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Performance of Varieties and Nutrient Levels on Growth and Yield of Linseed (*Linum usitatissimum* L.)

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A B S T R A C T

A field experiment was conducted to study the"Performance of varieties and nutrient levels on growth and yield of linseed (*Linum usitatissimum* L.)" at the Research Farm of Barrister Thakur Chhedilal, College of Agriculture and research Station, Bilaspur (Chhattisgarh) during 2019-20. The result revealed that growth and yield parameter like plant height (70.84 cm), primary (4.11), & 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 %), & benefit cost ratio (2.41) were significantly higher with variety V_1 (RLC-92) as compared to the other variety but was at par with V_5 (RLC-148). Similarly, in nutrient levels, the treatment F_3 (150 % RDF) obtained significantly higher growth and yield parameter like plant height (62.17 cm), primary (4.09), & 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), harvest index (30.40), as compared to F_1 (50 % RDF) but was at par with 100 % RDF (F2) except B:C ratio. Highest B:C ratio obtained by F_2 (2.13) However, since difference in yield and yield attributes between F_3 and F_2 was non-significant. Hence nutrient levels F_2 (100 % RDF) is economically viable for linseed crop.

Introduction

India is one of the world's leading oilseed growing country and oilseed sector has an important position in the agricultural industry. India is the world's fifth largest vegetable oil economy, alongside United States, China, Brazil and Argentina. India accounts for 12-15% of the global oilseeds area, 7-8 % of oilseeds production, 6-7% of vegetable oils production, 9-12% of vegetable oils imported and 9-10% of the edible oils consumed. The total production of oilseed in the country is estimated at 31.42 million tonnes in 2018-19.

Oilseeds production during 2018-19 is 1.77 million tonnes higher than the average Five-year production of oilseeds. (anonymous 2018-19).

India ranks 5th among world's linseed producing countries. In India linseed grown an area of 3.31 lakh ha. with 1.72 lakh tonnes production and its productivity is 523 kg/ha. [anonymous 2017-18]. In Chhattisgarh state linseed cultivated in an area of 0.45 lakh ha.with 0.14 lakh tonnes production and its productivity is 301 kg/ha [anonymous 2017-18]. Linseed consists of around 40% fat, 28% dietary fibre, 21% protein, 6% carbohydrates and 4% ash (Vaisey-Genser and Morris, 2010). Linseed plant is an abundant source of both edible and nonedible oil. Industrial oil is an important ingredient for paint, varnish, and stain manufacturing (Matheson, 1976). Edible linseed oil is used for human consumption and contains alpha-linolenic acid (ALA), a polyunsaturated fatty acid that provides nutritional and health benefits (Wood, 1997; Flax Council of Canada, 2004).

The productivity of linseed in Chhattisgarh state is below the national productivity. There are many factors responsible for low productivity of linseed in this state but selection of improved variety suitable for the environment and proper fertilization have prominent factors responsible for low productivity of linseed. Varieties differ in their yield ability depending on various physiological processes regulated by both genetic makeup and environment. It is the fact that, under all environmental conditions, a specified genotype does not exhibit the same phenotypic characteristics and different genotypes respond differentially to a specified environment and usually differ in their relative ranking (Ebehort and Russel, 1966). Plant nutrition is also a key input to improve productivity. Among the agro-techniques that can increase their productivity is judicious application of nutrients, especially nitrogen, phosphorus and potash (Pali and Tripathi 2000).Under the conditions explained above to generate more information. The present study is carried out on Performance of varieties and nutrient levels on growth and yield of linseed (*Linum usitatissimum* L.) with the following objectives include to find out the suitable variety of linseed for higher productivity and profitability. To find out the optimum nutrient level for variety of linseed. And also to compute the economics of different treatments under investigation.

Materials and Methods

Study area

The field experiment was conducted during Rabi season of 2019-20 at the Research Farm of Barrister Thakur Chhedilal, College of Agriculture and research Station, Bilaspur (Chhattisgarh). The Research Farm is situated at 22.09˚ N latitude, 82.12˚ E longitude and at an altitude of 292 m above mean sea level. The region falls under the Eastern plateau and hill region (Agro-climatic zone-VII) of India. The state of Chhattisgarh is classified into 3 agro-climatic zones, of which Bilaspur falls under the state zone of Chhattisgarh plains. The soil of the experimental site was sandy loam in texture, neutral in reaction (pH 7.09), low in organic matter (0.60%) and low in nitrogen (237.5 kg ha^{-1}), medium in phosphorus (14.34 kg ha^{-1}) &high in potassium (361.09 kg ha^{-1}) contents. During the experimental period, climatic parameters were favorable for better growth and development of linseed.

Treatments detail

The experiment has been carried out in factorial randomized block design (FRBD) with three replications and fifteen treatment combinations. The treatment consisting of 5

varieties viz., (V_1) RLC-92, (V_2) RLC-133, (V_3) RLC-138, (V_4) RLC-143, and (V_5) RLC-148 and 3 nutrient levels i.e., F_1 [50 % RDF], F_2 [100 % RDF], and F_3 [150 % RDF].

Crop management

The crop was sowing on 9th November 2019 and were harvested at maturity of the varieties (RLC-133 on 2nd march 2020, RLC-92, RLC-138 and RLC-148 on 7th march 2020, and RLC-143 on 11th march 2020). All the recommended agronomic management practices were followed except for the treatments.

Statistical analysis

Standard procedure was adopted for recording the data on various growth and yield parameters. Data collected were statistically analyses by the procedure suggested by Gomez and Gomez (1984).

Results and Discussion

Growth, yield attributing characters and yield of linseed

The seed yield, ultimate result of various interacting growth, development and yield contributing character. The data shown in table 1 and table 2 revealed that growth, yield attributing character and yield were significantly affected due to varieties and nutrient levels. Variety V_1 (RLC-92) gave significantly 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 (7.34g), seed yield (1483.70 kg / ha), straw yield (3290.58 kg / ha), and HI (31.07 %), were significantly higher with variety V_1(RLC-92) as compared to the other variety. However, capsules per plant, seeds per capsules, test weight (g), seed yield (kg/ha), straw yield (kg/ha) and harvest index (%) was at par with V_5 (RLC-148).

The lowest no. of primary branches per plant (3.49) and secondary branches per plant (19.76), dry matter accumulation (6.63g), number of capsules per plant (47.74), number of seed per capsules (7.67), seed yield (1151.86 kg ha^{-1}), straw yield (2921.37 kg ha^{-1}), & harvest index (28.31) was recorded with V_3 (RLC-138).

The lowest plant height (49.23 cm) and test weight (6.90 g). was recorded with the variety V_4 (RLC-143). The difference in variety V_1& V_5 was not significant hence both varieties are suitable for this region. The increase in yield might be due to difference in growth and yield attributing characters of the varieties i.e. plant height, no. of branches, no. of capsules plant^{-1}, no. of grain capsules^{-1}, and test weight resulted in enhancement of overall grain production kg ha^{-1} of the linseed crop. The results were corroborated with the finding of Lodhi and Chauhan *et al.,* (2002), Gokhale *et al.,* (2008), Prakash *et al.,* (2015), and Kurrey *et al.,* (2019).

Similarly, in nutrient levels, application of 150% RDF (F_3) recorded a higher value of growth parameters viz., plant height (62.17 cm), number of primary branches plant^{-1} (4.09), secondary branches plant^{-1} (21.96), and dry matter accumulation (7.81g), which was significantly superior over 50 % RDF (F_1) and 100% RDF (F_2).The Lowest plant height (56.24 cm), no. of primary branches plant^{-1}(3.35), no. of secondary branches plant $^{-1}$ (20.07) and dry matter accumulation (6.16 g) was recorded with the application of 50 % RDF (F_1). The yield and yield attributing characteristics viz., 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 in the treatment F_3 (150 % RDF) over treatment F_1 (50 %

RDF) but was statistically equal to treatment F_2 (100 % RDF).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 %) was recorded with the application of 50 % RDF (F_1). However, since difference in yield and yield attributes between F_3 and F_2 was non-significant. This might be due to increase in yield attributing characters with the application of 150 % RDF. Similar results were also noted by Kumar *et al.,* (2016) and Devedee *et al.,* (2019).

Economics of linseed

Among all the five linseed varieties cost of cultivation were similar (Rs 19129.19 ha^{-1}). The variety V_1 (RLC-92) recorded higher Gross return (Rs 65283.85 ha^{-1}), net return (Rs46154.65 ha^{-1}) and B: C ratio (2.41) were significantly superior over other varieties but was at par with V_5 (RLC-148). This increase in gross return, net return and B: C is due to higher grain yield received with V_1 and V_5. The results were corroborated with the finding of Maurya *et al.,* (2017). Lowest gross return (Rs 50682.64 ha^{-1}), net return (Rs31553.45 ha^{-1}) and B: C ratio (1.65) was obtained with V_3 (RLC-138). Similarly, cost of cultivation were minimum (Rs17598.19 ha^{-1}) with the application of 50 % RDF (F_1) which has increased by increase in nutrient levels.

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

Treatment	Plant height (cm)			
	Plant height (cm)	Primary branches $plant^{-1}$	Secondary branches $plant^{-1}$	Dry matter accumulation (g)
A. Varieties				
V1-RLC-92	70.84	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
CD 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	Yield attributing characters						
	Capsules /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
CD 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 F_3 (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 F_1 (50 % RDF) but was statistically equal to treatment F_2 (100% RDF) expect benefit cost ratio. Treatment F_2 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 F_1(50 % RDF).

In conclusion on the basis of the field experiment conducted during *rabi* season of 2019-20, it could be concluded that, the linseed variety V_1 (RLC-92) showed superiority in all growth and yield attributing characters but was at par with V_5 (RLC-148). The difference in variety V_1& V_5 was not significant hence both varieties are suitable for this region. Similarly, in nutrient levels, the treatment F_3 obtained significantly superior over F_1 but was at par with treatment F_2 however since difference in yield and yield attributes between F_3 and F_2 was non-significant. Hence nutrient levels F_2 (100 %) is economically viable for linseed crop.

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