



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(5): 308-311
Received: 19-02-2026
Accepted: 23-03-2026

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Response of different levels of fertilizers and foliar sprays on productivity of maize

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5d.5522>

Abstract

A field experiment was conducted during the *rabi* season of 2025–26 at the Research Farm, School of Agricultural Sciences, Malla Reddy University, Hyderabad, to investigate the response of different levels of fertilizers and foliar sprays on productivity of maize. The experiment was laid out in a randomized block design with seven treatments and three replications, using the hybrid Pioneer 3302. The treatments comprised varying fertilizer levels in combination with foliar sprays of iron (Fe), zinc (Zn), and boron (B). The results indicated that growth parameters, yield attributes, and productivity of maize were significantly influenced by the imposed treatments. Application of 125% recommended dose of fertilizers (RDF) in conjunction with foliar application of Fe, Zn, and B @ 1% (T₂) recorded the highest values of growth traits and yield. The enhanced performance under this treatment can be attributed to improved nutrient availability, efficient uptake, and synergistic interaction between macro and micronutrients, leading to better physiological and metabolic activity. In contrast, the control (T₇) treatment registered the lowest values for all parameters, highlighting the importance of balanced nutrient management in maize production, the study demonstrated that the integration of higher fertilizer doses with micronutrient foliar application markedly improved crop growth and productivity. It can be concluded that application of 125% RDF along with foliar spray of Fe, Zn, and B @ 1% is a viable nutrient management strategy for achieving higher productivity of maize.

Keywords: Maize, fertility levels, micronutrients, RDF, yield, nutrient management

1. Introduction

Maize (*Zea mays* L.) is one of the most widely cultivated cereal crops globally, grown across approximately 193 million hectares with an annual production exceeding 1147 million tonnes. India ranks fourth in maize production, covering about 10.74 million hectares with a total output of 38.09 million tonnes. In Telangana, maize occupies nearly 0.52 million hectares with a production of 2.86 million tonnes and an average productivity of 5557 kg ha⁻¹ (DA & FW, 2023). Owing to its high yield potential, adaptability, and diverse end uses, maize serves as a vital component in food, feed, and industrial sectors.

Nutritionally, maize grains are rich in carbohydrates (~70%), along with protein, oil, and essential minerals, making it a valuable energy source. The increasing demand from the poultry industry and agro-processing sectors has further enhanced its economic importance. Its C₄ photosynthetic pathway enables higher photosynthetic efficiency and resilience under varied agro-climatic conditions, making it a suitable crop for intensification and diversification (Ghosh *et al.*, 2020) [3].

Efficient nutrient management plays a crucial role in maximizing maize productivity. As an exhaustive crop, maize requires a balanced supply of macronutrients and micronutrients for optimal growth and yield. While macronutrients are needed in larger quantities, micronutrients such as iron (Fe), zinc (Zn), and boron (B) are equally vital due to their involvement in key physiological and biochemical processes (Shukla *et al.*, 2018) [12]. Imbalanced fertilization and intensive cropping systems have led to widespread micronutrient deficiencies, particularly zinc, which is critical for enzyme activation, auxin synthesis, and nutrient translocation (Ayyar and Appavoo, 2017) [1]. Iron plays an essential role in chlorophyll

synthesis, respiration, and photosynthesis, and its deficiency often leads to chlorosis, especially in alkaline soils. Foliar application of iron has been found effective in correcting such deficiencies (Jamshid Zadeh *et al.*, 2014). Boron is another essential micronutrient involved in cell division, pollen viability, sugar transport, and reproductive development, directly influencing grain formation and yield (Jolli *et al.*, 2020) [7]. Considering the increasing importance of balanced fertilization, the present study was undertaken to evaluate the effect of different fertilizer levels along with foliar application of micronutrients (Fe, Zn, and B) on the growth and productivity of maize, with the objective of identifying an efficient nutrient management strategy for enhanced crop performance.

2. Materials and Methods

The present field study, "Response of different levels of fertilizers and foliar sprays on productivity of maize," was conducted during 2025–2026 *rabi* season at the College Farm, School of Agricultural Sciences, Malla Reddy University, Hyderabad, which is in the Southern Telangana Zone, at latitude 17°19'21.643 N latitude, 78°24'21.433 E longitude and the farm is situated 542.3 meters above mean sea level. The climate of Maisammaguda is moderately warm, with a hot and humid *rabi* season. The mean maximum temperature is 30.8°C, while the mean minimum temperature is 24.2°C, and the mean relative humidity is 72%. The soil of the experimental field is sandy loam in texture and alkaline in nature, with a pH of (7.5).

The experiment was laid out in a randomized block design with 7 treatments and 3 replications; the gross plot size is 5.4 × 4.0 m and net plot size is 3.0 × 3.2 m. The treatments are T₁: 125% RDF + foliar sprays of Fe, Zn and B @ 0.5% T₂: 125% RDF + foliar sprays of Fe, Zn and B @ 1% T₃: 100% RDF + foliar sprays of Fe, Zn and B @ 0.5% T₄: 100% RDF + foliar sprays of Fe, Zn and B @ 1% T₅: 75% RDF + foliar sprays of Fe, Zn and B @ 0.5%, T₆: 75% RDF + foliar sprays of Fe, Zn and B @ 1% T₇: Control. The Maize hybrid Pioneer - 3302 is employed as a test crop and experimented adopting a recommended seed rate of 17-18 kg/ha and a row spacing of 60 × 20 cm. The recommended dose of fertilizers (RDF) comprising 240 kg N, 80 kg P₂O₅, and 80 kg K₂O ha⁻¹ was applied through urea, single super phosphate, and muriate of potash were distributed evenly among all treatment plots respectively.

Observations on growth parameters, yield, yield attributes, and micronutrient uptake (Fe, Zn, and B) were recorded from five randomly selected representative plants in each treatment, and the mean values were computed. After harvesting and threshing, the yield from each net plot was recorded and expressed in kg ha⁻¹. The data pertaining to growth, yield, yield attributes and economics were statistically analyzed using Randomized Block Design (RBD) by applying the standard procedures of Analysis

of Variance (ANOVA) as outlined by Gomez and Gomez (1984) [4].”

3. Results and Discussion

3.1 Growth Attributes

3.1.1 Plant height (cm)

Plant height varied due to different fertilizer treatments. Significantly highest plant height was recorded under treatment T₂ (125% RDF + foliar application of Fe, Zn, and B @ 1%), (247.4 cm) indicating the beneficial effect of enhanced and balanced nutrient supply on vegetative growth. Next highest in, T₁ (227.4 cm) which also exhibited improved plant height over the control. Significantly lowest plant height was observed in the (Control) treatment T₇ (115.1cm) where no external nutrient supplementation was applied. The combined application of higher fertilizer levels along with micronutrient foliar sprays ensured efficient nutrient uptake, better translocation, and sustained availability during the active growth period. This synergistic effect promoted cell division and elongation, resulting in increased plant height. Similar findings in maize were reported by Kumar *et al.* (2025) [10].

3.1.2 Leaf area index (LAI)

The integrated use of higher fertilizer levels along with micronutrient foliar sprays enhanced leaf production. Significantly highest leaf area index was recorded under treatment T₂ (125% RDF + foliar spray of Fe, Zn, and B @ 1%), (3.51) reflecting improved canopy structure and efficient light interception. This was followed by other nutrient-enriched treatments, T₁ (3.13) while the significantly lowest leaf area index was noted in the control T₇ (1.26). The variation in LAI among treatments highlights the significant effect of nutrient management (Singh *et al.*, 2019) [13].

3.1.3 Dry matter accumulation (g plant⁻¹)

The application of higher levels of recommended fertilizers in conjunction with micronutrient foliar sprays ensured a continuous and balanced supply of essential nutrients, thereby promoting efficient photosynthesis and assimilate production. Significantly highest dry matter production was recorded under treatment T₂ (125% RDF + foliar application of Fe, Zn, and B @ 1%), (504.9 g plant⁻¹) indicating a substantial improvement in biomass accumulation due to enhanced nutrient availability and utilization. This was followed by T₁ (463.8 g plant⁻¹) which also exhibited higher dry matter production compared to the control. Significantly the lowest dry matter production was observed in the control treatment T₇ (277.1g plant⁻¹). This resulted in greater accumulation of structural biomass and overall plant growth. These findings are in agreement with the results reported by Humstoe *et al.*

Table 1: Effect of different levels of fertilizers and foliar sprays on plant height (cm), Leaf area (cm²), Leaf area index and Dry matter production (g plant⁻¹) of *rabi* maize

Treatments	Plant height at harvest (cm)	Leaf area index at harvest	Dry matter production at harvest
T ₁ : 125% RDF + foliar sprays of Fe, Zn and B @ 0.5%	227.4	3.13	463.8
T ₂ : 125% RDF + foliar sprays of Fe, Zn and B @ 1%	247.4	3.51	504.9
T ₃ : 100% RDF + foliar sprays of Fe, Zn and B @ 0.5%	181.4	2.40	389.0
T ₄ : 100% RDF + foliar sprays of Fe, Zn and B @ 1%	204.3	2.75	427.4
T ₅ : 75% RDF + foliar sprays of Fe, Zn and B @ 0.5%	135.4	1.81	314.8
T ₆ : 75% RDF + foliar sprays of Fe, Zn and B @ 1%	161.3	2.09	352.2
T ₇ : Control	115.1	1.26	277.2
SEm±	6.1	0.07	11.7
CD (P=0.05)	18.7	0.24	36.2

3.2 Yield Attributes and Yield

3.2.1 Number of cobs plant⁻¹

The number of cobs per plant in maize was not affected by different nutrient management treatments. Although slight variations were observed among the treatments, these differences were statistically non-significant, indicating that the application of varying levels of RDF and foliar sprays of Fe, Zn and B had little or no effect on cob formation per plant. Across all treatments, maize plants produced nearly similar number of cobs, suggesting that this parameter was largely governed by the genetic potential of the hybrid rather than the nutrient management practices applied in the experiment.

3.2.2 Total grains per cob

Number of grains cob⁻¹ was significantly affected by varying levels of RDF combined with foliar application of micronutrients. Significantly highest number of grains per cob was recorded in T₂ (125% RDF + foliar spray of Fe, Zn and B @ 1%), (644) indicating the positive effect of higher nutrient levels combined with micronutrient foliar application. In contrast, significantly lowest number of grains per cob was observed in T₇ (control), (314) suggesting that the absence of both basal and foliar nutrient supplementation limited grain formation. These findings are consistent with Kalyani *et al.* (2023) [8] perceived that application of Zinc at 15 Kg ha⁻¹ along with RDF 150:75:75 Kg N-P₂O₅-K₂O ha⁻¹ resulted in a marked enhancement in grains per cob.

3.2.3 Cob length (cm)

The higher fertilizer levels combined with foliar micronutrient application promoted better cob development Cob length in maize. significantly highest cob length was observed in T₂ (125% RDF + foliar spray of Fe, Zn and B @ 1%), (33.5 cm) In contrast, significantly lowest cob length was recorded in T₇ (control), (16.8 cm) highlighting the limitation of cob growth in the absence of both basal and foliar nutrient supplementation. These results are in agreement with Jolli *et al.* (2020) [7] noted that the foliar application of ZnSO₄ @ 0.2% combined with boron 0.1% and iron 0.1% significantly enhanced the cob length in maize.

3.2.4 Cob girth (cm)

Cob girth remained comparable across different nutrient

management treatments Minor differences were observed, but they were statistically non-significant, indicating that cob thickness in maize was largely unaffected by variations in RDF or foliar micronutrient application.

3.2.5 Seed index (g)

The seed index (100 seed weight) of maize was not significantly affected by different nutrient management treatments. Although minor variations were observed among treatments, these differences were statistically non-significant, indicating that neither the level of RDF nor the foliar application of Fe, Zn and B had a noticeable effect on seed weight. This suggests that seed index is largely determined by the genetic potential of the maize hybrid rather than by the nutrient management practices applied in the experiment.

3.2.6 Grain Yield (kg ha⁻¹)

The application of different nutrient levels along with foliar sprays at critical growth stages significantly improved grain yield in maize. Among the treatments, T₂ (125% RDF + foliar application of Fe, Zn, and B @ 1%) recorded the significantly highest grain yield (9755 kg ha⁻¹), followed by T₁ (8955 kg ha⁻¹), whereas the (control) treatment T₇ registered the significantly lowest grain yield (4436 kg ha⁻¹). Treatment T₂ recorded 8.9, 19.2 and 94.1% higher grain yield over T₁, T₄ and T₇ (control) respectively. Similar findings were reported by Raj *et al.* (2024) [11].

3.2.7 Stover Yield (kg ha⁻¹)

A similar trend as observed in grain yield was also noticed in stover yield. the effectiveness of combining higher fertilizer levels with micronutrient foliar application, which promoted efficient photosynthesis and accumulation of dry matter. significantly the highest stover yield was observed under T₂ (125% RDF + foliar application of Fe, Zn, and B @ 1%), (13995 kg ha⁻¹) with T₁ next in order (12931 kg ha⁻¹), whereas the control T₇ (7706 kg ha⁻¹) produced the significantly lowest stover yield. The increased stover yield under T₂ can be attributed to enhanced vegetative growth and biomass accumulation due to improved nutrient availability. Similar observations were reported by Kathula *et al.* (2023) [9].

Table 2: Effect of different levels of fertilizers and foliar sprays on Yield Attributing Characters and Yield of *rabi* maize

Treatments	Number of cobs plant ⁻¹	Total grains per cob	Cob Length (cm)	Cob girth (cm)	Seed index (100 seed weight, g)	Grain Yield (kg ha ⁻¹)	Stover Yield (kg ha ⁻¹)
T ₁ : 125% RDF + foliar sprays of Fe, Zn and B @ 0.5%	1.7	590	30.4	16.8	31.1	8955	12931
T ₂ : 125% RDF + foliar sprays of Fe, Zn and B @ 1%	1.7	644	33.5	17.4	32.0	9755	13995
T ₃ : 100% RDF + foliar sprays of Fe, Zn and B @ 0.5%	1.6	479	24.8	15.7	29.5	7388	10822
T ₄ : 100% RDF + foliar sprays of Fe, Zn and B @ 1%	1.6	536	27.6	16.2	30.9	8184	11941
T ₅ : 75% RDF + foliar sprays of Fe, Zn and B @ 0.5%	1.4	367	19.5	14.3	27.9	5803	8738
T ₆ : 75% RDF + foliar sprays of Fe, Zn and B @ 1%	1.5	423	22.0	15.1	28.8	6582	9790
T ₇ : Control	1.4	314	16.8	13.2	26.8	5006	7706
SEm±	0.1	16	0.76	1.35	1.80	234	314
CD (P=0.05)	NS	48	2.4	NS	NS	721	968

4. Conclusion

The present study revealed that the application of 125% Recommended Dose of Fertilizers (RDF) along with foliar spray of Fe, Zn and B @ 1% (T₂) significantly improved the growth, yield attributes and yield of maize. Enhanced growth observed under this treatment was reflected through better crop

development and vigour throughout the growing period. Yield attributes such as cob length, cob girth, number of grains per cob and test weight were also superior under T₂ compared to the other treatments, which ultimately contributed to higher yield. The improvement in yield attributes and yield due to the balanced supply of nutrients and the beneficial effect of foliar

application of micronutrients during critical growth stages. In contrast, the control treatment (T₇) recorded the lowest growth, yield attributes and yield, indicating the importance of proper nutrient management in maize cultivation. Overall, the study concluded that the combined application of 125% RDF with foliar spray of Fe, Zn and B @ 1% proved to be an effective nutrient management practice for enhancing growth, yield attributes and yield of maize under the prevailing conditions.

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Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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