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Effect of nitrogen levels, micronutrients (S, Zn, and B) and growth hormones on growth and yield of linseed crop (*Linum usitatissimum* L.) Prayagraj region

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Abstract
Was carried out at the Crop Research Farm, Department of Agronomy, Faculty of Agriculture, Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj, Uttar Pradesh, during the Rabi season of 2025–2026. Ten treatments and three replications were used in the Randomized Block Design experiment. To assess their impact on linseed growth and yield, various nitrogen levels were mixed with growth hormones (Auxin, GA_3, and IBA) and micronutrients (Sulphur, Boron, and Zinc). The highest values for plant height, number of branches, capsules per plant, seeds per capsule, test weight, and seed production (12.85 q ha^{-1}) were found in the treatment Nitrogen @ 50 kg ha^{-1} + IBA + Zinc (T_4). Additionally, the same treatment yielded the highest benefit-cost ratio (2.74), net return (₹89,953 ha^{-1}), gross return (₹1,41,570 ha^{-1}), and harvest index (26.78%). Therefore, in the agroclimatic conditions of the Prayagraj region, the most effective treatment for increasing linseed production and profitability was found to be the combined application of nitrogen @ 50 kg ha^{-1} together with IBA and zinc.

Keywords: *Linum usitatissimum* L. treatment, growth hormones, micronutrients

Introduction
Grown for its oil and fiber, linseed, often known as flax, is a significant crop. It is a member of the Linaceae family and goes by the scientific name Linum usitatissimum. Due to the rich oil content of its seeds and the fact that its fibers are used to produce linen, this plant has been grown since ancient times. Being an annual herb, linseed completes its life cycle in a single growing season. It features narrow leaves, thin, upright stems, and tiny, often blue blooms, but some may be light pink or white. After the United States, China, and Brazil, India has the fourth-largest vegetable oil economy in the world. Oilseeds account for 10% of the nation's agricultural product value, 6% of the gross national product, and 14% of the gross cultivated land, making them the second-largest agricultural commodity after cereals. India's edible oil supply, demand, and gap are 18.94, 10.08, and 8.86 (47%) million tons, respectively. However, due to its greater potential yield, its cultivation is widely extended in irrigated areas. Every year, the Indian government publishes Advance Estimates to give a preliminary evaluation of agricultural production in the country's largest states.

The country's top producing states' linseed production levels are displayed in the Second Advance Estimate for 2025 [4]–2026. This assessment indicates that Madhya Pradesh is India's top producer of linseed. During the 2025 [4]–2026 season, the state produced roughly 0.73 lakh tons of linseed. Madhya Pradesh's soil types and climate are ideal for growing oilseed crops. In addition to other crops like wheat and legumes, farmers in the state have traditionally grown linseed. The state has maintained its top spot in linseed production thanks to favorable rainfall patterns, fertile soil, and enhanced farming techniques. The country's top producing states' linseed production levels are displayed in the Second Advance Estimate for 2025[4]–2026. This assessment indicates that Madhya Pradesh is India's top producer of linseed. During the 2025[4]–2026 season, the state produced roughly 0.73 lakh tons of linseed. Madhya Pradesh's soil types and climate are ideal for growing oilseed crops. In addition to other crops like wheat and legumes, farmers in the state have traditionally grown linseed. The state has maintained its top spot in linseed production thanks to favorable rainfall patterns, fertile soil, and enhanced farming techniques. The country's top producing states' linseed production levels are displayed in the Second Advance Estimate for 2025 [4]–2026. This assessment indicates that Madhya Pradesh is India's top producer of linseed. During the 2025 [4]–2026 season, the state produced roughly 0.73 lakh tons of linseed. Madhya Pradesh's soil types and climate are ideal for growing oilseed crops. In addition to other crops like wheat and legumes, farmers in the state have traditionally grown linseed. The state has maintained its top spot in linseed production thanks to favorable rainfall patterns, fertile soil, and enhanced farming techniques.

Materials and Methods
The experiment will be conducted at Prof. Rajendra Singh (Rajju Bhaiya) University, located in Naini in the Prayagraj region, during the *Rabi* season. This area falls under a humid subtropical climate, which is characterized by moderate winters and relatively warm temperatures during the cropping period. The *Rabi* season typically extends from October to March, providing suitable conditions for the growth of winter crops. The experimental site is expected to have fertile alluvial soil, common to the Indo-Gangetic plains, which supports good agricultural productivity. Adequate irrigation facilities are also available in this

region, ensuring proper water supply for crop growth. The climatic conditions, along with soil fertility, make the site appropriate for conducting agricultural experiments. Overall, the location provides a representative environment for studying crop performance, management practices, and the influence of climatic factors during the Rabi season under subtropical conditions.

During harvesting border rows from the both sides were first harvested, thereafter crop of the net plot was harvested. The harvested crop from each plot was separately bundled, tagged and brought to the threshing floor. After sun drying for sufficient days, the harvested material was weighted to record the botanical yield and then threshed. The economic yield was winnowed, cleaned and weighted plot wise. The grain yield was subtracted from biological yield to record straw yield.

Plate: 3.1 Field photo

Plate: 3.2 Plot Tagging

Treatment	Detail
T_1	Nitrogen 30 kg/ha + Auxin + Sulphur
T_2	Nitrogen 30 kg/ha + GA_3 + Boran
T3	Nitrogen 30 kg/ ha + IBA + Zinc
T4	Nitrogen 40 kg/ha + Auxin + Sulphur
T5	Nitrogen 40kg/ha + GA_3 + Boron
T6	Nitrogen 40 kg ha + IBA + Zinc
T7	Nitrogen 50 kg /ha + Auxin + Sulphur
T8	Nitrogen 50 kg/ha + GA_3 + Boron
T9	Nitrogen 50 kg/ha + IBA + Zinc
T10	Control

Result and Discussion

Plant height is a vital indicator of plant vegetative growth and development. The data regarding plant height as influenced by different varieties and spacing treatments at 20, 40, 60, and 80 DAS (Days after Sowing) are presented in the table and interpreted below.

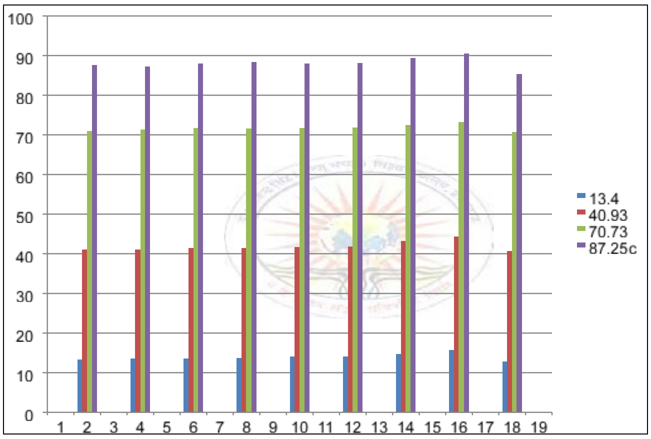
The plant height of linseed recorded at 30 days after sowing showed noticeable variation among the observed plants. The maximum plant height was 15.67 cm of treatment Nitrogen 50 kg/ha + IBA + Zinc, while the minimum height was 12.80 cm of treatment Control, indicating a range of 2.87 cm. Most of the observations were concentrated between 13.0 and 14.7 cm, suggesting relatively uniform growth under the experimental conditions. The average plant height was approximately 13.95 cm, reflecting satisfactory early vegetative development. At 60 days after sowing, the linseed plants exhibited substantial growth. The highest recorded plant height was 44.40 cm of treatment Nitrogen 50 kg/ha + IBA + Zinc, while the lowest was 40.67 cm of treatment Control, indicating a variation of 3.73 cm among the observations. The mean plant height was approximately 41.87 cm, suggesting vigorous vegetative growth during this stage. Most plants attained heights close to the average value, reflecting uniform growth and good adaptation to the prevailing environmental conditions.

At 90 days after sowing, the linseed plants attained their advanced vegetative growth stage, exhibiting heights ranging from 70.73 cm to 73.20 cm. The maximum plant height recorded was 73.20 cm of treatment Nitrogen 50 kg/ha + IBA + Zinc, while the minimum height was 70.73 cm of treatment Control, resulting in a variation of 2.47 cm among the observations. The average plant height was approximately 71.63 cm, indicating robust and consistent plant growth. Most plants showed heights close to the mean value, reflecting uniform development and favorable growing conditions.

At the harvesting stage, the linseed plants reached their maximum growth potential, with plant heights ranging from 85.33 cm to 90.56 cm. The highest plant height recorded was 90.56 cm of treatment Nitrogen 50 kg/ha + IBA + Zinc, whereas the lowest was 85.33 cm of treatment Control, indicating a variation of 5.23 cm among the observations. The average plant height was approximately 88.00 cm, reflecting vigorous growth and successful crop establishment throughout the growing season.

The results revealed a progressive increase in plant height of linseed from 30 days after sowing to the harvesting stage under different nutrient and growth regulator treatments. Plant height increased from an average of 13.95 cm at 30 DAS to 88.00 cm at harvest, indicating continuous vegetative growth throughout the crop period. The treatment receiving Nitrogen 50 kg ha^{-1} + IBA + Zinc consistently recorded the highest plant height at all growth stages, whereas the control treatment showed the lowest values.

S. No	Treatment	Growth Parameter
T_1	Nitrogen 30 kg/ha + Auxin + Sulphur	87.25c
T_2	Nitrogen 30 kg/ha + GA_3 + Boron	87.65
T3	Nitrogen 30 kg/ ha + IBA + Zinc	87.24
T4	Nitrogen 40 kg/ha + Auxin + Sulphur	87.96
T5	Nitrogen 40kg/ha + GA_3 + Boron	88.42
T6	Nitrogen 40 kg ha + IBA + Zinc	88.02
T7	Nitrogen 50 kg /ha + Auxin + Sulphur	88.12
T8	Nitrogen 50 kg/ha + GA_3 + Boron	89.32
T9	Nitrogen 50 kg/ha + IBA + Zinc	90.56
T10	Control	85.33
	F-test	
	SE m (±)	
	CD at 5%	



Number of Branches at 60DAS AND 90DAS

S. No	Treatment	Growth Parameter
T_1	Nitrogen 30 kg/ha + Auxin + Sulphur	81.33
T_2	Nitrogen 30 kg/ha + GA_3 + Boron	81.67
T3	Nitrogen 30 kg/ ha + IBA + Zinc	82.67
T4	Nitrogen 40 kg/ha + Auxin + Sulphur	82.67
T5	Nitrogen 40kg/ha + GA_3 + Boron	83.33
T6	Nitrogen 40 kg ha + IBA + Zinc	83.67
T7	Nitrogen 50 kg /ha + Auxin + Sulphur	85.33
T8	Nitrogen 50 kg/ha + GA_3 + Boron	85.33
T9	Nitrogen 50 kg/ha + IBA + Zinc	80.67
T10	Control	85.33

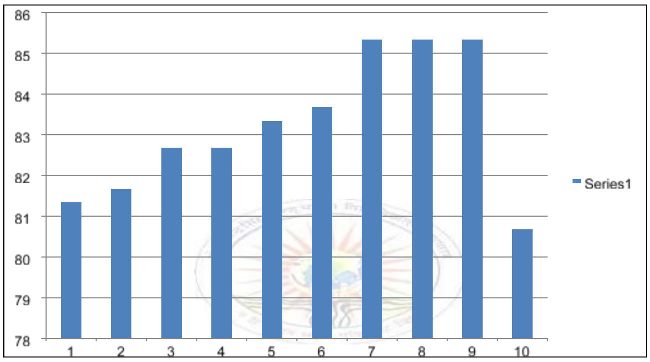


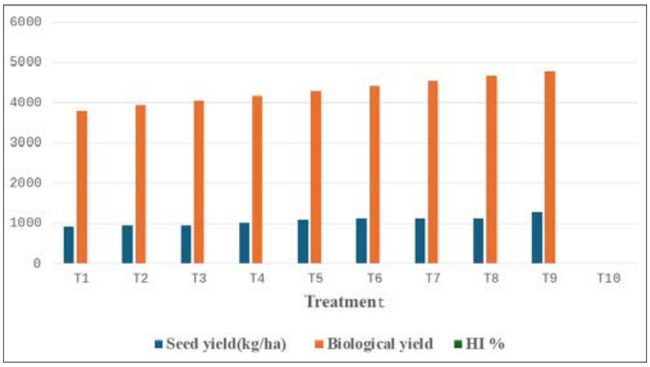
Plate:3.4 Field Visit (Advisor Sir)

Harvest Index (%)

The harvesting index of linseed varied among the ten treatments, indicating differences in the efficiency of partitioning biological yield into economic yield. The maximum harvesting index (26.78%) was recorded in one treatment 9, whereas the minimum value (23.41%) was observed in control, resulting in a variation of 3.37 percentage points. Most of the treatments exhibited harvesting index values between 23.55% and 25.51%, suggesting relatively consistent performance under the experimental conditions. The average harvesting index was approximately 24.64%, reflecting satisfactory conversion of total biomass into seed yield. A higher harvesting index indicates more efficient assimilate partitioning towards seed production. Overall, the results demonstrate that the treatments positively influenced resource allocation and yield efficiency in linseed.

Harvest Index (HI %)

T. No.	Seed yield(kg/ha)	Biological yield(kg/ha)	HI (%)
T_1	911	3800	23.98%
T_2	947	3950	23.98%
T_3	948	4050	23.41%
T_4	1018	4180	24.35%
T_5	1097	4300	25.51%
T_6	1126	4420	25.48%
T_7	1139	4550	25.03%
T_8	1137	4680	24.29%
T_9	1285	4800	26.78%
T_{10}	883	3750	23.55%



Conclusion

The present investigation entitled "Effect of Nitrogen Levels, Micronutrients (S, Zn, and B) and Growth Hormones on Growth and Yield of Linseed Crop (*Linum usitatissimum* L.) in Prayagraj Region" revealed that the combined application of nitrogen, micronutrients, and growth hormones significantly influenced the growth, yield attributes, yield, and economics of linseed. Among the different treatment combinations, Nitrogen @ 50 kg ha^{-1} + IBA + Zinc (T_9) proved to be the most effective and recorded the maximum plant height, number of branches, capsules per plant, seeds per capsule, test weight, seed yield (12.85 q ha^{-1}), and harvest index (26.78%). This treatment also produced the highest gross return . (₹1,41,570 ha^{-1}), net return (₹89,953 ha^{-1}), and benefit-cost ratio (2.74). The superior performance of this treatment may be attributed to enhanced nutrient availability and improved physiological activities, resulting in better growth and assimilate partitioning. Therefore, the application of Nitrogen @ 50 kg ha^{-1} along with IBA and Zinc may be recommended for obtaining higher productivity and profitability of linseed under the agro-climatic conditions of Prayagraj region.

References

1. Jhala AJ, Hall LM. Flax (*Linum usitatissimum* L.): Current Uses and Future Applications. Australian Journal of basic and Applied Sciences,2010:4(9):4304-4312.
2. Tripathi V, Abidi AB, Marker S, Bilal S. LINSEED and linseed oil: health benefits- a review. International

Journal of Pharmacy and General Science,2013:(3):434442.
3. Husain K, Malik YP, Srivastava RL, Pandey R. Production technology and industrial uses of dual purpose linseed (*Linum usitatissimum*): An overview. Indian Journal of Agronomy,2009:54(4):374 – 372.
4. Kikon N, Longkumer LT, Amlari I, Tzudir L, Nongmaithem D, Yadav R, et al. Effect of IAA, GA3, Salicylic Acid and Tebuconazole on Growth, Productivity and Economics of Linseed (*Linum usitatissimum* L.) Cultivation under Rainfed Conditions. Indian Journal of Agricultural Research,2025:59:1368-1374.
5. Hussain K, Diyyal FA, Nawaz K, Arshad N, Ali U, Qurban M. Promoting growth and morpho-physiological attributes in linseed (*Linum usitatissimum* L.) using indole acetic acid and gibberellic acid applied individually or jointly as foliar spray. International Journal Of Applied And Experimental Biology,2023:2:69-78.
6. Dohat MP, Patel RA, Patel VY, Patel HK. Effect of Irrigation and Nitrogen on Growth and Yield of Linseed (*Linum usitatissimum* L.). Journal of Pure and Applied Microbiology,2017:11(2):949-951.
7. Singh S, Singh W. Effect of sources and levels of sulphur on yield, quality and nutrient uptake by linseed (*Linum usitatissimum*). Indian Journal of Agronomy,2005:52(2):158-159.