

Original Research Article

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Effect of Bio-Fertilizers and Micronutrients on Growth and Yield of Maize (*Zea mays* L.)

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ABSTRACT

Keywords

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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, India. The soil of the field was sandy loam, its pH was 8.0 and EC 0.56 ds/m. The result showed that growth parameters viz. higher plant height (195.05 cm), plant dry weight (90.30 g), number of cobs/plant (2.33), rows/cob (18.23), seeds/row (33.36), seed index (22.3 g), seed yield (5.15 t/ha), stover yield (25.55 t/ha) were recorded significantly high with the application of seed inoculation of Azotobacter (25 g kg⁻¹) and PSB (25 g kg⁻¹) along with foliar application of Zinc (1 %) and Boron (1 %). So, the application of seed inoculation of Azotobacter (25 g kg⁻¹ seed) and PSB (25 g kg⁻¹ seed) along with foliar application of Zinc (1 %) and Boron (1 %) was found to be productive as well as economically feasible.

Introduction

Maize (*Zea mays* L.) is a major cereal crop cultivated worldwide due to its high yield potential and wide adaptability. According to FAOSTAT (2025), globally maize production is about 1.23 billion tonnes from nearly 205 million hectares, with an average productivity of 6.0 t ha⁻¹. In India, maize is the third most important cereal after rice and wheat. It is grown on about 10.5 million hectares with a production of around 38 million tonnes and an average productivity of 3.6 t ha⁻¹. Major producing states include Karnataka, Madhya Pradesh, Bihar, and Uttar Pradesh. Maize is widely used as food, feed, and industrial raw material. Biofertilizers such as

Azotobacter and phosphate-solubilizing bacteria (PSB) play a vital role in enhancing maize growth and productivity. *Azotobacter* fixes atmospheric nitrogen, improving nitrogen availability to plants and promoting better vegetative growth. PSB solubilizes insoluble phosphorus in the soil, making it accessible for plant uptake, which enhances root development and energy transfer. Luo *et al.*, (2024), Zhang *et al.*, (2025).

Micronutrients like zinc (Zn) and boron (B) play a crucial role in improving maize growth and yield. Zinc is essential for enzyme activation, protein synthesis, and auxin production, which enhances plant growth and development. Boron is important for cell division, pollen

viability, and seed formation, leading to better grain setting. Adequate supply of Zn and B enhances nutrient uptake, strengthens plant structure. The combined use of micronutrients and biofertilizers has shown a synergistic effect on maize by improving nutrient uptake, root development, and overall plant vigour. Therefore, an experiment was undertaken with seed inoculation with azotobacter and PSB along with foliar application of Zn and B at different growth stages to evaluate the growth and yield of Maize. [Haque et al., \(2025\)](#), [Kumar et al., \(2024\)](#).

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, Prayagraj, Uttar Pradesh. The soil of the experimental site was sandy loam in texture with a pH of 8.0 and electrical conductivity (EC) of 0.56 ds m⁻¹. The experiment consisted of 10 treatments which were replicated thrice in Randomized Block Design (RBD), viz., seed inoculation with 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.

The seeds of Advanta PAC 751 were sown at a spacing of 60 cm × 20 cm with recommended dose of fertilizers (RDF) (120-60-40 kg N-P₂O₅-K₂O ha⁻¹). Foliar application was carried out at 30 and 45 days after sowing (DAS).

Result and Discussion

Results concluded that the seed inoculation with Azotobacter (25 g kg⁻¹) and PSB (25 g kg⁻¹) along with foliar application of Zinc (1 %) and Boron (1 %) significantly affected the growth and yield attributes of maize (Table 1). The treatment Azotobacter 25 g kg⁻¹ seed + PSB 25 g kg⁻¹ seed + Zinc 1% + Boron 1% recorded the maximum plant height (195.05 cm), plant dry weight (90.30 g), number of cobs/plant (2.33), rows/cob (18.23), seeds/row (33.36), seed index (22.3 g), seed yield (5.15 t ha⁻¹), stover yield (25.55 t ha⁻¹). The improvement in these attributes may be attributed to the ability of Azotobacter to fix atmospheric nitrogen and the role of PSB in solubilizing unavailable phosphorus, thereby enhancing nutrient availability. Furthermore,

zinc and boron play vital roles in photosynthesis and other metabolic activities, while boron also promotes cell division and facilitates the translocation of sugars within the plant.

These results are in conformity with the findings reported by [Imran et al., \(2020\)](#), [Ahmad et al., \(2021\)](#), and [Meena et al., \(2022\)](#).

Higher plant height (195.05 cm) was observed with application Azotobacter 25 g kg⁻¹ seed + PSB 25 g kg⁻¹ seed + Zinc 1% + Boron 1% which is due to their beneficial effects on nutrient availability, root development, and plant growth-promoting activities as azotobacter converts atmospheric nitrogen into plant-available forms and PSB improves phosphorus availability by solubilizing insoluble phosphates in the soil through the release of organic acids and complementary physiological and biochemical roles of these micronutrients in plant growth. Similar findings were also recorded by [Singh et al., \(2020\)](#).

In conclusion, the application of Azotobacter 25 g kg⁻¹ seed + PSB 25 g kg⁻¹ seed + Zinc 1% + Boron 1% significantly improved the growth and yield attributes of maize.

Therefore, integrated use of biofertilizers and micronutrients can be recommended for the enhancing maize productivity.

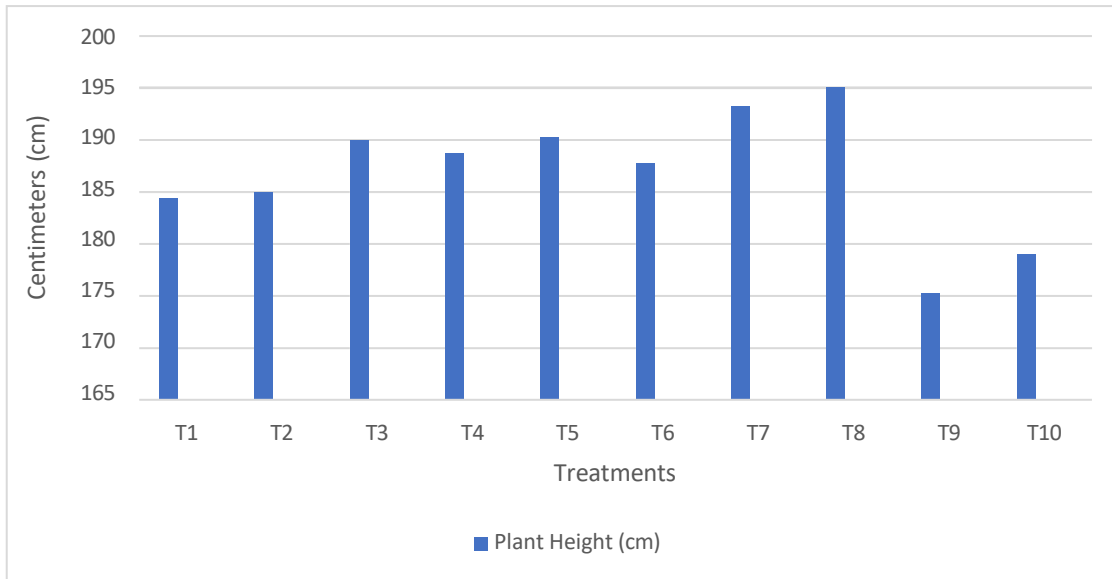
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Table.1 Effect of Biofertilizers and Micronutrients on growth and yield attributes of Maize.

S. no	Treatment combination	At harvest							
		Plant Height (cm)	Plant Dry Weight (g)	Cobs /plant	Rows /cob	Seeds / row	Seed Index (g)	Seed yield (t ha ⁻¹)	Stover Yield (t ha ⁻¹)
1.	Azotobacter 25 g kg ⁻¹ seed + Zinc 0.75 % + Boron 0.75 %	184.43	79.28	1.46	16.10	28.46	19.53	3.55	20.67
2.	Azotobacter 25 g kg ⁻¹ seed + Zinc 1 % + Boron 1%	184.99	85.50	1.33	16.50	30.30	19.43	3.70	22.09
3.	Azotobacter 25 g kg ⁻¹ seed + Zinc 1.5 % + Boron 1.5 %	190.00	84.24	1.33	17.06	29.53	21.00	4.29	23.47
4.	PSB 25 g kg ⁻¹ seed + Zinc 0.75 % + Boron 0.75 %	188.71	84.09	1.60	15.86	29.30	20.10	4.57	23.75
5.	PSB 25 g kg ⁻¹ seed + Zinc 1 % + Boron 1 %	190.26	86.51	1.40	17.23	31.73	21.40	4.80	23.82
6.	PSB 25 g kg ⁻¹ seed + Zinc 1.5 % + Boron 1.5 %	187.77	78.54	1.40	17.20	30.36	20.06	4.32	22.41
7.	Azotobacter 25 g kg ⁻¹ seed + PSB 25 g kg ⁻¹ seed + Zinc 0.75 % + Boron 0.75 %	193.27	88.44	1.66	17.53	32.86	21.76	4.90	23.99
8.	Azotobacter 25 g kg ⁻¹ seed + PSB 25 g kg ⁻¹ seed + Zinc 1% + Boron 1%	195.05	90.30	2.33	18.23	33.36	22.30	5.15	25.55
9.	Azotobacter 25 g kg ⁻¹ seed + PSB 25 g kg ⁻¹ seed + Zinc 1.5 % + Boron 1.5 %	175.22	81.32	1.53	17.11	29.90	19.60	3.92	20.98
10.	Control (RDF) – N:P:K – 120:60:40 kg/ha	179.03	77.52	1.50	17.10	29.76	20.30	3.65	21.19
	F - Test	S	S	S	S	S	S	S	S
	S.Em (±)	3.59	1.59	0.18	0.17	0.24	0.22	0.09	0.27
	CD (p= 0.05)	10.66	4.71	0.55	0.50	0.72	0.64	0.28	0.81

Figure.1 Effect of Biofertilizers and Micronutrients on plant height (cm) of Maize.



Author Contributions

Thakur Prajyot Shivaram: Investigation, formal analysis, writing—original draft. Rajesh Singh: Validation, methodology, writing—reviewing. Akankhya Pradhan:—Formal analysis, writing—review and editing. Kumar Raj: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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