (1151.86 kg ha⁻¹), straw yield (2921.37 kg ha¹), and harvest index (28.31). The variety V4 (RLC-143) had the lowest plant height (49.23 cm) and test weight (6.90 g). The difference between the varieties V1& V5 was not statistically significant, making both varieties suitable for this area. Differences in the growth and yield-related characteristics of the cultivars, such as plant height, number of branches, number of capsules per plant, number of grains per

capsule, and test weight, may have contributed to the increase in yield, which led to an improvement in the overall kilogram ha⁻¹ production of linseed grain. The results were consistent with the findings of Lodhi and Chauhan et al. (2002), Gokhale et al. (2008), Prakash et al. (2015), and Kurrey et al. (2019). Similarly, in nutrient levels, the application of 150% RDF (F3) resulted in a significantly higher value of growth parameters, namely plant height (62.17 cm), number of primary branches plant⁻¹ (4.09), secondary branches plant⁻¹ (21.96), and dry matter accumulation (7.81 g), compared to 50 % RDF (F1) and 100% RDF (F2). Applying 50 % RDF (F1) resulted in the lowest plant height (56.24 cm), number of primary branches plant⁻¹ (3.35), number of secondary branches plant⁻¹ (20.07), and dry matter accumulation (6.16 g). In the treatment F3 (150 % RDF), the yield and yield-attributing traits—capsules per plant (60.24), seed per capsules (8.39), test weight (7.44 g), seed yield (1409.25 kg ha⁻¹), straw yield (3223.11 kg ha⁻¹), and harvest index (30.41 %)—were significantly higher than in the treatment F1 (50 % RDF), but statistically equivalent to the treatment F2 (100 % RDF). The application of 50 % RDF (F1) resulted in the lowest capsules per plant (46.96), seed per capsules (7.47), test weight (6.84 g), seed yield (1139.92 kg ha⁻¹), straw yield (2937.07 kg ha⁻¹), and harvest index (27.91 %). However, the difference between the yield and yield characteristics of F3 and F2 was not significant, which may be due to the increase in yield-attributing characters with the application of 150 % RDF. Devedee et al., (2019) and Kumar et al., (2016) came to similar conclusions.

The economics of linseed

The cost of cultivation was roughly the same for all five linseed kinds (Rs 19129.19 ha⁻¹). The variety V1 (RLC-92) had a significantly higher Gross return (Rs 65283.85 ha⁻¹), net return (Rs46154.65 ha⁻¹), and B: C ratio (2.41) than other varieties, but was on par with V5 (RLC-148). The higher grain yield received with V1 and V5 is the cause of the increase in gross return, net return, and B: C. The results were supported by Maurya et al.'s (2017) findings. The lowest gross return (Rs 50682.64 ha⁻¹), net return (Rs31553.45 ha⁻¹), and B: C ratio (1.65) were all found in V3 (RLC-138). In the same way, when using 50% RDF (F1), which has a higher nutrient content, the cost of farming was the lowest (Rs17598.19 ha⁻¹).

Table.1 Effect of varieties and nutrient levels on growth attributes of linseed at harvest

Treatment	Plant height (cm)	Primary branches plant ⁻¹	Second branches plant ⁻¹	Dry matter accumulation(g)
A. Varieties				
V1-RLC-92	7.84	4.11	22.86	7.44
V2-RLC-133	59.02	3.62	20.71	6.89
V3-RLC-138	50.42	3.49	19.76	6.63
V4-RLC-143	49.23	3.58	20.04	6.81
V5-RLC-148	64.34	3.80	21.89	7.00
S. Em+-	1.21	0.07	0.52	0.16
CD at 5%	3.49	0.21	1.51	0.45

B. Nutrient levels				
N1-50% RDF	56.24	3.35	20.07	6.16
N2-100% RDF	57.90	3.72	21.13	6.89
N3-150% RDF	62.17	4.09	21.96	7.81
S.Em+-	0.93	0.06	0.40	0.12
C.D at 5%	2.71	0.16	1.17	0.35
C. Interaction				
S.Em+-	2.09	0.12	0.90	0.27
CD at 5%	NS	NS	NS	NS

Table.2 Yield attributing characters and yield of linseed as influenced by varieties and nutrient levels

Treatment	Capsule/plant	Seeds/capsule	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg ha ⁻¹)	Harvest index (%)	B:C Ratio
A. Varieties							
V1-RLC-92	60.78	8.33	7.34	1483.70	3290.58	31.07	2.41
V2-RLC-133	53.63	7.95	7.08	1281.95	3062.33	29.47	1.94
V3-RLC-138	47.74	7.67	7.27	1151.86	2921.37	28.31	1.65
V4-RLC-143	52.15	7.82	6.90	1176.42	2949.69	28.38	1.70
V5-RLC-148	55.86	8.18	7.25	1426.40	3222.48	30.66	2.28
S. Em+-	2.38	0.13	0.11	26.16	73.03	0.48	0.06
C.D at 5%	6.88	0.37	0.30	75.78	211.52	1.39	0.18
B. Nutrient levels							
N1-50% RDF	46.96	7.47	6.84	1139.92	2937.07	27.91	1.85
N2-100% RDF	54.89	8.12	7.22	1363.03	3107.70	30.40	2.13
N3-150% RDF	60.24	8.39	7.44	1409.25	3223.11	30.41	2.01
S.Em+-	1.84	0.10	0.08	20.27	56.57	0.37	0.05
CD at 5%	5.33	0.28	0.24	58.70	163.85	1.07	0.14
C. Interactions							
S.Em+-	4.11	0.22	0.18	45.32	126.50	0.83	0.11
CD at 5%	NS	NS	NS	NS	NS	NS	NS

Treatment F3 (150% RDF) recorded a significantly higher cost of cultivation (Rs20660.20 ha⁻¹), Gross return (Rs 62008.03 ha⁻¹), and net return (Rs 41347.83 ha⁻¹) as compared to treatment F1 (50 % RDF) but was statistically equal to treatment F2 (100% RDF) expect benefit cost ratio. Treatment F2 gave high benefit- cost ratio (2.13). The lowest gross return (Rs 50157.48 ha⁻¹), net return (Rs 32559.29 ha⁻¹) and benefit cost ratio (1.85) was recorded treatment F1(50 % RDF).

Conclusion

As a conclusion, it may be said that the linseed variety V1 (RLC-92) outperformed V5 (RLC-148) in all growth and yield-attributing features during the field trial conducted during the rabi season of 2023–2024. Both varieties are appropriate for this area because the difference in variety between V1 and V5 was not considerable. Similarly, in nutrient levels, the treatment F3 obtained significantly superior over F1 but was at par with treatment F2

however since the difference in yield and yield attributes between F3 and F2 was non significant. Therefore, a nutrient level of F2 (100%) is financially feasible for flax.

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