



ISSN Print: 2618-060X
 ISSN Online: 2618-0618
 NAAS Rating (2026): 5.20
 IJRA xxxx; xx(x): 01-LPAGE
www.agronomyjournals.com
 Received: xx-xx-xxxx
 Accepted: xx-xx-xxxx
 Published: xx-xx-xxxx

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Effect of different bio-stimulants application on growth and yield of soybean (*Glycine max* L.)

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DOI: xxxxxxxxx

ABSTRACT

A field trial was conducted during kharif season, 2025 at Experimental Farm, Agronomy Section, College of Agriculture, Latur (Maharashtra), to study the effect of different bio-stimulants application on growth and yield of soybean (*Glycine max* L.). The experimental field was laid out in a Randomized Block Design (RBD) with seven treatments replicated three times. The treatments were T_1 - Control, T_2 - RDF, T_3 - RDF + FYM @ 5 t/ha, T_4 - RDF + Multi micronutrients grade II @ 0.5% at 25 DAS, T_5 - RDF + Foliar application @ 1% 0:52:34 at 60 DAS, T_6 - RDF + Bio-zyme @ 0.2% at 30 DAS and T_7 - RDF + Nutrient formulation @ 0.4% at 30 DAS. The results showed that RDF + Bio-zyme @ 0.2% at 30 DAS (T_6) recorded the highest growth attributes viz. plant height, number of branches plant-1, number of functional leaves plant-1, leaf area plant-1, total dry matter accumulation plant-1 and seed yield which was at par with RDF + Multi micronutrients grade II @ 0.5% at 25 DAS (T_4) and RDF + Nutrient formulation @ 0.4% at 30 DAS (T_7).

Keywords: Soybean, Bio-stimulants, Bio-zyme, Foliar application, Growth and Yield

Introduction

Soybean (*Glycine max* (L.) Merrill) is an important leguminous crop belonging to the family Leguminosae (Fabaceae) and genus *Glycine*, and is believed to have originated in East Asia. Although botanically classified as a pulse crop, the Food and Agriculture Organization categorizes soybean as an oilseed because of its high oil content. The seeds contain approximately 40-42% protein, around 20% cholesterol-free oil and about 23% carbohydrates; the protein is rich in lysine (about 5%), while the oil is rich in polyunsaturated fatty acids. Soybean produces nearly two to three times more high-quality protein per hectare than most other pulse crops and is valuable for food, feed and industrial purposes. It also improves soil fertility by fixing 45 to 60 kg atmospheric nitrogen per hectare through root nodules and contributes about 0.5 to 1.5 tonnes of organic matter per hectare through leaf drop. During 2024-25, soybean occupied approximately 146.70 million hectares worldwide and produced 420.77 million tonnes of grain. Brazil produced 169.00 million tonnes, followed by the United States of America (118.83 million tonnes), Argentina (49.00 million tonnes), China (20.65 million tonnes) and India (12.58 million tonnes). India covered 129.57 lakh hectares under soybean. In Maharashtra, the crop occupied 44.68 lakh hectares and produced 52.22 lakh tonnes. The Marathwada region accounted for 22.90 lakh hectares and 27.84 lakh tonnes, while Latur district occupied 4.389 lakh hectares and produced 5.640 lakh tonnes (Anonymous, 2025) [1]. Biostimulants are biologically active products that differ from conventional fertilizers because they are not mainly used to overcome severe nutrient deficiencies. They may contain beneficial microorganisms, trace elements, enzymes, plant growth regulators and seaweed extracts, and may be applied through seed treatment, soil application or foliar spraying. These products stimulate natural physiological processes in plants and the rhizosphere, thereby enhancing nutrient uptake, root growth, biological nitrogen fixation, photosynthesis, stress tolerance, crop quality, vigour and productivity. In soybean, foliar application of natural and synthetic biostimulants has improved seed quality and antioxidant activity (Kocira, 2018) [2]. Calvo *et al.* (2014) [3] classified the major biostimulants as microbial inoculants, humic acids, fulvic acids, protein hydrolysates or amino acids and seaweed extracts. Bio-zyme is an eco-friendly, non-toxic and cost-effective plant growth stimulant derived from the Norwegian seaweed *Ascophyllum nodosum*. It contains precursors of auxins and cytokinins, enzymes, hydrolysed proteins and naturally occurring nutrients that promote root and shoot growth, flowering, seed development and tolerance to environmental stress. Foliar feeding is particularly effective when nutrient uptake through the root system becomes inadequate. In soybean, active root nodulation generally declines after 45-50 days of sowing; foliar nutrients can therefore meet crop demand during pod development and seed filling (Sharifi *et al.*, 2018) [4]. Although the recommended dose of fertilizers is important for maintaining soybean productivity, nutrient availability during the reproductive stage may become inadequate because of increased crop demand. Integrated use of organic sources, foliar nutrients, micronutrients and biostimulants may improve nutrient-use efficiency, photosynthetic activity, translocation of assimilates and seed develop

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ment. Information on the comparative effectiveness of FYM, multi-micronutrient Grade II, water-soluble fertilizer 00:52:34, Bio-zyme and nutrient formulation under Latur conditions is limited; hence, the present investigation was undertaken.

Materials and method

The experiment was conducted during *kharif* season, 2025 at Experimental Farm, Agronomy Section, College of Agriculture, Latur (Maharashtra). The mean maximum temperature during the crop growth period was 29.30 °C, while the mean minimum temperature was 20.60 °C. The experimental soil was clayey in texture, low in available nitrogen (112.9 kg ha⁻¹), medium in available phosphorus (7.46 kg ha⁻¹) and high in available potassium (1145.60 kg ha⁻¹). The soil was moderately alkaline in reaction with pH 7.4, electrical conductivity 0.24 dS m⁻¹ and organic carbon 0.58%. The experiment was laid out in a Randomized Block Design with three replications. The treatments were T₁- Control, T₂- RDF, T₃- RDF + FYM @ 5 t/ha, T₄- RDF + Multi micronutrients grade II @ 0.5% at 25 DAS, T₅- RDF + Foliar application @ 1% 0:52:34 at 60 DAS, T₆- RDF + Bio-zyme @ 0.2% at 30 DAS and T₇- RDF + Nutrient formulation @ 0.4% at 30 DAS. The treatments were allotted randomly to the plots within each replication. Soybean variety MAUS-158 was sown by dibbling on 18 July 2025 using a seed rate of 65 kg ha⁻¹ and spacing of 45 cm x 5 cm. The gross plot size was 5.40 m x 4.50 m and the net plot size was 4.50 m x 3.90 m. The recommended fertilizer dose was 30:60:30:20 NPKS kg ha⁻¹. Urea, single super phosphate and muriate of potash were used as fertilizer sources, and the bio-stimulant or foliar nutrient treatments were applied according to the treatment schedule. Cultural practices and plant protection measures were carried out according to need. Five plants were randomly selected and tagged from each net plot for recording biometric observations. Plant height was measured from ground level to the base of the topmost fully opened leaf. Branches arising directly from the main stem and fully

opened functional trifoliate leaves were counted. Leaf area plant⁻¹ was calculated from leaf length, breadth, number and the leaf area constant. For total dry matter, representative plants were sun dried and then oven dried at 65 ± 2 °C for 48 hours to constant weight. Cleaned seed obtained from each net plot was weighed and converted into seed yield (kg ha⁻¹) using the hectare factor. Data obtained on various variables were analysed by the 'Analysis of Variance Method' (Panse *et al.*, 1967) [5].

Result and Discussion

Growth attributes

Application of RDF + Bio-zyme @ 0.2% at 30 DAS (T₆) recorded the highest plant height, number of branches plant⁻¹, number of functional leaves plant⁻¹, leaf area plant⁻¹ and total dry matter accumulation plant⁻¹. It was at par with RDF + Multi micronutrients grade II @ 0.5% at 25 DAS (T₄) and RDF + Nutrient formulation @ 0.4% at 30 DAS (T₇), and found significantly superior to the remaining treatments. Control (T₁) recorded the lowest values for growth attributes and seed yield of soybean. Bio-zyme supplies natural growth-promoting substances, including precursors of auxins and cytokinins, enzymes, hydrolysed proteins and naturally occurring nutrients. These constituents stimulate cell division and elongation, root growth and nutrient assimilation, resulting in greater vegetative growth. Greater leaf area, improved photosynthetic activity and enhanced nutrient assimilation increased photosynthate production and biomass accumulation. Better assimilate supply also supported reproductive development and seed formation. These findings were in accordance with Biradar (1998) [6], Singh *et al.* (2014) [7], Tandon *et al.* (2015) [8], Vishwanatha *et al.* (2022) [9], Aishwarya *et al.* (2023) [10] and Dudde *et al.* (2023) [11].

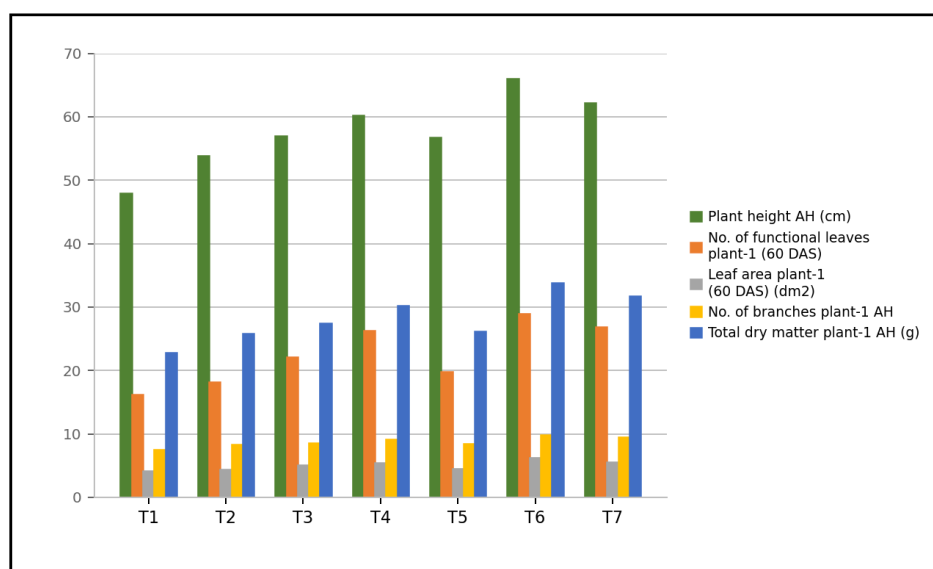


Figure 1. Mean of growth attributes of soybean as affected by various treatments

Seed yield (kg ha⁻¹)

The mean seed yield of soybean was 2419 kg ha⁻¹. The highest seed yield (2985 kg ha⁻¹) was recorded with RDF + Bio-zyme @ 0.2% at 30 DAS (T₆), which was at par with RDF + Multi micronutrients grade II @ 0.5% at 25 DAS (T₄) (2814 kg ha⁻¹) and RDF + Nutrient formulation @ 0.4% at 30 DAS (T₇) (2882 kg ha⁻¹). These treatments were significantly superior to the remaining treatments. Control (T₁) recorded the lowest seed yield (1573 kg ha⁻¹). The increase in seed yield resulted from improvement in plant growth, leaf area, dry matter accumulation, pod number and seed yield attributes. Bio-zyme promoted physiological activity and nutrient assimilation, thereby improving reproductive efficiency and assimilate translocation to seeds.

These findings were in line with Biradar (1998) [6], Dikey *et al.* (2020) [12], Bodke *et al.* (2022) [13], Aishwarya *et al.* (2023) [10], Dudde *et al.* (2023) [11] and Kolekar *et al.* (2025) [14].

Conclusion

The application of RDF + Bio-zyme @ 0.2% at 30 DAS (T₆) recorded the highest growth attributes viz. plant height at harvest, number of branches plant⁻¹ at harvest, number of functional leaves plant⁻¹, leaf area plant⁻¹, total dry matter accumulation at harvest and Seed yield (kg ha⁻¹) of soybean, closely followed by application of RDF + Nutrient formulation @ 0.4% at 30 DAS (T₇) and RDF + Multi micronutrients grade II @ 0.5% at 25 DAS (T₄).

Table 1. Mean of growth attributes and yield of soybean as influenced by various treatments.

Treatments	Plant height AH (cm)	No. of functional leaves plant ⁻¹ (60 DAS)	Leaf area plant ⁻¹ (60 DAS) (dm ²)	No. of branches plant ⁻¹ AH	Total dry mat- ter plant ⁻¹ AH (g)	Seed yield (kg ha ⁻¹)
T ₁ - Control	47.95	16.23	4.15	7.50	22.78	1573
T ₂ - RDF	53.84	18.23	4.41	8.37	25.83	1982
T ₃ - RDF + FYM @ 5 t/ha	56.98	22.10	5.05	8.60	27.45	2300
T ₄ - RDF + Multi micronutrients grade II @ 0.5% at 25 DAS	60.25	26.27	5.44	9.17	30.20	2814
T ₅ - RDF + Foliar application @ 1% 0:52:34 at 60 DAS	56.69	19.77	4.52	8.43	26.16	2400
T ₆ - RDF + Bio-zyme @ 0.2% at 30 DAS	65.99	28.93	6.21	9.83	33.81	2985
T ₇ - RDF + Nutrient formulation @ 0.4% at 30 DAS	62.22	26.83	5.56	9.53	31.78	2882
SE ±	2.67	0.95	0.31	0.38	1.72	122
CD @ 5%	8.24	2.92	0.97	1.17	5.30	378

*AH-at harvest *DAS-days after sowing

Acknowledgement

We are grateful to the Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani for the financial assistance and infrastructural facilities provided for the conduct of this research work.

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How to cite this article: Shinde D, Suryavanshi V, Patange M, Lomate P, Bhairawad V, Gomladu K, et al. Effect of different bio-stimulants application on growth and yield of soybean (*Glycine max* L.). *International Journal of Research in Agronomy*. xxxx;xx(x):01-LPAGE. doi: <https://www.doi.org/xxxxxx>

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