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Effect of application of micronutrients on growth attributes and yield of sunflower (*Helianthus annuus* L.)

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ABSTRACT

A field experiment was conducted during kharif season, 2025 at Experimental Farm, Oilseeds Research Station, Latur (Maharashtra), to study the response of sunflower (*Helianthus annuus* L.) to different micronutrients. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments replicated three times. The treatments were T_1 - RDF (90:45:45 kg N:P₂O₅:K₂O ha⁻¹), T_2 - RDF + ZnSO₄ @ 20 kg ha⁻¹, T_3 - RDF + ZnSO₄ @ 25 kg ha⁻¹, T_4 - RDF + FeSO₄ @ 15 kg ha⁻¹, T_5 - RDF + FeSO₄ @ 20 kg ha⁻¹, T_6 - RDF + Borax @ 4.0 kg ha⁻¹, T_7 - RDF + Borax @ 5.0 kg ha⁻¹, T_8 - RDF + Multi-micronutrient Grade I @ 20 kg ha⁻¹, T_9 - RDF + Multi-micronutrient Grade I @ 25 kg ha⁻¹ and T_{10} - RDF + Multi-micronutrient Grade I @ 30 kg ha⁻¹. Application of RDF + Multi-micronutrient Grade I @ 25 kg ha⁻¹ (T_9) recorded the highest plant height, number of functional leaves plant⁻¹, leaf area plant⁻¹, total dry matter accumulation plant⁻¹, stem girth, head diameter and seed yield. It was statistically at par with T_2 , T_{10} and T_8 and significantly superior to the remaining treatments for these parameters. The lowest values were recorded with RDF alone (T_1). The highest seed yield (2184 kg ha⁻¹) was obtained with T_9 .

Keywords: Sunflower, Zinc, Iron, Boron, Multi-micronutrient, Growth and yield

Introduction

Sunflower (*Helianthus annuus* L.), commonly known as 'Surajmukhi' in India, is an important oilseed crop belonging to the family Asteraceae. It is a short-duration, photo- and thermo-insensitive crop that adapts to diverse soils, climates and cropping systems. The crop is drought tolerant, requires a low seed rate and has considerable potential for increasing edible-oil production (Heiser, 1978) [1].

Sunflower seed contains about 45–50% oil and 14–19% protein. Its oil is rich in linoleic acid and also contains oleic acid and vitamins A, D, E and B-complex. Besides its use as edible oil, it is utilized in soaps, cosmetics, margarine and shortening products, while the protein-rich oil cake is used as poultry and livestock feed (Adeleke et al., 2020) [2].

Nutrient management is one of the major agronomic factors governing sunflower growth, achene yield and oil production. Farmers generally emphasize nitrogen, phosphorus and potassium while micronutrients receive less attention. Their deficiency can restrict vegetative growth, seed setting and crop productivity. Micronutrient application has been reported to improve plant height, leaf development and dry matter production in sunflower (Kumbhar et al., 2017; Siddiqui et al., 2009) [3, 4].

Zinc is involved in enzyme activation, auxin synthesis, protein and nucleic-acid metabolism and membrane stability. Adequate zinc nutrition therefore supports cell elongation, leaf expansion, photosynthesis and seed development. Because zinc is strongly fixed in soil and its movement below the root zone is limited, its application is important for correcting deficiency and avoiding yield loss (Brennan et al., 1988) [5].

Sunflower is highly sensitive to boron deficiency, particularly during reproductive development. Boron is essential for cell-wall formation, translocation of assimilates, pollen viability, pollen-tube growth and fertilization. Its deficiency at flowering can increase the proportion of unfilled seeds and reduce seed yield (Rerkasem, 1986; Chatterjee et al., 2000) [7, 6].

Iron is essential for chlorophyll formation, photosynthetic electron transport and several enzymatic and metabolic processes. Its deficiency appears first on young leaves as interveinal chlorosis and may restrict growth and assimilate production. Adequate iron nutrition consequently supports vegetative development and the formation of assimilates required for seed growth (Kakar et al., 2000) [8].

Multi-micronutrient mixtures provide several essential nutrients in balanced proportions and are particularly useful where more than one micronutrient is deficient. Their soil application can improve chlorophyll formation, enzyme activity, nutrient-use efficiency and assimilate translocation, thereby supporting both vegetative and reproductive development of sunflower.

Although micronutrients are required in small quantities, their balanced supply is essential for completing the plant life cycle and realizing the yield potential of sunflower. Therefore, the present investigation was

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conducted to determine the response and requirement of zinc, iron, boron and Multi-micronutrient Grade I in sunflower during *kharif* season.

Materials and method

The experiment was conducted during *kharif* season, 2025 at Experimental Farm, Oilseeds Research Station, Latur (Maharashtra), situated in the semi-arid region of the state. The mean maximum and minimum temperatures during the crop-growth period were 29.27 °C and 20.67 °C, respectively. The experimental soil was clayey, low in available nitrogen (237.1 kg ha⁻¹), medium in available phosphorus (18.30 kg ha⁻¹) and very high in available potassium (495.31 kg ha⁻¹). It was moderately alkaline (pH 7.75) and contained 0.54 ppm available zinc, 0.14 ppm available boron and 1.98 ppm available iron. The experiment was laid out in a Randomized Block Design with three replications. The treatments were T₁- RDF (90:45:45 kg N:P₂O₅:K₂O ha⁻¹), T₂- RDF + ZnSO₄ @ 20 kg ha⁻¹, T₃- RDF + ZnSO₄ @ 25 kg ha⁻¹, T₄- RDF + FeSO₄ @ 15 kg ha⁻¹, T₅- RDF + FeSO₄ @ 20 kg ha⁻¹, T₆- RDF + Borax @ 4.0 kg ha⁻¹, T₇- RDF + Borax @ 5.0 kg ha⁻¹, T₈- RDF + Multi-micronutrient Grade I @ 20 kg ha⁻¹, T₉- RDF + Multi-micronutrient Grade I @ 25 kg ha⁻¹ and T₁₀- RDF + Multi-micronutrient Grade I @ 30 kg ha⁻¹. Treatments were allotted randomly within each replication.

Sunflower hybrid LSFH-171 was sown on 21 July 2025 by dibbling, using 5–6 kg seed ha⁻¹ at 60 cm × 30 cm spacing. Gross and net plot sizes were 5.40 m × 4.50 m and 4.20 m × 3.90 m, respectively. Half of the nitrogen and the full doses of phosphorus, potassium, zinc, iron, boron and Multi-micronutrient Grade I were applied at sowing according to the treatments. The remaining half of nitrogen was top-dressed at 30 DAS. Recommended crop management and plant-protection practices were followed uniformly.

Five plants from each net plot were randomly selected and labelled for recording biometric observations. Plant height, stem girth and total dry matter plant⁻¹ were recorded at 30, 45, 60 and 75 DAS and at harvest; functional leaves plant⁻¹ and leaf area plant⁻¹ were recorded

at 30, 45, 60 and 75 DAS; and head diameter was recorded at 60 and 75 DAS and at harvest. Plant height was measured from the base of the plant to the growing tip, functional leaves were counted, leaf area was determined from sampled plants, stem girth was measured with Vernier callipers and head diameter was measured with a scale. Total dry matter plant⁻¹ was determined by the oven-dry method. After harvest, cleaned seed yield from each net plot was recorded and converted to kg ha⁻¹. The data were statistically analysed according to the procedure for Randomized Block Design and treatment significance was tested using the critical difference at 5%. Panse *et al.* (1967) [9].

Result and discussion

Application of RDF + Multi-micronutrient Grade I @ 25 kg ha⁻¹ (T₉) recorded the highest plant height at harvest, number of functional leaves plant⁻¹ at 60 DAS, leaf area plant⁻¹ at 60 DAS, total dry matter plant⁻¹ at harvest, head diameter at harvest and seed yield. For these parameters, T₉ was statistically at par with RDF + ZnSO₄ @ 20 kg ha⁻¹ (T₂), RDF + Multi-micronutrient Grade I @ 30 kg ha⁻¹ (T₁₀) and RDF + Multi-micronutrient Grade I @ 20 kg ha⁻¹ (T₈), and was significantly superior to the remaining treatments. RDF alone (T₁) recorded the lowest values for all these growth attributes and seed yield.

The improvement in growth under balanced micronutrient nutrition may be attributed to complementary physiological functions of zinc, iron, boron and other micronutrients supplied through Multi-micronutrient Grade I. Zinc supports auxin synthesis and enzyme activation, iron promotes chlorophyll formation and electron transport, and boron aids cell-wall development and assimilate translocation. These processes increase leaf development, photosynthetic efficiency, dry matter accumulation and head growth. Comparable improvements in sunflower growth with micronutrient application were reported by Gawande *et al.* (2022) [10], Sharma *et al.* (2024) [11] and Soumya *et al.* (2025) [12].

treatments.

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

Treatments	Plant height AH (cm)	No. of functional leaves plant ⁻¹ (60 DAS)	Leaf area plant ⁻¹ (60 DAS) (dm ²)	Head diameter AH (cm)	Total dry matter plant ⁻¹ AH (g)	Seed yield (kg ha ⁻¹)
T ₁ - RDF (90:45:45 kg N:P ₂ O ₅ :K ₂ O ha ⁻¹)	144.15	19.33	41.23	15.21	85.49	1376
T ₂ - RDF + ZnSO ₄ @ 20 kg ha ⁻¹	202.15	30.83	61.43	20.81	122.49	2012
T ₃ - RDF + ZnSO ₄ @ 25 kg ha ⁻¹	171.42	25.51	53.87	17.87	102.82	1680
T ₄ - RDF + FeSO ₄ @ 15 kg ha ⁻¹	179.81	27.23	55.23	18.35	105.16	1762
T ₅ - RDF + FeSO ₄ @ 20 kg ha ⁻¹	163.64	24.19	52.19	17.21	98.82	1579
T ₆ - RDF + Borax @ 4.0 kg ha ⁻¹	154.35	21.13	45.71	15.93	93.49	1411
T ₇ - RDF + Borax @ 5.0 kg ha ⁻¹	159.28	22.87	49.34	16.48	96.82	1529
T ₈ - RDF + Multi-micronutrient Grade I @ 20 kg ha ⁻¹	193.45	28.11	57.14	19.64	115.82	1963
T ₉ - RDF + Multi-micronutrient Grade I @ 25 kg ha ⁻¹	206.45	31.79	64.12	21.24	123.82	2184
T ₁₀ - RDF + Multi-micronutrient Grade I @ 30 kg ha ⁻¹	198.85	29.71	59.87	20.47	118.49	2004
SE ±	8.20	1.45	2.76	0.95	4.01	87
CD @ 5%	24.36	4.31	8.21	2.82	11.91	258

*AH - at harvest *DAS - days after sowing

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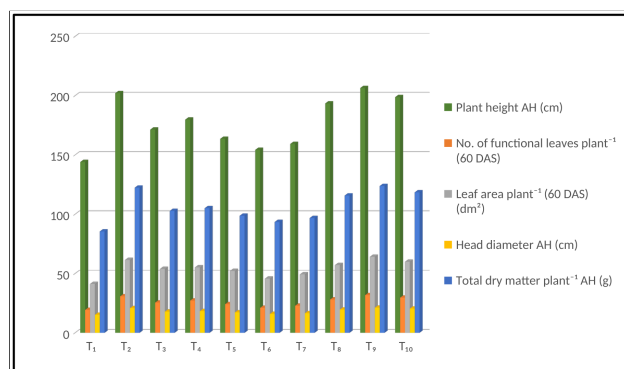


Figure. Mean of growth attributes of sunflower as affected by various treatments

Seed yield (kg ha⁻¹)

Mean seed yield of sunflower was 1750 kg ha⁻¹. The highest seed yield (2184 kg ha⁻¹) was recorded with RDF + Multi-micronutrient Grade I @ 25 kg ha⁻¹ (T₉), which was statistically at par with RDF + ZnSO₄ @ 20 kg ha⁻¹ (T₂) (2012 kg ha⁻¹), RDF + Multi-micronutrient Grade I @ 30 kg ha⁻¹ (T₁₀) (2004 kg ha⁻¹) and RDF + Multi-micronutrient Grade I @ 20 kg ha⁻¹ (T₈) (1963 kg ha⁻¹), and was significantly superior to the remaining treatments. The lowest seed yield (1376 kg ha⁻¹) was recorded with RDF alone (T₁).

The increase in seed yield was the cumulative result of improved leaf area, dry matter accumulation, head diameter, seed filling and assimilate partitioning. Balanced micronutrient supply enhances photosynthetic efficiency, reproductive success and translocation of assimilates from source organs to developing seeds, thereby increasing economic yield. Similar increases in sunflower seed yield due to micronutrient application were reported by Immanuel *et al.* (2020) [13], Raghavendra *et al.* (2020) [14] and Sharma *et al.* (2024) [11].

Conclusion

The application of RDF + Multi-micronutrient Grade I @ 25 kg ha⁻¹ (T₉) recorded the highest plant height at harvest (206.45 cm), number of functional leaves plant⁻¹ at 60 DAS (31.79), leaf area plant⁻¹ at 60 DAS (64.12 dm²), total dry matter accumulation plant⁻¹ at harvest (123.82 g), stem girth at 75 DAS (9.70 cm), head diameter at harvest (21.24 cm) and seed yield (2184 kg ha⁻¹).

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