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Effect of bio-fertilizers and micronutrients on economics of maize (*Zea mays* L.)

¹ Thakur Prajyot Shivaram, ² Rajesh Singh, ³ Kumar Raj and ⁴ Akankhya Pradhan

¹M.Sc. scholar, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

²Professor, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

³Ph.d scholar, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

⁴Ph.d scholar, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

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Corresponding Author: Thakur Prajyot Shivaram

Abstract

The field experiment titled “Effect of Bio-Fertilizers and Micronutrients on Growth and Yield of Maize (*Zea mays* L.)”, was conducted during *Zaid* season, 2025 at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj, Uttar Pradesh. The soil of the field was sandy loam, its pH was 8.0 and EC 0.56 ds/m. The result showed that the highest cost of cultivation was observed with application of Azotobacter 25 g kg⁻¹ seed + PSB 25 g kg⁻¹ seed + Zinc 1.5% + Boron 1.5% (INR 59262/ha), higher gross return (INR 149150.00/ha) and higher net return (INR 95444.00/ha) was obtained with the application of Azotobacter 25 g kg⁻¹ seed + PSB 25 g kg⁻¹ seed + Zinc 1% + Boron 1%. Whereas higher B.C ratio (1.85) was found with application of PSB 25 g kg⁻¹ seed + Zinc 1% + Boron 1%, PSB 25 g kg⁻¹ seed + Zinc 1.5% + Boron 1.5%.

Keywords: Maize, zinc, boron, azotobacter, PSB

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops globally, serving as a staple food, feed, and industrial raw material. It is cultivated across diverse agro-climatic conditions, with global production exceeding 1.2 billion tonnes in recent years. In India, maize ranks as the third most important cereal after rice and wheat, contributing significantly to food security and the livestock sector. Its high genetic yield potential and adaptability make it a key crop for sustainable agriculture. Maize grains are rich in carbohydrates, proteins, vitamins, and minerals, enhancing their nutritional and economic value. At the global level, maize is grown on approximately 200 million hectares, with total production exceeding

1.2 billion tonnes annually: The United States, China, Brazil, and Argentina are the leading producers. In the Indian, maize ranks third among cereal crops after rice and wheat. It is cultivated over an area of about 10 to 11 million hectares, producing nearly 35 to 38 million tonnes annually. The average productivity is around 3.5 tonnes per hectare. The major maize-growing states in India include Karnataka, Madhya Pradesh, Maharashtra, Telangana, and Bihar. (FAOSTAT 2025) ^[4] Biofertilizers such as Azotobacter and phosphate-solubilizing bacteria (PSB) play a vital role in

improving maize growth and productivity. Azotobacter enhances nitrogen availability through biological nitrogen fixation and secretes growth- promoting substances like auxins and gibberellins, leading to better root development and plant vigour. PSB increases phosphorus availability by solubilizing insoluble phosphates in the soil, thereby improving nutrient uptake and yield attributes. Among micronutrients, zinc (Zn) is essential for enzyme activation, protein synthesis, and chlorophyll formation, while boron (B) is crucial for cell division, pollen viability, and grain formation. Combined application of these biofertilizers and micronutrients enhances nutrient use efficiency, promotes better cob development, and ultimately increases grain yield and quality of maize. Alori *et al.* (2021), Luo *et al.* (2024), Haque *et al.* (2025) ^[1, 5, 7].

The integrated use of biofertilizers and micronutrients has a synergistic effect on crop growth and yield. Therefore, an experiment was undertaken with seed treatment of azotobacter and PSB along with foliar application of Zn and B at different growth stages to evaluate the economics of Maize.

Materials and methods

The field experiment was conducted during the *Zaid* season of 2025 at the Crop Research Farm, Department of

Agronomy, Naini Agricultural Institute, which is a constituent unit of Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh. The soil of experimental site was sandy loam with a pH of 8.0 and electrical conductivity (EC) of 0.56 ds m⁻¹. The experiment consist of 10 treatments which were replicated thrice in RBD viz. seed inoculation of Azotobacter (25 g kg⁻¹ seed), PSB (25 g kg⁻¹ seed) and Azotobacter + PSB (25 g kg⁻¹ seed each) along with foliar application of Zinc and Boron at 0.75%, 1% and 1.5% concentrations along with control. where foliar application time was at 30 and 45 days after sowing (DAS). The seeds of maize were Advanta PAC 751 were sown at spacing 60 cm X 20 cm with RDF (120-60-40 kg N-P2O5-K2O ha⁻¹).

Result and discussion

Economics

The highest cost of cultivation was observed with application of Azotobacter + PSB + Zinc 1.5% + Boron 1.5% (INR 59262/ha) because of higher foliar doses of zinc, boron and seed treatment of azotobacter and PSB. The higher gross return (INR 149150.00/ha) and higher net return (INR 95444.00/ha) was obtained with the application of Azotobacter + PSB+ Zinc 1% + Boron 1%. Whereas higher B.C ratio (1.85) was found with application of PSB + Zinc 1% + Boron 1%, PSB + Zinc 1.5% + Boron 1.5%. It might be recorded higher due to a substantial increase in grain yield and net returns with only a marginal increase in the cost of cultivation. Similar findings were recorded by Singh *et al.* (2023).

Table 1: Effect of Biofertilizers and Micronutrients on economics of Maize.

S. no	Treatment combination	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1.	Azotobacter 25 g kg ⁻¹ seed + Zinc 0.75% + Boron 0.75%	48930	105870.00	62660.00	1.45
2.	Azotobacter 25 g kg ⁻¹ seed + Zinc 1% + Boron 1%	52230	110890.00	67184.00	1.54
3.	Azotobacter 25 g kg ⁻¹ seed + Zinc 1.5% + Boron 1.5%	49002	141590.00	88380.00	1.66
4.	PSB 25 g kg ⁻¹ seed + Zinc 0.75% + Boron 0.75%	48882	133430.00	85220.00	1.77
5.	PSB 25 g kg ⁻¹ seed + Zinc 1% + Boron 1%	52110	139020.00	90314.00	1.85
6.	PSB 25 g kg ⁻¹ seed + Zinc 1.5% + Boron 1.5%	59142	126090.00	81888.00	1.85
7.	Azotobacter 25 g kg ⁻¹ seed + PSB 25 g kg ⁻¹ seed + Zinc 0.75% + Boron 0.75%	59190	126430.00	67288.00	1.14
8.	Azotobacter 25 g kg ⁻¹ seed + PSB 25 g kg ⁻¹ seed + Zinc 1% + Boron 1%	51972	149150.00	95444.00	1.78
9.	Azotobacter 25 g kg ⁻¹ seed + PSB 25 g kg ⁻¹ seed + Zinc 1.5% + Boron 1.5%	59262	115060.00	65858.00	1.34
10.	Control (RDF) - N:P:K - 120:60:40 kg/ha	40770	108790.00	68020.00	1.67

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