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Karur Latha
M.Sc. Scholar, Department of Agronomy, Naini Agriculture Institute, Shuats, Prayagraj, Uttar Pradesh, India

Renuka Bhakher
M.Sc. Scholar, Department of Agronomy, Naini Agriculture Institute, Shuats, Prayagraj, Uttar Pradesh, India

Chintale Yallaling Sanjay
M.Sc. Scholar, Department of Agronomy, Naini Agriculture Institute, Shuats, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Karur Latha
M.Sc. Scholar, Department of Agronomy, Naini Agriculture Institute, Shuats, Prayagraj, Uttar Pradesh, India

Influence of molybdenum and zinc on economics of groundnut

Karur Latha, Renuka Bhakher and Chintale Yallaling Sanjay

Abstract
At the Crop Research Farm of the Department of Agronomy, SHUATS, Prayagraj (U.P), a field experiment was undertaken in the month of *Zaid* in 2022. The experiment was set up using a Randomized Block Design, with each of the 10 treatments being reproduced three times. The result showed that highest gross return (194045.00 INR ha^{-1}), net return (129352.00 INR ha^{-1}) were recorded with applying 2.0 kg ha^{-1} molybdenum and 0.75% zinc foliar spray while highest benefit cost ratio (2.11) with application of 1.5 kg ha^{-1} molybdenum along with zinc foliar spray 0.75% on groundnut crop.

Keywords: Groundnut, zinc, molybdenum, growth, yield

Introduction
Groundnut used for cultivation (*Arachis hypogaea* L.) is a member of the genus Arachis and the subtribe *Stylosanthinae* of the tribe *Aeschynomenea* of the family Leguminosae. It is an annual, self-pollinating legume from the tropics. The sixth-most significant oilseed crop in the world is groundnut. It has a protein content of 26-28%, a fat content of 48-50%, and a high concentration of vitamins, minerals, and dietary fibre. Reddy and Reddy (2000) [7] found a favourable correlation between groundnut pod production and the number of pegs and pods per plant, 100-kernel weight, total number of flowers produced per plant, and flowers produced per plant during the first four weeks. Cysteines, an amino acid that is necessary for animal development, are found in groundnuts. Groundnut cake, which is obtained after oil extraction and includes 7 to 8% N, 1.5% P, and 1% K, is regarded useful organic waste and animal feed because of its high protein content. Globally, 50% of groundnut is used for oil extraction, 37% confectionary and 12% for seed purpose (Nurezannat et al., 2019) [6].
Molybdenum is a component of the enzyme nitrogenase, which bacteria use in a symbiotic relationship with legume crops to fix nitrogen. Additionally, it is essential for the metabolism of sulphate, protein synthesis, and nitrogen. Molybdenum is required in pollen formation so Mo deficient plant will cause effect in their fruits and pollen grains formation (Nasar *et al.*, 2018) [4]. That application of molybdenum increased the yield, nodulation and oil content in groundnut. The functions of molybdenum in leguminous plants include nitrate reduction, nodulation, nitrogen fixation and general metabolism. (Togay *et al.*, 2008)
Zinc is a well-known enzyme component that is also necessary for the production of pyruvic decarboxylase and insole acetic acid. As catalysts, zinc is necessary for several metabolic processes. Additionally, zinc raises the amount of fat, protein, and caloric value in oilseed crops. When there is a zinc deficit, the midrib and veins of the leaves begin to yellow from the lamina to the base. Later, dorsal leaf veins become dark and necrotic brown patches appear. As a crucial structural component or regulatory cofactor of numerous enzymes and proteins, zinc plays a significant role in numerous crucial biochemical processes, including the metabolism of carbohydrates, photosynthesis, the conversion of sugars to starch, proteins, and auxin (a growth regulator), the formation of pollen, the integrity of biological membranes, and resistance to infection by specific pathogens. (Alloway 2008) [3].

Material and Methods
In order to achieve the pre-set objectives of the present exploration, a field experiment was conducted during the summer season of the year 2021 on Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences (U.P.).

Data on initial soil analysis indicated that the experimental site was sandy loam and neutral in reaction with pH 7.2 and EC 0.26 dS/m. The soil was available phosphorus (13.6 kg/ha), potassium (215.4 kg/ha) and available sulphur (12.41 ppm). The present experiment was laid out in Randomised Block Design with ten treatments combinations of zinc and molybdenum with three replications. The collected data for various parameters were statistically analyzed using Fishers analysis of variance (ANOVA) technique and the treatments were compared at 5% levels of significance.

Groundnut was sown @ 125 kg seed ha^{-1} with rows 30 cm apart and 10 cm plant to plant spacing and variety was 'Kadiri Lepakshi' or 'Kadiri 1812'. The crop was fertilized with the recommended dose of fertilizer (RDF) was Nitrogen 20 kg ha^{-1}, Phosphorus 60 kg ha^{-1} and Potassium 40 kg ha^{-1}. The source for N, P and K were given in the form of Urea, DAP and MOP respectively. Recommended doses of N, P, K along with different levels of Molybdenum and foliar application of Zinc were applied.

Treatment Combinations

Treatment combinations	
T_1	0.5 kg ha^{-1} Molybdenum + 0.25% zinc
T_2	0.5 kg ha^{-1} Molybdenum + 0.50% zinc
T_3	0.5 kg ha^{-1} Molybdenum + 0.75% zinc
T_4	1.5 kg ha^{-1} Molybdenum + 0.25% zinc
T_5	1.5 kg ha^{-1} Molybdenum + 0.50% zinc
T_6	1.5 kg ha^{-1} Molybdenum + 0.75% zinc
T_7	2.0 kg ha^{-1} Molybdenum + 0.25% zinc
T_8	2.0 kg ha^{-1} Molybdenum + 0.50% zinc
T_9	2.0 kg ha^{-1} Molybdenum + 0.75% zinc
T_{10}	Control (RDF 20:60:40 kg ha^{-1} NPK)

Economics

Cost of cultivation (INR ha^{-1})

Cost of cultivation (63,429.00 INR ha^{-1}) was found to be highest in treatment with application of 2.0 kg INR ha^{-1} Molybdenum + 0.75% zinc and the minimum cost of cultivation (58,021.00 INR ha^{-1}) was found to be in treatment control plot as compared to other treatments.

Gross Return (INR ha^{-1})

Gross returns (1,94,045.00 INR ha^{-1}) was found to be highest in treatment with application of 1.5 kg INR ha^{-1}molybdenum + 0.75% zinc and the minimum gross (1,48,222 INR ha^{-1}) was found to be in treatment with application of 0.5 kg ha^{-1} molybdenum + 0.25% zinc as compared to other treatments.

Net Return (INR ha^{-1})

Net returns (1,31,578.00 INR ha^{-1}) was found to be highest in treatment with application of 1.5 kg ha^{-1} molybdenum + 0.75% zinc and the minimum gross (88,014.00 INR ha^{-1}) was found to be in treatment with application of 0.5 kg ha^{-1} molybdenum + 0.25% zinc as compared to other treatments.

Benefit Cost Ratio

Benefit cost ratio (2.11) was found to be highest in treatment with application of 1.5 kg ha^{-1} molybdenum + 0.75% zinc and the minimum Benefit cost ratio (1.46) was found to be in treatment with application of 0.5 kg ha^{-1} molybdenum + 0.25% zinc as compared to other treatments

The experimentation results indicated that maximum benefit cost ratio by the higher doses of zinc. This could be explained by the increased grain production brought on by greater Zn levels (Palsande *et al.* 2019) [2]. Similarly reported by Singh and Singh (2012) [1].

Table 1: Influence of Molybdenum and zinc on Economics of Groundnut

	Treatment Combinations	Cost of cultivation (INR ha^{-1})	Gross return (INR ha^{-1})	Net return (INR ha^{-1})	Benefit: Cost ratio
1.	0.5 kg ha^{-1} Molybdenum + 0.25% zinc	60,208.00	1,48,222.00	88,014.00	1.46
2.	0.5 kg ha^{-1} Molybdenum + 0.50% zinc	60,396.00	1,52,495.00	92,099.00	1.52
3.	0.5 kg ha^{-1} Molybdenum + 0.75% zinc	60,583.00	1,57214.00	96,631.00	1.60
4.	1.5 kg ha^{-1} Molybdenum + 0.25% zinc	62,092.00	1,65,616.00	1,03,524.00	1.67
5.	1.5 kg ha^{-1} Molybdenum + 0.50% zinc	62,280.00	1,65,976.00	1,03,696.00	1.66
6.	1.5 kg ha^{-1} Molybdenum + 0.75% zinc	62,467.00	1,94,045.00	1,31,578.00	2.11
7.	2.0 kg ha^{-1} Molybdenum + 0.25% zinc	63,054.00	1,74,139.00	1,11,085.00	1.76
8.	2.0 kg ha^{-1} Molybdenum + 0.50% zinc	63,242.00	1,81,438.00	1,18,196.00	1.87
9.	2.0 kg ha^{-1} Molybdenum + 0.75% zinc	63,429.00	1,92,781.00	1,29,352.00	2.04
10.	Control (RDF 20:60:40 kg ha^{-1} NPK)	58,021.00	179,990.00	1,21,969.00	2.10

Conclusion

Based on the above findings, it can be concluded that by applying foliar spray of molybdenum and basal zinc application increase yield as well as economics in groundnut crop.

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