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Studies on Growth, Yield and Economic Aspects of Lentil (*Lens culinaris* Medikus) var. IPL 220 as Influenced by Bioregulator and Micro Nutrient in Meerut District

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Abstract: A field experiment was undertaken during the Rabi season of 2024 in the Department of Botany at Meerut College, Meerut, and Western Uttar Pradesh. This study aims to determine the effects of foliar feeding bioregulator and micronutrient on the growth, yield, and economic aspects of lentil (Lens culinaris Medikus) Var. IPL 220 using a randomized block design. There are 10 treatments total, with the control treatment (T1) (N:P:K at 20:40:20 kg/ha) and the remaining treatments (T2-T10) containing a combination of bioregulator (Thiourea) and micronutrient (Zinc) that are replicated three times. The application of T10 (Thiourea 1000 ppm + Zinc 100 ppm) produced the largest plant height (43.04 cm), the highest number of branches per plant (3.86), the highest dry matter accumulation per plant (12.16 gm), and the highest number of pods per plant (81.94), according to the experimental data. The highest benefit-to-cost ratio (2.58), greatest seed yield (1.53 t ha-1), gross return (Rs. 77,445 ha-1), and net return (Rs. 555,895 ha-1) have all been observed with the application of T10 (Thiourea 1000 ppm + Zinc 100 PPM).

Keywords: *Lens culinaris* Medikus, Bioregulator and Micro Nutrient, Meerut District.

INTRODUCTION

India is the world's largest producer of pulses, accounting for one-fourth of global production and about one-third of the world's total area under cultivation. After Canada, India is the world's second-largest producer of lentils. India, Canada, Bangladesh, Iran, China, Nepal, and Syria are the world's leading producers of lentils. In India, lentils are grown on 1469 thousand hectares of land, yielding 1035 metric tons and 705 kg of productivity per hectare .Mostly farmed as a rain-fed crop in Uttar Pradesh, Uttarakhand, Madhya Pradesh, Jharkhand, Bihar, and West Bengal, lentils are the third most important pulse crop in North India. In the diets of the impoverished countries, lentils are essential. After soybeans, lentils have the second-highest protein-to-calorie ratio of any legume. High in protein (20–30%), minerals (2–5%), and vitamin B9, lentils contribute a number of vital nutrients to a person's diet. Generally high in micronutrients, lentil may offer sufficient dietary intake, particularly for zinc (Fe), zinc (Zn), and selenium (Se).

Thiourea is a chemical that contains sulfur and nitrogen and has a higher capacity for absorption and water solubility. One possible bioregulator for reducing abiotic stress is thiourea. The two primary functional groups of the Thiourea molecule are "thiol," which is said to be essential for the oxidative stress response, and "imino," which is remarkably capable of meeting the elevated N requirement under abiotic stress conditions. It is widely known that thiols preserve the cell's disrupted redox state (-SH/-S-S-ratio) and enable it to function normally under stress (Nathawat, *et al*.,, 2007 and Dhikwal, *et al*.,, 2012). Its application and involvement in boosting grain filling under drought have also been proven. Increased metabolite translocation, improved photosynthesis, and coordinated control of the source-sink connections in plants are all directly linked to this at the physiological level (Pandey, *et al*.,, 2013).

When plants lack zinc, their metabolism is drastically altered, they develop chlorosis, particularly in young leaves, and their reutilization is severely reduced. Numerous plant enzymes that are essential to the oxidation-reduction processes of respiration and photosynthesis contain zinc. Zinc is a component of numerous enzymes, including ferredoxine, superoxide dismutase, and cytochrome

MATERIALS AND METHODS

During the 2024 Rabi season, a field experiment was carried out at the Department of Botany at Meerut College Meerut Western Uttar Pradesh Meerut is situated 219 meters above mean sea level (MSL) at latitudes 28°7' to 29°02' north and longitudes 77°40' to 77°45' east. to evaluate how micronutrients and bioregulators affect lentil (Lens culinaris Medikus) growth and yield.

Ten treatments with three replications each made up the Randomized Block Design trial. The size of each treatment net plot is 3 m by 3 m. The initial treatment (T1) is classified as the control. Muriate of Potash provides 20 kg ha-1 K2O, 40 kg ha-1

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P2O5 via DAP, and 20 kg ha-1 N via urea and DAP. The remaining treatments were administered with the recommended fertilizer dosage (RDF). Applying 20 kg ha-1 of urea and DAP, 40 kg ha-1 of DAP, and 20 kgha-1 of muriate of potash in addition to micronutrients like zinc and bioregulators like thiourea in the following combinations

Thiourea 500 ppm + Zinc 50 ppm (T2), Thiourea 500 ppm + Zinc 75 ppm (T3), Thiourea 500 ppm + Zinc 100 ppm (T4), Thiourea 750 ppm + Zinc 50 ppm (T5), Thiourea 750 ppm + Zinc 75 ppm (T7), Thiourea 1000 ppm + Zinc 50 ppm (T9), Thiourea 1000 ppm + Zinc 75 ppm (T10). Zinc and thiourea were mixed with water and sprayed on the leaves during the stages of pod formation and flower commencement

When the lentil crop reached harvest maturity, it was harvested treatment-wise. Five randomly chosen representative plants from each plot of each replication were manually measured for growth parameters, such as plant height (cm), number of branches, and dry matter accumulation g plant-1. Following harvest, seeds were taken out of each net plot and allowed to dry in the sun for three days. The seed yield per hectare was calculated and expressed in tonnes after it had been winnowed and cleaned. Each net plot's stover production was measured and quoted in tons per hectare following ten days of full sun drying. The data was calculated and analyzed using Gomez and Gomez's (1984) statistical approach. After calculating the price of seed with straw and the entire cost of crop production, the benefit: cost ratio was determined.

RESULTS AND DISCUSSION

Impact on Growth Metrics Height of Plants

The result makes it clear that as crop growth progressed, the measured plant height rose. The highest height of 43.04 cm was obtained at harvest for treatment T10 (Thiourea 1000 ppm + Zinc 100 ppm). T10 had the tallest plants at harvest, whereas T8 and T9 treatments were statistically comparable to T10. The continuous delivery of nutrients at every stage of growth, combined with chemical fertilizers and the advantageous relationship between zinc and thiourea, may be the reason for treatment T10's highest plant height. The improved growth and development of the crop may have resulted from the thiourea treatment's potential to target the meristematic activity of apical tissues, which has stimulatory effects on cell division and increases shoot length and cell number for improved leaf area (primarily due to increased nutrition of sulfur and nitrogen). Trivedi, *et al*., (2011) state that the increased zinc availability to plants may have boosted enzymatic and metabolic activity, which in turn increased crop growth.

Number of Branches per Plant

T10 (Thiourea 1000 ppm + Zinc 100 ppm) produces the most branches (3.86) at the harvest stage, but T9 is statistically equal to the maximum. Thiourea raised the concentrations of total chlorophyll and starch in the leaves as well as the net photosynthetic rates, allowing the treatment to produce the greatest number of branches per plant. Yadav (2002) also noted similar results.

Dry Matter Accumulation

At the harvesting stage, the treatment T10 (Thiourea 1000 ppm + Zinc 100 ppm) recorded the highest dry matter accumulation of 12.16 (g), while the treatments T8 and T9 were statistically shown to be comparable to the maximum dry matter accumulation. Its function in protein synthesis and starch creation, as well as in the synthesis and maintenance of chlorophyll in plants, may be the cause of this. It's possible that the increased zinc availability to plants boosted enzymatic and metabolic processes, which in turn accelerated crop development. (2011) Trivedi, *et al*.,

Yield and Yield Attributes Number of Pods/Plant

The statistical examination of the number of pods per plant revealed a significant effect. The greatest and most significant number of pods per plant (81.94) was reported by treatment Thiourea 1000 ppm + 100 ppm Fe. As opposed to Thiourea 1000 ppm + 100 ppm Fe, Thiourea 1000 ppm + 50 ppm Fe and Thiourea 1000 ppm + 75 ppm Fe showed statistical parity. This could be explained by the crop's increased nitrogen metabolism and prolonged moisture retention, particularly during periods of moisture stress, which may have contributed to the crop bearing more pods per plant at harvest. These outcomes are consistent with research by Singh, R.P., and Dasharath Singh (2017) that shows the benefits of foliar spray for a gradual increase in pulse yield.

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Figure 1: Lentil Crop in Different Fields

Seed Yield

Different combinations of zinc and thiourea with chemical fertilizers have a substantial impact on seed yield. T10 (Thiourea 1000 ppm + Zinc 100 ppm) had the highest output (1.52 t ha-1) (Table 2).

When compared to treatment T10 (Thiourea 1000 ppm + Zinc 100 ppm), the effects of Zinc and Thiourea had a substantial impact on seed output at production increased over farmer practices (T1).The results showed that treatments T8 and T9 were statistically equivalent to the maximum (T10).The effect of thiourea on growth and development may be reflected in the increase in yield seen in this study.

Because there were more branches per plant pod, there were more seeds, which may have increased photosynthesis and increased the transport of assimilates to the seeds, increasing their weight. This resulted in a better yield. These findings are consistent with those of Anitha, *et al*., (2005) and (2006). Applying zinc sulfate helps with the production of chlorophyll, assimilates transportation to sinks, and ultimately boosts the output of seeds and stover. This could involve a rise in the synthesis of carbohydrates. Zinc foliar spray had a similar effect on cowpea, according to Anitha, *et al*., (2005).

Stover Yield

Thiourea, zinc, and plant growth regulators are used. Additionally, zinc enhances photosynthesis, which has a major impact on the lentil crop's stover production. The highest stover output was obtained by treatment T10 (Thiourea 1000 ppm + Zinc 100 ppm), while treatments T8 and T9 were determined to be statistically comparable to the maximum. Lentil seed yield showed a similar pattern to that of stover yield. Because thiourea improves dry matter partitioning, increases net photosynthesis, and increases nitrate reductase activity, the rise in seed and stover production brought on by thiourea application is a direct reflection of an increase in growth and yield characteristics. These findings closely match those of Shekhawat, *et al*., (2003), Anitha, *et al*., (2006), and Sharma, *et al*., (2002). The largest number of pods per plant was recorded by T10 (Thiourea 1000 ppm + Zinc 100 ppm) with T8, and T9 is comparable to T10. This could be explained by the crop's increased nitrogen metabolism and prolonged moisture retention, particularly during periods of moisture stress, which may have contributed to the crop bearing more pods per plant at harvest.

The yield parameters of lentils were considerably improved by the application of zinc. The total effect of growth-attributable traits and yield-attributable traits, like the number of pods per plant, is the crop's yield. These results corroborate those previously published by Khan, *et al*., (2014) and Kumar, *et al*., (2009).

ECONOMICASPECTS

The highest gross return (Rs. 77,445 ha-1), maximum net return (Rs. 55,895 ha-1), and higher benefit cost ratio (2.59) among the various nutrient source combinations were observed by (T10) Thiourea 1000 ppm + Zinc 100 ppm.

In conclusion, the maximum seed production (1.52 t/ha) and gross return (77.44x 103 Rs./ha) were observed by the Thiourea 1000 ppm + 100 ppm Fe treatment. In terms of the seed yield of the lentil variety "IPL 220," Thiourea 1000 ppm + 100 ppm Fe produced the highest net return (55.89 × 103 Rs./ha) and benefit:cost ratio (2.59), which may make it more appealing to farmers because it is more profitable economically and also achieved statistical parity with Thiourea 1000 ppm + 50 ppm Fe and Thiourea 1000 ppm + 75 ppm Zn.

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