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Biostimulants Impact on Agronomic Traits of Fortnight Harvested *Zea mays*

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ABSTRACT

Stunted growth is a common reason for low productivity in plants. Biostimulants (BS) enhance plant's capability to increase nutrient uptake and to resist biotic and abiotic stresses because of natural minerals and beneficial microbes. To examine the impact of BS on the growth of *Zea mays*, a 15-day experiment was carried out. BS showed significant positive results of up to 48% increase in overall plant growth. BS application offers a promising strategy to fulfill a plant's requirement for growth, development and to provide enhanced yield. Therefore, it's necessary for further experimental study to understand beneficial impacts of BS on soil health and sustainable agriculture.

KEYWORDS

Biostimulants; Biotic and abiotic stress; Stunted growth; Plant nutrition; Soil health

ARTICLE HISTORY

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Introduction

Stunted growth of plant leads to reduction in yield [1]. Biotic or abiotic stressors or improper availability/uptake of nutrients by plants are some of the major reasons behind stunted growth of plants [2]. BS are mixture of material (formulated byproducts) composed of natural components or microorganisms that serve as soil conditioner [3]. microbes like plant-growth-promoting bacteria (PGPB), amino acids and manure composts [4]. BS enhances soil health, simulates natural processes in plants for beneficial nutrient uptake efficiency, and plant efficiency to tolerate biotic and abiotic stress, directly or indirectly enhancing plant growth and yield quality and quantity [5].

Climate change is continuously increasing the frequency and intensity of biotic and abiotic stress factors [6]. Due of heat and water stress-induced due to climate change, *Zea mays* can face 17% of yield reduction in South Asia if similar trends of crop yield continue till 2050 [7]. PH are non-microbial BS contain signaling peptides and free amino acids and have been found to modify plant microbiomes. SE is another important category of organic non-microbial BS, with red, green, and brown macroalgae being the most common. Microalgae are proposed as a renewable source of BS. Microbial BS like plant growth regulators and arbuscular mycorrhizal fungi are considered sustainable and efficient tools for securing yield stability under low-input conditions and improving crop tolerance to abiotic stressors [8].

Zea mays production recorded 10.3 million tons in Pakistan in 2023 from cultivated area of 1.330 million hectares [9,10]. As *Zea mays* is sensitive to various stresses and nutrients limitations (like phosphorus), BS plays an important role in enhancing its agronomical parameters by stimulating root production, improving nutrient absorption, and enhancing water use efficiency in maize under regulated deficit irrigation conditions, particularly when applied to seeds or during early plant development [11,12]. The objective of study was to investigate the impacts of BS on *Zea mays* growth attributes at germination phase against normal plant growth.

Materials and Methodology

Focusing on the impact of BS on *Zea mays* germination a pot experiment was conducted in Multan to provide valuable insights into the potential benefits of these stimulants in enhancing plant growth. The study, conducted over a 15-day period, utilized *Zea mays* hybrid seeds (YSM 111D) from Certus Seeds, sown in sandy loam soil from the research area. Rely, a product from Kanzo Ag, was applied as the biostimulant source.

Before sowing, the soil was analyzed for physicochemical properties, revealing a soil pH of 8.2, electrical conductivity of 1.9 dSm^{-1}, organic matter content of 0.7%, extractable soil phosphorus at 25 $mgkg^{-1}$, and extractable soil potassium at 66 $mgkg^{-1}$.

The experiment consisted of two treatments: Treatment 1 (T1) involved the application of BS, while Treatment 2 (T2) served as the control with tap water only. Each treatment had three replications. Applied nitrogen, phosphorus and potassium ratio per pot was 0.519 g, 0.568 g and 0.309 g respectively. Seeds were sown on 2nd April 2023 and harvested on 17th April 2023. The results demonstrated significant positive impacts of BS on various growth parameters (Table 1).

Table 1. Least significant difference (LSD) between T1 and T2.

T:	RL	SL	LL	PL
T1:	8.0 A	19.0 A	11.0 A	27.0 A
T2:	4.5 B	12.0 B	6.0 B	16.6 B

T: Treatments; RL: Root Length; SL: Shoot Length; LL: Leaf Length; PL: Plant Length.

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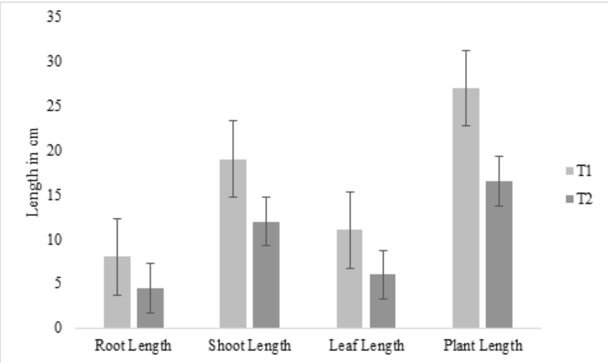
Results and Discussion

As demonstrated LSD of Table 1, the average root length in T1 was observed as 8 cm, while it was 4.5 cm in T2. Shoot length was 19 cm in T1 and 12 cm in T2, while leaf length measured 11 cm in T1 and 6 cm in T2 (Graph 1). The experiment with BS treatment showed a significant positive difference in root length, shoot length, and leaf length, which were 43%, 36%, and 45%, respectively. The BS-treated experiment (T1) showed a plant length of 27 cm, whereas it was 16.6 cm in T2. BS showed potential on *Zea mays* average growth, which was up to 38.8% than T1. BS enhances nutrient uptake through various mechanisms, such as stimulating enzymes and acting as chelators [13]. Humic substances improve nitrogen uptake by stimulating enzymes and can be effective if applied correctly, despite being naturally present in soils [14]. Amino acids reduce nitrogen fertilizer use by stimulating enzymes and chelating micronutrients, especially useful for correcting deficiencies [15]. Seaweed extract increases root size and hormonal action [16]. PGPB shows promise in increasing phosphorus and micronutrient availability (Figure 1) [17].

Figure 1. Fortnightly harvested crop.



Graph 1. Agronomic traits comparison between T1 & T2.

Conclusions

BS in agriculture offers potential for improved crop sustainability by decreasing the ratio of stunted growth. BS had a favorable effect on *Zea mays* growth during germination. When compared to the control, the root, shoot, leaf, and overall plant length all significantly increased with BS application. There was an overall growth enhancement of up to 38.8%, with increases ranging from 36% to 45%. These findings demonstrate the potential of BS to improve plant growth and nutrient uptake, which is crucial when considering the stresses brought on by climate change. Field studies and regulatory frameworks are necessary for validation. Integrating BS into organic farming practices and assessing economic viability compared to conventional practices will support their adoption. Future research is needed to improve formulations, develop application methods, and explore synergies.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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