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Study on soil and foliar application of zinc sulphate and boron on growth and yield of sunflower (*Helianthus annuus* L.)

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Abstract

A field trial was conducted during pre-rabi season, 2024 at Agriculture Technology School, Latur (Maharashtra), to study the effect of soil and foliar application of micronutrients on growth and yield of sunflower (*Helianthus annuus* L.). The experimental field was laid out in a Randomized Block Design (RBD) with eight treatments replicated three times. The treatments were T₁- Control, T₂- 100% RDF (90:45:45 kg NPK kg/ha), T₃- RDF + soil application of ZnSO₄ @ 25 Kg/ha, T₄- RDF + soil application of Borax @ 5 Kg/ha, T₅- RDF + foliar application of 0.5% ZnSO₄ at head formation, T₆- RDF + foliar application of 0.2% Borax at head formation, T₇- RDF + soil application of ZnSO₄ @ 25 Kg/ha + Borax @ 5 Kg/ha and T₈- RDF + foliar application of 0.5% ZnSO₄ + 0.2% Borax at head formation. The results showed that the application of RDF + soil application of ZnSO₄ @ 25 kg/ha + Borax @ 5 kg/ha (T₇) showed significantly highest growth attributes viz. plant height plant⁻¹, number of functional leaves plant⁻¹, leaf area plant⁻¹, head diameter leaves plant⁻¹, and total dry matter accumulation leaves plant⁻¹ which were followed by application of RDF + foliar application of 0.5% ZnSO₄ + 0.2% Borax at head formation (T₈) and significantly superior over rest of the treatments. While the lowest was observed for treatment control (T₁). Highest seed yield was recorded by application of RDF + soil application of ZnSO₄ @ 25 kg/ha + Borax @ 5 kg/ha (T₇).

Keywords: Sunflower, zinc, boron, foliar application, growth and yield

Introduction

Sunflower, also known as 'Surajmukhi', is a familiar plant in India. It has been used as an ornamental plant for quite a sometime. It belongs to *Compositae* family and is a day-neutral, short duration, drought, and salinity tolerant oilseed crop. It can be utilized as an ideal catch crop when land is kept fallow. With roughly 20% protein and 40-50% vegetable oil, sunflower seeds are incredibly nutrient rich and have a high calorific value. The oil is believed to be of high quality due to its non-cholesterol properties and has been recommended for the patient having heart problem. Oil is also utilized in the production of soaps and cosmetics. The oil cake has 40-44% high-quality protein. It is great for poultry and animal rations. It can also be used to make infant food. Seeds can be consumed raw or roasted. It contains 60 to 73% linoleic acid, with adequate amount of calcium, iron and vitamins like A, B, E and K (Rajendra *et al.*, 2013) [9]. One of the main agronomic elements influencing sunflower oil and achene productivity is nutrient management. Particularly in the production of sunflowers, farmers have historically overused N, P, and K fertilizers but neglected the use of micronutrients. Poor seed setting and a large percentage of chaffy seeds in the capitulum's centre are two major causes of sunflowers' low output. Due to their impact on growth and yield components, micronutrients have been found to be crucial in raising the seed setting percentage in sunflowers. Therefore, applying micronutrients can boost seed production. The most common issue causing significant losses in crop yield seems to be micronutrient deficiencies. The use of micronutrients has a significant impact on seed setting percentage, as well as growth and production. (Kumbhar *et al.*, 2017) [5]. The most common micronutrient deficiency in a wide range of soils is of zinc. (Graham *et al.*, 1992 & Cakmak *et al.*, 1996) [2,1]. Plants grown in zinc-deficient soils are more vulnerable to environmental stress, which in turn promote the development of deficiencies and result in

stunted growth. Boron deficiency has also been identified in India alongside zinc. In certain areas of India, lack of boron is becoming a major obstacle to sustainable agricultural productivity. Applying sufficient and balanced amounts of zinc and boron to oilseed crops is necessary (Rex Immanuel *et al.*, 2019b & 2019c) ^[10, 11]. Keeping in view the present experiment was conducted to study the effect of soil and foliar application of micronutrients on growth and yield of sunflower (*Helianthus annuus* L.).

Materials and Methods

The experiment was conducted during pre-rabi season, 2024-2025 at Agriculture Technology School, Latur which is situated on an elevation of 631 m above the mean sea level, between 17°52' N to 18°50' N and 76°18' E to 79°12' E comes under semi-arid region of Maharashtra state. The mean maximum temperature during crop growth period is 29.87°C while the mean minimum temperature is 19.76 °C. The soil of experimental plot was clayey in texture with chemical composition such as low in available nitrogen (242.61 kg ha⁻¹), medium in available phosphorous (18.56 kg ha⁻¹) and very high in available potassium (396.72 kg ha⁻¹). The soil was slightly alkaline in reaction and having pH 7.64. low in available zinc (0.54 ppm) and boron (0.14 ppm). The present experiment was laid out in Randomized Complete Block Design with three replications. The allotment of treatments to various plots in each replication was done by randomization. T₁- Control, T₂- 100% RDF (90:45:45 kg NPK kg/ha), T₃- RDF + soil application of ZnSO₄ @ 25 Kg/ha, T₄- RDF + soil application of Borax@ 5 Kg/ha, T₅- RDF + foliar application of 0.5% ZnSO₄ at head formation, T₆- RDF + foliar application of 0.2% Borax at head formation, T₇- RDF + soil application of ZnSO₄ @ 25 Kg/ha + Borax@ 5 Kg/ha and T₈- RDF + foliar application of 0.5% ZnSO₄ + 0.2% Borax at head formation. Sowing was done by dibbling with seed rate of 5 kg/ha. Sunflower hybrid LSFH-171 was sown with recommended fertilizer dose of 90:45:45 kg/ha. Gross plot was of size 5.4 m x 4.5 m and net plot of 4.2 m x 3.9 m. Soil application of half dose of nitrogen and full dose of phosphorous, potassium, zinc and boron was applied through urea, SSP, MOP, zinc sulphate (36%) and borax (20%) respectively at the time of sowing and remaining half dose of nitrogen (urea) was applied at 30 days after sowing. Foliar spray of ZnSO₄ @0.5% and boron @ 0.2% was done at 45 days after sowing. Standard package of practices was followed. The statistical technique of analysis of variance was employed to analyse the recorded data (Panse and Sukhatme, 1967) ^[8].

Results and Discussion

Growth attributes

The perusal data in Table 1 showed that the plant height plant⁻¹, number of functional leaves plant⁻¹, leaf area plant⁻¹, head diameter leaves plant⁻¹, and total dry matter accumulation leaves plant⁻¹ of sunflower were influenced significantly due to various treatments. Application of RDF + soil application of ZnSO₄ @ 25 Kg/ha + Borax@ 5 Kg/ha (T₇) recorded significantly highest value of plant height plant⁻¹ (163.92 cm), number of leaves plant⁻¹ (22.98), leaf area plant⁻¹ (49.19 dm²), head diameter plant⁻¹ (16.56 cm) and dry matter plant⁻¹ (100.87 g) which was at par with the application of RDF + foliar application of 0.5% ZnSO₄ + 0.2% Borax at head formation (T₈) and found significantly superior over rest of the treatments. Treatment control (T₁) recorded the lowest values for growth attributing characters of the crop. Since zinc is necessary for the synthesis of proteins and auxin in plants and as it activates enzymes like proteinase and peptidases, it has a positive impact on plant height, cell elongation and leaf area expansion. Zinc also increases photosynthetic efficiency and chlorophyll production which in turn improves assimilation of resources. Boron micronutrient accelerates vegetative growth of the plant and increases the number of leaves, strengthen the cell wall and support the structural integrity of the head tissue. These findings were in conformity with the results of Immanuel *et al.*, (2019) ^[3], Lotha *et al.*, (2021) ^[7] and Kundu *et al.*, (2023) ^[6].

Yield

The data presented in Table 1 showed that seed yield of sunflower was influenced significantly due to various treatments. Highest seed yield (1416 kg ha⁻¹) of sunflower was observed with the application of RDF + soil application of ZnSO₄ @ 25 Kg/ha + Borax@ 5 Kg/ha (T₇) which was at par with the application of RDF + foliar application of 0.5% ZnSO₄ + 0.2% Borax at head formation (T₈) and found significantly superior over rest of the treatments. Treatment control (T₁) recorded the lowest values for growth attributing characters of the crop. This response is mostly caused by the dominant roles that zinc and boron play in enhancing the crop's capacity for photosynthetic activity and assimilation through their involvement in a number of enzymatic and other biochemical processes. Improved nitrogen transfers from source to sink allows for improved yield characteristics and, ultimately, increase in seed yield of sunflower. These findings were in line with the conclusions of Immanuel *et al.*, (2020) ^[4] and Kundu *et al.*, (2023) ^[6].

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

Treatments	Plant height AH (cm)	No. of functional leaves plant ⁻¹ (60 DAS)	Leaf area plant ⁻¹ (60DAS) (dm ²)	Head diameter AH (cm)	Total dry matter plant ⁻¹ AH (g)	Seed yield (kg ha ⁻¹)
T ₁ - Control	125.56	18.51	39.74	13.47	61.60	1018
T ₂ - 100% RDF (90:45:45 NPK kg/ha)	158.50	19.96	46.70	14.83	80.03	1260
T ₃ - RDF + soil application of ZnSO ₄ @ 25 Kg/ha	186.35	25.67	55.64	17.78	108.65	1695
T ₄ - RDF + soil application of Borax@ 5 Kg/ha	168.39	24.33	52.94	17.13	104.70	1452
T ₅ - RDF + foliar application of 0.5% ZnSO ₄ at head formation	181.88	25.12	53.90	17.50	106.36	1643
T ₆ - RDF + foliar application of 0.2% Borax at head formation	163.92	22.98	49.19	16.56	100.87	1416
T ₇ - RDF + soil application of ZnSO ₄ @ 25 Kg/ha + Borax@ 5 Kg/ha	202.16	28.90	61.44	19.83	118.34	1975
T ₈ - RDF + foliar application of 0.5% ZnSO ₄ + 0.2% Borax at head formation	192.09	26.00	58.13	18.71	114.29	1801
SE ±	7.54	1.11	2.28	0.72	4.37	89
CD @ 5%	22.61	3.31	6.83	2.16	13.11	269

*AH-at harvest *DAS- days after sowing

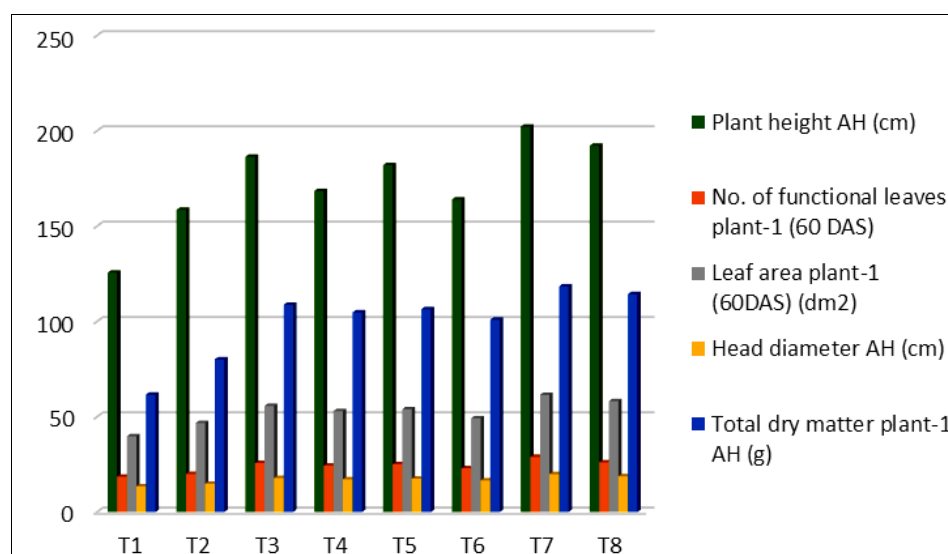


Fig 1: Mean of growth attributes of sunflower as affected by various treatments

Conclusion

The application of treatment RDF + soil application of ZnSO_4 @ 25 Kg/ha + Borax @ 5 Kg/ha showed significantly highest growth attributes viz. plant height plant⁻¹, number of functional leaves plant⁻¹, leaf area plant⁻¹, head diameter plant⁻¹, total dry matter accumulation plant⁻¹ and seed yield, closely followed by application of RDF + foliar application of 0.5% ZnSO_4 + 0.2% Borax at head formation

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