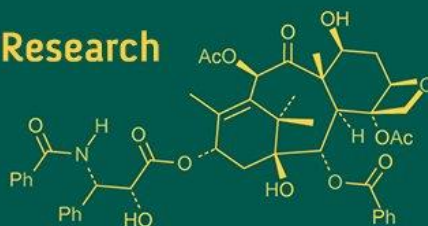


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Response of various micronutrients on yield and quality of onion

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Abstract

The Present investigation entitled “Response of various micronutrients on yield and quality of onion” was conducted at Horticultural Instructional farm, Department of Horticulture, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur C.G. during rabi season of 2025-26. The experiment was laid out in a Randomized Block Design (RBD) with 8 treatments and 3 replications to assess the impact of different combinations of micronutrients on plant growth, yield and quality attributes. The experiment comprised different treatments including Recommended Dose of Fertilizers (RDF) alone and its combinations with foliar application of ZnSO_4 , FeSO_4 and borax at specified concentrations. The results indicated that significant differences were observed among treatments for all the parameters studied. The findings revealed that the treatment receiving RDF + ZnSO_4 @ 0.5% + FeSO_4 @ 0.5% + Borax @ 0.25% (T_8) recorded the highest bulb yield (316.98 q ha^{-1}), followed by RDF + ZnSO_4 @ 0.5% + Borax @ 0.25% (T_5), whereas the lowest yield was observed under control (RDF alone) (T_1). Growth parameters such as plant height, number of leaves per plant and neck thickness, along with quality parameters including bulb diameter and average bulb weight, were significantly improved with combined micronutrient application. The study concluded that the combined foliar application of micronutrients, particularly ZnSO_4 , FeSO_4 and borax along with RDF, significantly enhanced growth, yield and quality of onion. Therefore, integrated use of micronutrients can be recommended for improving productivity and profitability of onion under field conditions.

Keywords: Onion, micronutrient, foliar spray, yield parameters, pungency

1. Introduction

Onion (*Allium cepa* L.) is an important vegetable and spice crop in India, forming an integral part of daily diets. It belongs to the family Alliaceae and has a diploid chromosome number of $2n = 2x = 16$. The crop has been cultivated for more than 4700 years and is not found growing naturally in the wild. It is believed to have been first domesticated in the mountainous regions of present-day Turkmenistan and northern Iran, close to the early civilizations of the Near East, particularly the Sumerians. Hence, Southwest Asia is regarded as the primary center of onion domestication, while the Mediterranean region, known for its genetic variability, is considered a secondary center (Fritsch & Friesen, 2002) [4]. The distinctive pungency of onion is due to the volatile compound allyl propyl disulphide (Khan *et al.*, 2007) [6].

Commonly known as pyaz in Hindi, onions are consumed in several forms—raw in salads, cooked as a vegetable, or used in pickles. White and yellow onion varieties are also processed into flakes, pastes, and powders. Nutritionally, onions are rich in minerals and other essential nutrients, containing calcium (180 mg/100 g), phosphorus (50 mg/100 g), iron (0.7 mg), carbohydrates (11.0 g), proteins (1.2 g), dietary fibre (0.6 g), and vitamin C (11 mg), along with other trace minerals (0.4 g). Their typical pungency is attributed to the sulphur-based compound allyl propyl disulphide (Gopalakrishnan, 2007) [5]. As reported by Watt and Merrill (1950) [10], onions contain 11 amino acids. On average, most onion varieties consist of approximately 89% water, 4% sugars, 1% protein, 2% fibre, and 0.1% fat. They are rich in vitamin C, vitamin B6, and folic acid, and also serve as a good source of dietary fibre.

Globally, major onion-producing countries include Brazil, Iran, Pakistan, Spain, China, India, the USA, Turkey, and Japan. India is a major exporter of onion and the second largest producer in the world next to China. In India, onion is cultivated in an area of 17.9 lakh ha with production of 302.08 lakh MT per annum and an average productivity is 16.87 t/ha (Anonymous, 2023) [2].

Gujarat significantly contributes to national production, cultivating 0.10 million hectares and producing 2.55 million tonnes, with the highest productivity of 25.55 t/ha. Maharashtra ranks first in cultivation area and total production, whereas Gujarat holds the top position in productivity (Anonymous, 2022) [1]. In Chhattisgarh, onion cultivation spans 23.681 thousand hectares, producing about 393.244 thousand metric tonnes annually and a productivity of 16.61 t ha⁻¹ (Chhattisgarh Agri portal, Area and production statistics 2022-23).

In recent years, micronutrients have gained significant attention in crop production due to the widespread occurrence of their deficiencies across various regions of the country. Researchers from almost all states have reported notable improvements in crop performance following micronutrient fertilization. Zinc (Zn) and boron (B) are essential trace elements required by plants, as they participate in numerous enzymatic reactions and play a vital role in plant growth and development. Several studies have also suggested that a wide range of materials can serve as potential sources of plant nutrients (Denre *et al.*, 2016) [3]. The application of micronutrients to soils lacking these elements has been shown to significantly enhance the yield of various crops. Micronutrients play a crucial role in several plant metabolic activities such as cell wall formation, respiration, photosynthesis, chlorophyll synthesis, enzymatic activity, and nitrogen fixation. Acting as cofactors for numerous enzymes, they are vital for improving crop yield and quality and are essential for optimal plant growth and productivity.

Zinc is involved in auxin synthesis and enzyme activation, boron plays a key role in cell division, cell wall development and translocation of carbohydrates; while iron is essential for chlorophyll formation and energy transfer processes. Deficiency of these micronutrients adversely affects growth, bulb development and quality of onion, resulting in reduced productivity. Therefore, foliar application of micronutrients has emerged as an effective approach to enhance nutrient use efficiency and improve growth, yield and quality parameters in onion.

Iron is an essential micronutrient required by almost all living organisms, as it plays a crucial role in several metabolic processes, including DNA synthesis, respiration, and photosynthesis. It activates numerous metabolic pathways and serves as a prosthetic group component in

many enzymes. In plants, iron chlorosis commonly occurs due to an imbalance between the soil's iron solubility and the plant's iron requirements. Iron is vital for various physiological and biochemical functions, being a key element of important enzymes such as cytochromes in the electron transport chain.

2. Materials and Methods

2.1 Experimental Site and Location: The experiment was carried out at Barrister Thakur Chhedilal College of Agriculture and Research Station, Horticulture Research Farm, Bilaspur (Chhattisgarh), during the Rabi season of 2025-2026. The research Farm is located 292.3 meters above mean sea level in latitude 22.9°N and longitude 82.12°E. The area is classified as part of India's Eastern Plateau and Hill Region (Agro-climatic zone VII). The state of Chhattisgarh is divided into three agro climatic zones namely Chhattisgarh plains, Northern hills zone, Bastar plateau and Bilaspur is located in the state's plains zone.

2.2 Climate Condition: During the experimental period, the area experienced cool to moderate temperatures, with average daily temperatures ranging between 13 °C to 30 °C, and relative humidity fluctuating between 40% to 85%. Rainfall during the crop growth period was negligible, and the crop was grown under irrigated conditions.

2.3 Treatment details

The experiment was laid out in a Randomized Block Design (RBD) with eight treatments replicated thrice. The treatments were T₁: RDF @ 120:80:80 N₂O₂O kg ha⁻¹, T₂: T₁ + ZnSO₄ @ 0.5% at 30 and 60 DAP, T₃: T₁ + Borax @ 0.25% at 30 and 60 DAP, T₄: T₁ + FeSO₄ @ 0.5% at 30 and 60 DAP, T₅: T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP, T₆: T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP, T₇: T₁ + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP and T₈: T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP. Foliar application of micronutrients was carried out at 30 and 60 days after transplanting using a knapsack sprayer to evaluate their effect on growth, yield, yield attributes and quality of onion (*Allium cepa* L.).

2.4 Statistical analysis

The data collected for all the characters were subjected to statistical analysis as per the procedure of Randomized Block Design with factorial concept in OPSTAT. The 'F' test was used for test of significance. The Standard Error of Mean (S.E.m.±) was computed in each case. For the treatment effects which were found significant, critical difference (C.D.) at 5 percent level of probability was worked out to compare the treatments mean.

Table 1: Details of treatment combination

S. No.	Treatments
T ₁	RDF @ 120:80:80 NPK Kg ha ⁻¹
T ₂	T ₁ + ZnSO ₄ @ 0.5% at 30 DAP and 60 DAP
T ₃	T ₁ + Borax @ 0.25% at 30 DAP and 60 DAP
T ₄	T ₁ + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP
T ₅	T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% at 30 DAP and 60DAP
T ₆	T ₁ + ZnSO ₄ @ 0.5% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP
T ₇	T ₁ + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP
T ₈	T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP

3. Results and Discussion

3.1 Growth parameters

3.1.1 Plant height (cm)

Plant height was significantly influenced by micronutrient application. At 30 DAT, the effect of treatments was found to be non-significant; however, the maximum plant height was recorded in T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (36.70 cm). At 60 and 90 DAT, the highest plant height was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP) (57.62 and 63.47 cm, respectively), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) (51.75 and 57.32 cm, respectively) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (50.91 and 56.76 cm, respectively), whereas the lowest plant height was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) (42.01 and 45.41 cm, respectively). Similar findings were reported by Sethupathi *et al.* (2019) [8]

3.1.2 Number of leaves plant⁻¹

Number of leaves per plant was significantly influenced by micronutrient application. At 30 DAT, the effect of treatments was found to be non-significant; however, the maximum number of leaves per plant was recorded in T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP). At 60 and 90 DAT, the highest number of leaves per plant was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP), whereas the lowest number of leaves per plant was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹). Similar findings were reported by Miah *et al.* (2020).

3.1.3 Collar thickness (mm)

Collar thickness was significantly influenced by micronutrient application. At 30 DAT, the effect of treatments was found to be non-significant; however, the maximum collar thickness was recorded in T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP). At 60 DAT, the highest collar thickness was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP), whereas the lowest collar thickness was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹).

At 90 DAT, the highest collar thickness was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP), whereas the lowest collar thickness was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹). These findings are in close conformity with the results reported by Kumar *et al.* (2021) [7].

3.2 Yield parameters

3.2.1 Polar Diameter

Polar diameter was significantly influenced by micronutrient application. The highest polar diameter was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP) (56.85 mm), followed by T₅ (T₁ + ZnSO₄

@ 0.5% + Borax @ 0.25% at 30 and 60 DAP) (52.93 mm) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (52.44 mm), whereas the lowest polar diameter was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) (44.23 mm). The increase in polar diameter may be attributed to enhanced cell enlargement, improved photosynthetic activity and efficient translocation of assimilates under micronutrient application. These findings are in close conformity with the results reported by Sethupathi *et al.* (2019) [8] and Singh *et al.* (2022) [9]

3.2.2 Equatorial Diameter

Equatorial diameter was significantly influenced by micronutrient application. The highest equatorial diameter was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP) (66.62 mm), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) (62.10 mm) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (61.34 mm), whereas the lowest equatorial diameter was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) (52.16 mm). The increase in equatorial diameter may be attributed to enhanced cell division, cell enlargement and efficient translocation of assimilates towards developing bulbs under micronutrient application. These findings are in close conformity with the results reported by Singh *et al.* (2022) [9]

3.2.3 Average bulb weight (g)

Average bulb weight was significantly influenced by micronutrient application. The highest average bulb weight was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP), whereas the lowest average bulb weight was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹). The increase in average bulb weight may be attributed to enhanced photosynthetic activity, efficient translocation of assimilates and improved nutrient utilization under micronutrient application, resulting in better bulb development and accumulation of dry matter. These findings are in close conformity with the results reported by Singh *et al.* (2022) [9].

3.2.4 Bulb Yield (q ha⁻¹)

Bulb yield was significantly influenced by micronutrient application. The highest bulb yield was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP) (328.50 q ha⁻¹), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) (296.69 q ha⁻¹) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (291.30 q ha⁻¹), whereas the lowest bulb yield was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) (224.75 q ha⁻¹). The increase in bulb yield may be attributed to improved vegetative growth, enhanced photosynthetic efficiency and better translocation of assimilates towards bulb formation. Zinc plays a key role in enzyme activation and auxin synthesis, iron contributes to chlorophyll formation and energy transfer, while boron facilitates carbohydrate movement and cell division. The combined application of these micronutrients enhanced bulb development, resulting in higher yield. These findings are in close conformity with the results reported by Sethupathi *et al.* (2019) [8], Singh *et al.* (2022) [9].

3.3 Quality parameters

3.3.1 TSS

Total soluble solids (TSS) content was significantly influenced by micronutrient application. The highest TSS was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP) (14.21 °Brix), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) (13.42 °Brix) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (13.32 °Brix), whereas the lowest TSS was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) (11.25 °Brix). The increase in TSS may be attributed to enhanced photosynthetic activity, improved carbohydrate synthesis and efficient translocation of sugars from leaves to bulbs under micronutrient application. Zinc activates several enzymes involved in carbohydrate metabolism, iron improves photosynthetic efficiency through chlorophyll synthesis, while boron facilitates sugar transport and accumulation in storage organs, thereby increasing the TSS content of bulbs. These findings are in close conformity with the results reported by Kumar *et al.* (2021)^[7]

3.3.2 Ascorbic acid (mg/100 g)

Ascorbic acid content was significantly influenced by micronutrient application. The highest ascorbic acid content was observed in T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5% at 30 and 60 DAP) (14.38 mg 100g⁻¹), followed by T₅ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% at 30 and 60 DAP) (13.60 mg 100g⁻¹) and T₆ (T₁ + ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 30 and 60 DAP) (13.41 mg 100g⁻¹), whereas the lowest ascorbic acid content was recorded in T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) (11.51 mg 100g⁻¹). The increase in ascorbic acid content may be attributed to enhanced photosynthetic activity, improved carbohydrate metabolism and increased biosynthesis of ascorbic acid under micronutrient application. Zinc plays an important role in enzyme activation and metabolic processes, iron contributes to energy transfer and synthesis of essential metabolites, while boron facilitates translocation of sugars and synthesis of organic compounds, thereby improving the ascorbic acid content of onion bulbs. These findings are in close conformity with the results reported by Kumar *et al.* (2021)^[7]

Table 1: Response of various micronutrients on Plant height (cm) of onion.

Treatments	30 DAT	60 DAT	90 DAT
RDF @ 120:80:80 NPK Kg ha ⁻¹	35.80	42.01	45.41
T ₁ + ZnSO ₄ @ 0.5% at 30 DAP and 60 DAP	36.10	47.17	51.53
T ₁ + Borax @ 0.25% at 30 DAP and 60 DAP	35.70	46.84	51.03
T ₁ + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	36.66	46.47	50.81
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% at 30 DAP and 60DAP	35.66	51.75	57.32
T ₁ + ZnSO ₄ @ 0.5% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	36.70	50.91	56.76
T ₁ + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	36.64	47.40	52.05
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	36.30	57.62	63.47
SEm (±)	1.809	1.350	1.658
CD (5%)	NS	4.10	5.03

Table 2: Response of various micronutrients on Number of leaves plant⁻¹ of onion.

Treatments	30 DAT	60 DAT	90 DAT
RDF @ 120:80:80 NPK Kg ha ⁻¹	3.69	5.34	8.24
T ₁ + ZnSO ₄ @ 0.5% at 30 DAP and 60 DAP	3.40	6.73	10.14
T ₁ + Borax @ 0.25% at 30 DAP and 60 DAP	3.54	6.41	9.71
T ₁ + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	3.71	6.07	9.46
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% at 30 DAP and 60DAP	3.33	7.51	11.63
T ₁ + ZnSO ₄ @ 0.5% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	3.54	7.20	11.35
T ₁ + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	3.32	6.84	10.21
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	3.64	8.34	12.82
SEm (±)	0.275	0.201	0.374
CD (5%)	NS	0.61	1.13

Table 3: Response of various micronutrients on Collar Thickness (mm) of onion.

Treatments	30 DAT	60 DAT	90 DAT
RDF @ 120:80:80 NPK Kg ha ⁻¹	5.90	7.53	9.39
T ₁ + ZnSO ₄ @ 0.5% at 30 DAP and 60 DAP	5.96	9.48	11.57
T ₁ + Borax @ 0.25% at 30 DAP and 60 DAP	6.10	9.02	11.32
T ₁ + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	5.83	8.95	10.85
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% at 30 DAP and 60DAP	5.97	11.51	13.10
T ₁ + ZnSO ₄ @ 0.5% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	5.71	11.32	12.75
T ₁ + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	5.97	10.21	11.66
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	6.03	12.85	14.63
SEm (±)	0.363	0.409	0.430
CD (5%)	NS	1.24	1.30

Table 4: Response of various micronutrients on Yield and yield parameters of onion.

Treatments	Polar Diameter (mm)	Equatorial Diameter (mm)	Average Bulb weight (g)	Bulb Yield (q ha ⁻¹)
RDF @ 120:80:80 NPK Kg ha ⁻¹	44.23	52.16	51.95	224.75
T ₁ + ZnSO ₄ @ 0.5% at 30 DAP and 60 DAP	48.73	57.60	57.74	263.62
T ₁ + Borax @ 0.25% at 30 DAP and 60 DAP	48.50	57.40	57.28	258.73
T ₁ + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	48.15	57.06	56.87	256.85
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% at 30 DAP and 60DAP	52.93	62.10	62.70	296.69
T ₁ + ZnSO ₄ @ 0.5% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	52.44	61.34	60.56	291.30
T ₁ + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	49.57	57.82	58.17	266.10
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	56.85	66.62	67.35	328.50
SEm (±)	1.013	1.365	1.432	9.697
CD (5%)	3.07	4.14	4.34	29.41

Table 5: Response of various micronutrients on quality parameters of onion.

Treatments	TSS (°Brix)	Ascorbic acid (mg/100 g)
RDF @ 120:80:80 NPK Kg ha ⁻¹	11.25	11.51
T ₁ + ZnSO ₄ @ 0.5% at 30 DAP and 60 DAP	12.70	12.73
T ₁ + Borax @ 0.25% at 30 DAP and 60 DAP	12.52	12.64
T ₁ + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	12.20	12.41
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% at 30 DAP and 60DAP	13.42	13.61
T ₁ + ZnSO ₄ @ 0.5% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	13.32	13.41
T ₁ + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	12.77	12.90
T ₁ + ZnSO ₄ @ 0.5% + Borax @ 0.25% + FeSO ₄ @ 0.5% at 30 DAP and 60 DAP	14.21	14.38
SEm (±)	0.251	0.185
CD (5%)	0.61	0.56

4. Conclusion

The treatment T₈ (T₁ + ZnSO₄ @ 0.5% + Borax @ 0.25% + FeSO₄ @ 0.5%) recorded the highest values for all the parameters including bulb size, bulb weight, total yield, TSS, ascorbic acid content, Plant height, number of leaves, neck thickness. The control treatment T₁ (RDF @ 120:80:80 NPK kg ha⁻¹) recorded the lowest performance in all growth, yield and quality parameters. The results clearly indicated that the combined application of Zn, B, and Fe effectively enhanced the physiological and biochemical processes of the onion crop, thereby improving overall bulb yield and quality.

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