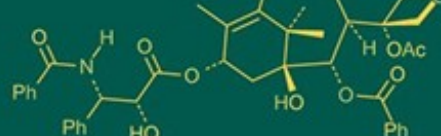


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Effect of foliar application of micronutrients on the growth and yield of cotton (*Gossypium hirsutum*)

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ABSTRACT

A field experiment entitled "Effect of foliar application of micronutrients on growth, yield and quality of cotton (*Gossypium hirsutum* L.)" was conducted during the Kharif season of 2025–26 at the Integrated Farming System Research Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The experiment was undertaken to evaluate the influence of foliar application of micronutrients on the growth and yield performance of cotton under field conditions. The experiment was laid out in a Randomized Block Design with appropriate treatment combinations and replications following the recommended package of practices. Foliar application of micronutrients was carried out at the recommended crop growth stages. Observations on plant growth parameters, including plant height, number of monopodial branches, number of sympodial branches, along with yield attributes such as number of bolls per plant, and seed cotton yield, were recorded and statistically analysed. The results indicated that foliar application of micronutrients significantly improved vegetative growth and yield attributes over the control. Enhanced nutrient availability through foliar feeding promoted better physiological activity, resulting in increased plant growth, improved boll development and higher seed cotton yield. The study demonstrated that balanced foliar nutrition with micronutrients is an effective strategy for enhancing cotton productivity under the agro-climatic conditions of Akola and can be recommended as a component of integrated nutrient management for sustainable cotton production.

Keywords: Cotton, Foliar application, Micronutrients, Plant growth, Boll yield, Seed cotton yield, Nutrient management

PG Scholar,

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the most important commercial fibre crops and is popularly known as "White Gold" due to its economic importance. It provides natural fibre for the textile industry, while cottonseed serves as a valuable source of edible oil and protein-rich meal. India has the largest area under cotton cultivation in the world; however, productivity remains comparatively low because a major proportion of the crop is grown under rainfed conditions.

Cotton requires a balanced supply of nutrients throughout its growth period. Continuous cultivation, inadequate use of organic manures and imbalanced fertilizer application have resulted in widespread deficiencies of micronutrients such as zinc, iron and boron. These nutrients play an important role in plant growth, flowering, boll development and yield. Under rainfed conditions, nutrient uptake from the soil is often restricted because of limited moisture availability during critical growth stages. Foliar application of micronutrients is an effective method of supplying nutrients directly to plants, improving nutrient use efficiency and reducing micronutrient deficiencies.

Maharashtra is one of the major cotton-growing states of India, where declining soil fertility and micronutrient deficiencies often limit crop productivity. Therefore, foliar application of micronutrients can serve as an effective nutrient management practice to improve crop growth and yield under field conditions. Keeping these facts in view, the present investigation was undertaken to evaluate the effect of foliar application of micronutrients on the growth and yield of cotton under the agro-climatic conditions of Akola, Maharashtra.

Materials and methods

A field experiment entitled "Effect of Foliar Application of Micronutrients on Growth and Yield of Cotton (*Gossypium hirsutum* L.)" was conducted during the Kharif season of 2025–26 at the Integrated Farming System Research Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The experimental field was levelled, well-drained and clayey in texture with slightly alkaline soil (pH 8.21), low organic carbon and available nitrogen, medium available phosphorus and high available potassium.

The experiment was laid out in a Randomized Block Design (RBD) with different foliar micronutrient treatments and replications under recommended agronomic practices. Foliar application of micronutrients was carried out at the prescribed crop growth stages. Observations were recorded on growth parameters, namely plant height, number of monopodial branches plant⁻¹ and number of sympodial branches plant⁻¹. Yield parameters such as number of bolls plant⁻¹, boll weight and seed cotton yield were also recorded. The experimental data were subjected to statistical analysis following the standard procedure for Randomized Block Design, and treatment means were compared at the 5 per cent level of significance.

Results and discussion

1. Growth parameter

1.1 Plant height

Plant height was significantly influenced by foliar application of micronutrients at 60, 90, 120 DAS and at harvest, whereas no significant differences were observed at 30 DAS. Treatment T₇ (RDF + foliar

spray of MNS @ 15 ml L⁻¹) recorded the highest plant height at 60 DAS (64.98 cm), 90 DAS (123.98 cm), 120 DAS (136.65 cm) and at harvest (146.02 cm), which was statistically at par with T₆ (12.5 ml L⁻¹) and T₅ (10 ml L⁻¹). The lowest plant height was recorded under T₁ (RDF), with values of 28.04, 45.23, 86.75, 95.23 and 102.32 cm at 30, 60, 90, 120 DAS and harvest, respectively.

The increased plant height under T₇ may be attributed to the combined effect of recommended fertilization and foliar application of micronutrients, which enhanced chlorophyll synthesis, auxin production, cell elongation and overall plant growth. Similar findings were reported by Hallikeri *et al.* (2011) [1], Katkar *et al.* (2012) [2], Giri *et al.* (2014) [3] and Kulvir Singh *et al.* (2015).

Table 1. Effect of different treatments on plant height

Particular	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
T ₁ - RDF (Control)	28.04	45.23	86.75	95.23	102.32
T ₂ - RDF + Foliar Spray of MNS 2 ml/L	28.43	48.00	92.45	102.54	108.36
T ₃ - RDF +Foliar Spray of MNS 5 ml/L	29.26	53.17	98.76	110.65	116.43
T ₄ - RDF + Foliar Spray of MNS 7.5 ml/L	31.71	55.64	105.54	118.92	127.82
T ₅ - RDF + Foliar Spray of MNS 10 ml/L	30.63	60.54	112.56	126.54	138.23
T ₆ - RDF + Foliar Spray of MNS 12.5ml/L	31.24	63.12	117.87	131.43	142.60
T ₇ - RDF + Foliar Spray of MNS 15 ml/L	30.09	64.98	123.98	136.65	146.02
SE (M) +	1.22	2.35	4.45	5.09	5.24
CD P = 0.05	NS	7.23	13.70	15.67	16.15
GM	29.91	55.81	105.42	117.42	126.97

1.2 Number of monopodial branches plant⁻¹

The number of monopodial branches plant⁻¹ was significantly influenced by foliar application of micronutrients at all growth stages. Treatment T₇ (RDF + foliar spray of MNS @ 15 ml L⁻¹) recorded the highest number of monopodial branches at 60 DAS (2.10), 90 DAS (2.24), 120 DAS (2.24) and at harvest (2.24). At 90 DAS, 120 DAS and harvest, T₇ remained statistically at par with T₆ (RDF + foliar spray of MNS @ 12.5 ml L⁻¹). The lowest number of monopodial branches was recorded under T₁ (RDF), with values of 1.26, 1.40, 1.40 and 1.40 at 60, 90, 120 DAS and harvest, respectively.

The increase in monopodial branches under T₇ may be attributed to the role of micronutrients in enhancing auxin synthesis, chlorophyll formation and cell division, resulting in vigorous vegetative growth and branch development. Similar findings were reported by More *et al.* (2018) [4], Raj *et al.* (2019) [5] and Karademir (2020).

1.3 Number of sympodial branches plant⁻¹

The number of sympodial branches plant⁻¹ was significantly influenced by foliar application of micronutrients at all growth stages. Treatment T₇ (RDF + foliar spray of MNS @ 15 ml L⁻¹) recorded the highest number of sympodial branches at 60 DAS (7.86), 90 DAS (17.20), 120 DAS (24.34) and at harvest (24.34). At 90 DAS, T₇ was statistically at par with T₆ (16.64) and T₅ (15.39), while at 120 DAS

and harvest it remained at par with T₆ (22.04). The lowest number of sympodial branches was recorded under T₁ (RDF), with values of 4.40, 13.32, 17.34 and 17.34 at 60, 90, 120 DAS and harvest, respectively.

The increased number of sympodial branches under T₇ may be attributed to improved photosynthetic efficiency, enhanced carbohydrate translocation and better reproductive growth due to foliar application of micronutrients. Similar findings were reported by Nehra *et al.* (2006) [6], Bhalerao *et al.* (2012) [7], Gangaiah *et al.* (2013) and Patil *et al.* (2016)

2. Yield and yield attributes

2.1 Number of picked bolls plant⁻¹

The number of picked bolls plant⁻¹ was significantly influenced by foliar application of micronutrients. Treatment T₇ (RDF + foliar spray of MNS @ 15 ml L⁻¹) recorded the highest number of picked bolls (48.45), which was statistically at par with T₆ (45.82) and T₅ (44.27), whereas the lowest number of picked bolls (37.24) was recorded under T₁ (RDF). The increased boll production under T₇ may be attributed to improved boll retention, reduced square and boll shedding, and enhanced reproductive development due to foliar application of micronutrients. Similar findings were reported by Giri *et al.* (2014) [3], Halemani *et al.* (2004) and Nehra *et al.* (2006) [6].

Table 2. Effect of different treatments on number of picked bolls

Particular	At harvest
T ₁ - RDF (Control)	37.24
T ₂ - RDF + Foliar Spray of MNS 2 ml/L	38.10
T ₃ - RDF +Foliar Spray of MNS 5 ml/L	40.30
T ₄ - RDF + Foliar Spray of MNS 7.5 ml/L	42.37
T ₅ - RDF + Foliar Spray of MNS 10 ml/L	44.27
T ₆ - RDF + Foliar Spray of MNS 12.5ml/L	45.82
T ₇ - RDF + Foliar Spray of MNS 15 ml/L	48.45
SE (M) +	1.74
CD (5%)	5.37
GM	42.36

2.2 Lint yield

Foliar application of micronutrients significantly influenced lint yield per plant and per hectare. Treatment T₇ (RDF + foliar spray of MNS @ 15 ml L⁻¹) recorded the highest lint yield per plant (76.96 g plant⁻¹) and lint yield per hectare (1222.28 kg ha⁻¹), which were statistically at par with T₆ (74.84 g plant⁻¹ and 1162.25 kg ha⁻¹, respectively). The lowest lint yield per plant (60.65 g plant⁻¹) was recorded

in T₂, while the minimum lint yield per hectare (915.34 kg ha⁻¹) was recorded under T₁ (RDF). The higher lint yield under T₇ may be attributed to improved boll development, enhanced photosynthetic efficiency and better translocation of assimilates due to foliar application of micronutrients. Similar findings were reported by Sawan *et al.* (2007) [8], Hallikeri *et al.* (2010) [9], Katkar *et al.* (2013) [10] and Paslawar *et al.* (2015) [11].

2.3 Seed cotton yield

Foliar application of micronutrients significantly influenced seed cotton yield per plant and per hectare. Treatment T₇ (RDF + foliar spray of MNS @ 15 ml L⁻¹) recorded the highest seed cotton yield per plant (219.89 g plant⁻¹) and per hectare (3492.22 kg ha⁻¹), which were statistically at par with T₆ (213.84 g plant⁻¹ and 3220.71 kg ha⁻¹, respectively). The lowest seed cotton yield per plant (173.27 g plant⁻¹) was recorded in T₂, while the minimum seed cotton yield per hectare (2615.26 kg ha⁻¹) was recorded under T₁ (RDF). The higher seed cotton yield under T₇ may be attributed to increased dry matter accumulation, improved boll retention and enhanced photosynthetic efficiency due to foliar application of micronutrients. Similar findings were reported by Bibi *et al.* (2008) [12], Khargkharate *et al.* (2014), Gokhale *et al.* (2020) and Velmurugan *et al.* (2021) [13].

Table 3. Effect of different treatments on lint yield (g plant⁻¹), lint yield (kg ha⁻¹), seed cotton yield (g plant⁻¹) and seed cotton yield (kg ha⁻¹)

Particular	Lint yield (g plant ⁻¹)	Lint yield (kg ha ⁻¹)	Seed cotton yield (g plant ⁻¹)	Seed cotton yield (Kg ha ⁻¹)
T ₁ - RDF (Control)	61.26	915.34	175.02	2615.26
T ₂ - RDF + Foliar Spray of MNS 2 ml/L	60.65	924.00	173.27	2639.99
T ₃ - RDF +Foliar Spray of MNS 5 ml/L	62.45	951.42	178.42	2718.34
T ₄ - RDF + Foliar Spray of MNS 7.5 ml/L	62.54	958.89	178.69	2739.68
T ₅ - RDF + Foliar Spray of MNS 10 ml/L	65.22	1012.84	186.35	2893.82
T ₆ - RDF + Foliar Spray of MNS 12.5ml/L	74.84	1162.25	213.84	3220.71
T ₇ - RDF + Foliar Spray of MNS 15 ml/L	76.96	1222.28	219.89	3492.22
SE (M) +	3.06	47.16	8.75	134.74
CD (5%)	9.43	145.32	26.95	415.2
GM	66.27	1021.00	189.35	2902.86

2.4 Biological yield

Biological yield was significantly influenced by foliar application of micronutrients. Treatment T₇ (RDF + foliar spray of MNS @ 15 ml L⁻¹) recorded the highest biological yield (9663.01 kg ha⁻¹), which was statistically at par with T₆ (9142.07 kg ha⁻¹). The lowest biological yield (7847.10 kg ha⁻¹) was recorded under T₁ (RDF). The higher biological yield under T₇ may be attributed to increased dry matter accumulation, enhanced vegetative growth and improved photosynthetic efficiency due to foliar application of micronutrients. Similar findings were reported by Raj *et al.* (2019) [5], Hallikeri *et al.* (2011) [1], Katkar *et al.* (2013) [10] and Giri *et al.* (2014) [3].

2.5 Harvest index

Harvest index was not significantly influenced by the different foliar micronutrient treatments. Although foliar application of micronutrients improved both biological yield and seed cotton yield, the increase in economic yield was proportional to the increase in total biomass, resulting in a non-significant variation in harvest index among the treatments. Similar findings were reported by Sandeep *et al.* (2014) [14], Blaise *et al.* (2016) [15], Ayyadurai *et al.* (2019) [16] and Dhamak *et al.* (2022).

Table 4. Effect of different treatments on biological yield (kg ha⁻¹) and harvest index of cotton.

Particular	Biological yield (kg ha ⁻¹)	Harvest index
T ₁ - RDF (Control)	7847.10	33.33
T ₂ - RDF + Foliar Spray of MNS 2 ml/L	8042.52	32.83
T ₃ - RDF +Foliar Spray of MNS 5 ml/L	8226.31	33.04
T ₄ - RDF + Foliar Spray of MNS 7.5 ml/L	8424.17	32.52
T ₅ - RDF + Foliar Spray of MNS 10 ml/L	8721.54	33.18
T ₆ - RDF + Foliar Spray of MNS 12.5ml/L	9142.07	35.23
T ₇ - RDF + Foliar Spray of MNS 15 ml/L	9663.01	36.14
SE (M) +	294.85	0.82
CD (5%)	908.61	NS
GM	8580.96	33.8

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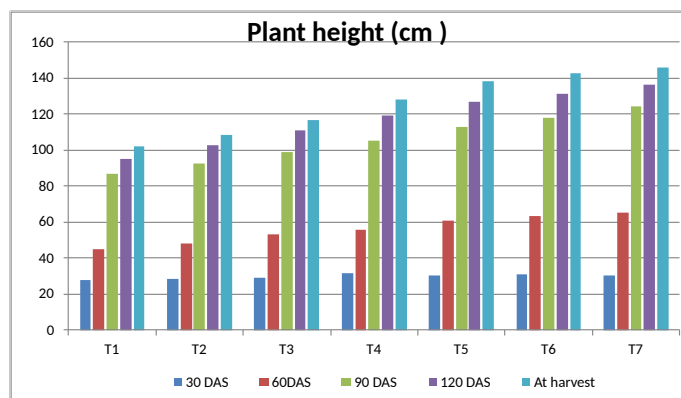


Figure 1. Plant height as influenced by different treatments

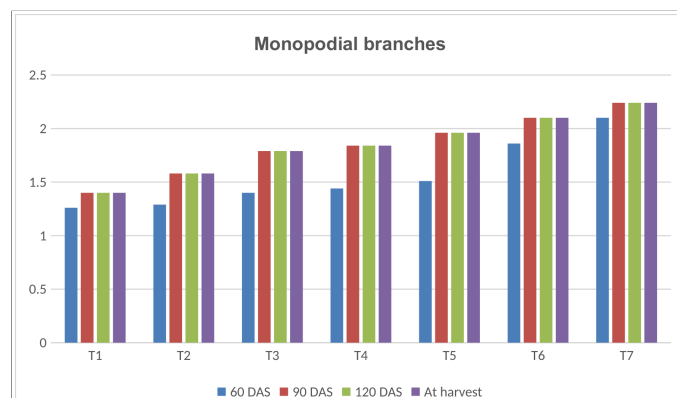


Figure 2. Monopodial branches as influenced by different treatments

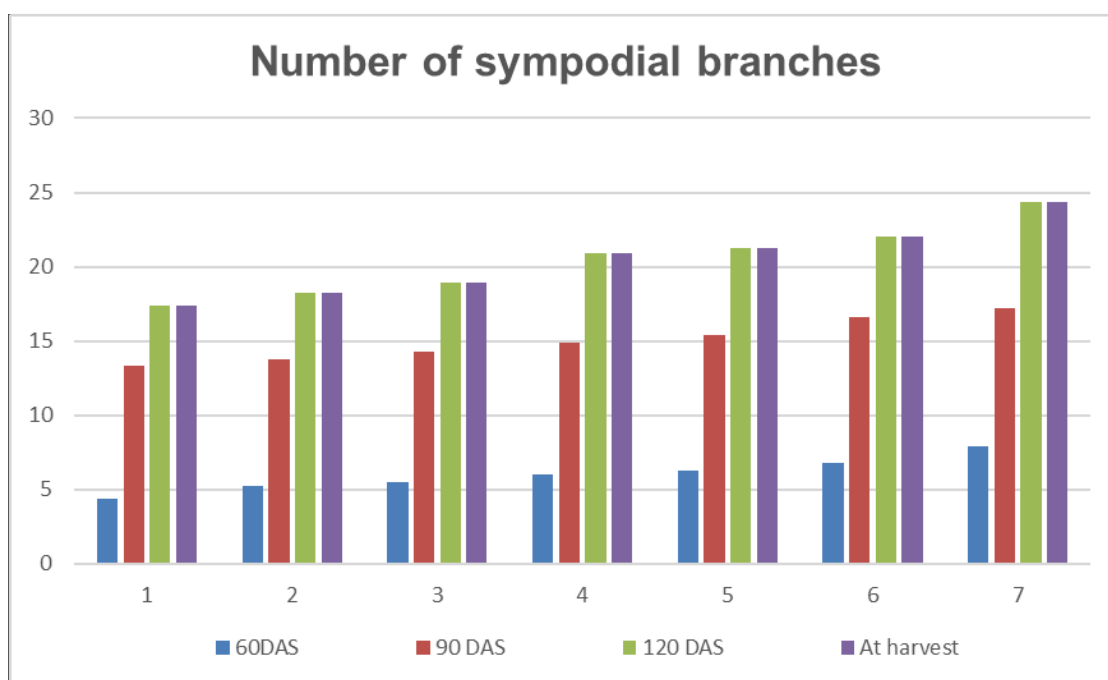


Figure 3. Sympodial branches as influenced by different treatments

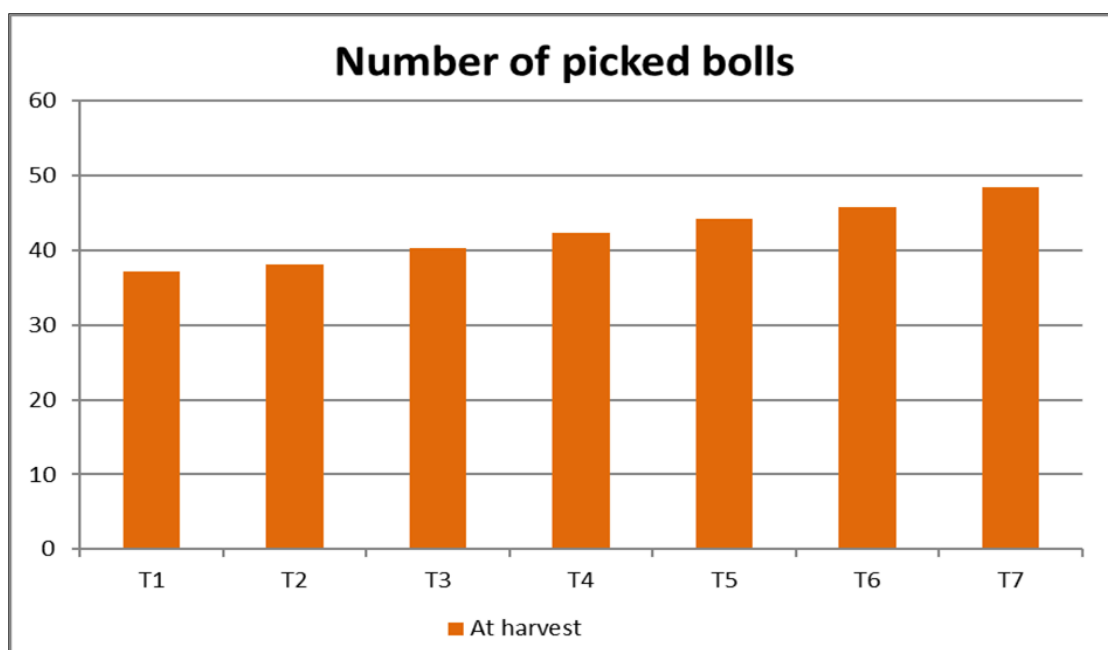


Figure 4. Number of picked bolls as influenced by different treatments

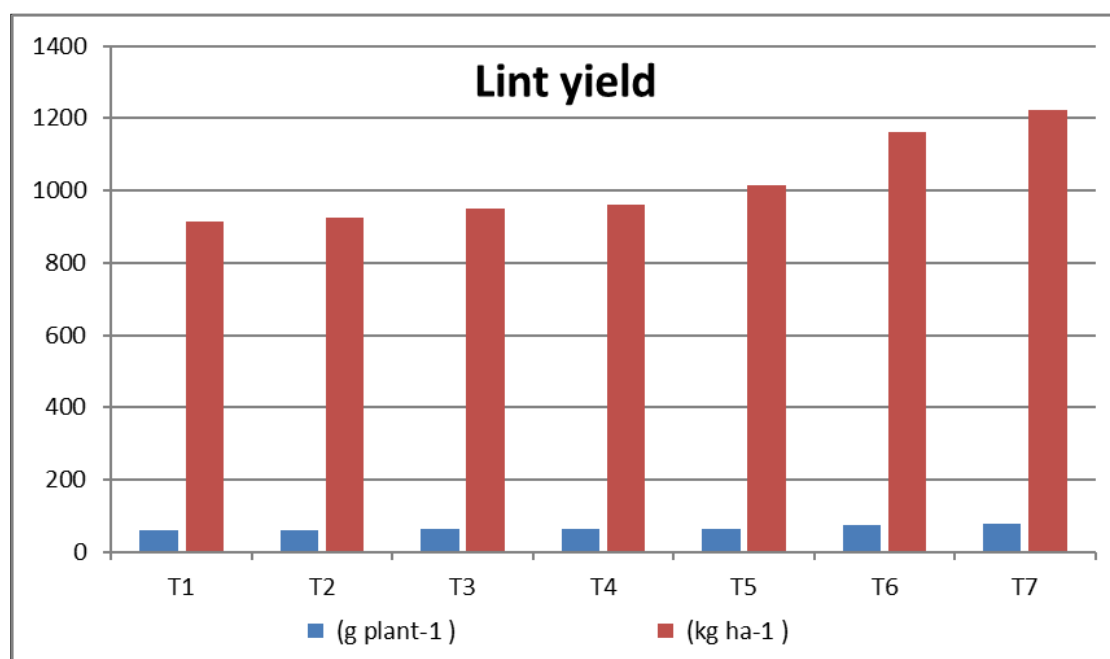


Figure 5. Lint yield g plant⁻¹ and lint yield kg ha⁻¹ as influenced by different treatments.

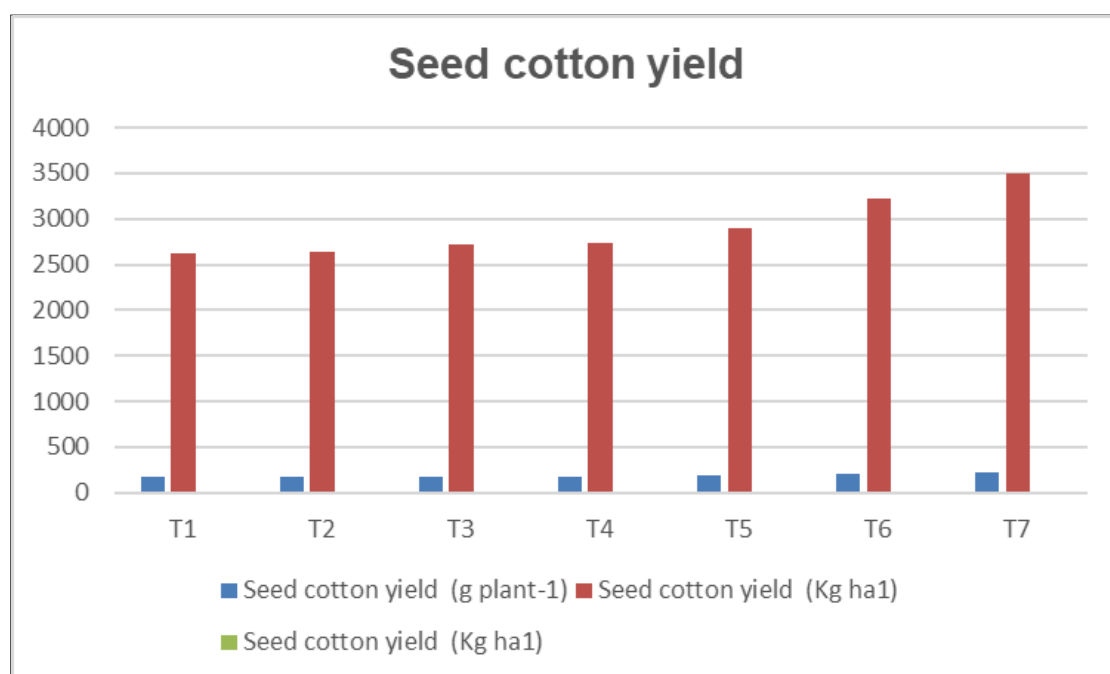


Figure 6. Seed cotton yield g plant⁻¹ and seed cotton yield kg ha⁻¹ as influenced by different treatments

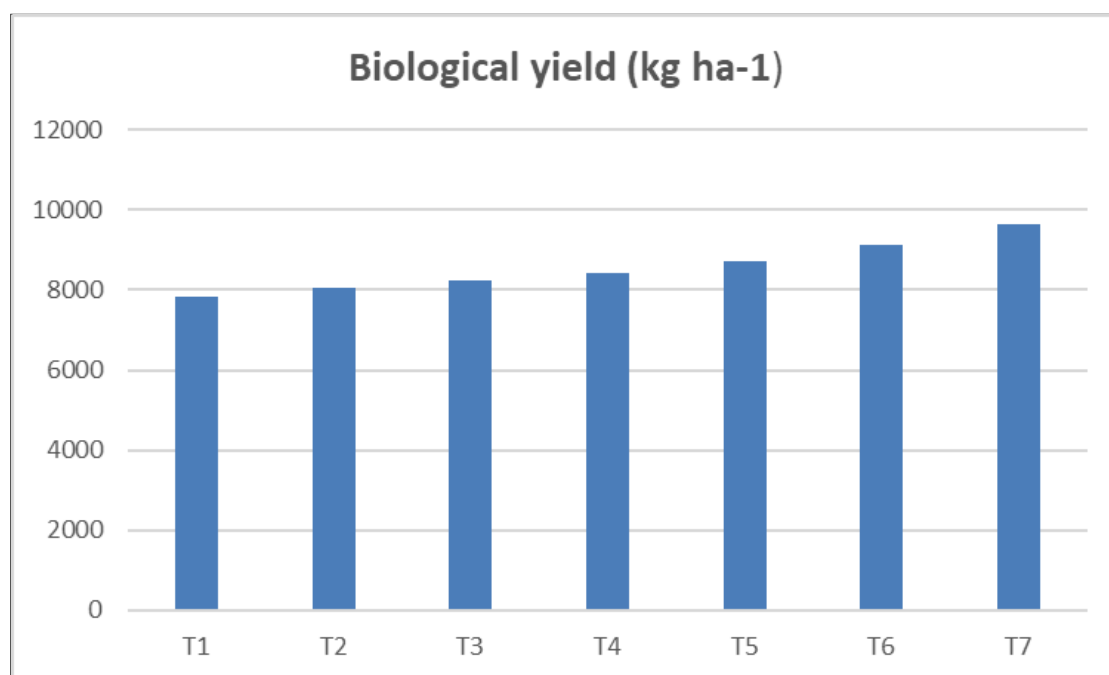


Figure 7. Biological yield as influence by different treatments

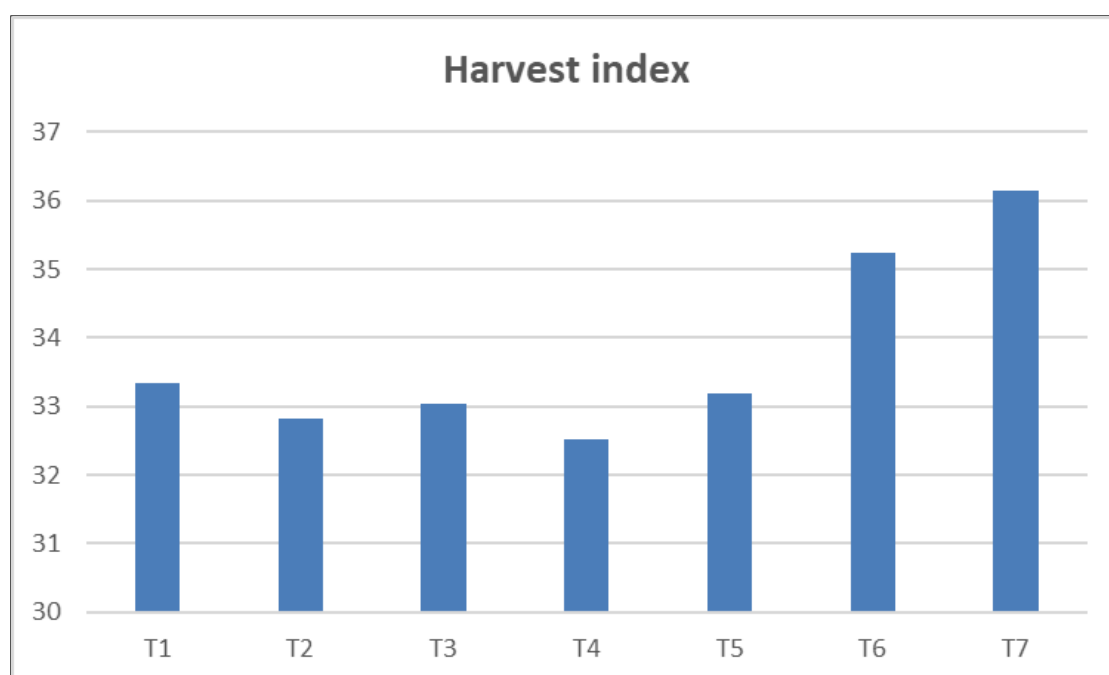


Figure 8. Harvest index as influence by different treatments.

Conclusion

The present investigation demonstrated that foliar application of micronutrients significantly improved the growth and yield of cotton. Among the treatments, T₇ (RDF + foliar spray of PDKV Grade XI micronutrient mixture @ 15 ml L⁻¹) recorded superior performance in terms of plant height, number of leaves, monopodial and sympodial branches, number of picked bolls, lint yield, seed cotton yield and biological yield. The treatment remained statistically at par with T₆ (12.5 ml L⁻¹) and T₅ (10 ml L⁻¹) for most of the parameters. Therefore, foliar application of PDKV Grade XI micronutrient mixture @ 15 ml L⁻¹ along with the recommended dose of fertilizers can be recommended for improving growth and productivity of cotton under the agro-climatic conditions of Akola.

References

- Hallikeri SS, Halemani HL, Nandagavi RA, Nooli SS. Response of Bt cotton to foliar nutrition under rainfed conditions. *Karnataka Journal of Agricultural Sciences*. 2011;24(2):145–148.
- Katkar RN, Wanjari RH, Gajbhiye BR. Foliar nutrition in cotton: A review. *Agricultural Reviews*. 2012;33(4):312–318.
- Giri AN, Aundhekar RL, Kapse PS, Suryawanshi SB. Effect of foliar application of micronutrients on growth and yield of Bt cotton. *Journal of Cotton Research and Development*. 2014;28(1):89–92.
- More SP, Deshmukh DS, Patil SB. Impact of secondary and micronutrients on productivity and quality of Bt cotton. *International Journal of Science, Environment and Technology*. 2018;7(3):1025–1030.
- Raj SA, Chandrasekar C. Influence of nano-fertilizers on growth and yield of cotton (*Gossypium hirsutum* L.). *Journal of Pharmacognosy and Phytochemistry*. 2019;8(3):451–454.

6. Nehra KC, Dhaka AK, Singh R. Effect of integrated nutrient management on growth and yield of American cotton (*Gossypium hirsutum* L.). *Haryana Journal of Agronomy*. 2006;22(1):45-48.
7. Bhalerao SA, Kale AA, Deshmukh PS. Response of Bt cotton to foliar application of micronutrients. *Journal of Agricultural Research*. 2012;47(2):189-194.
8. Sawan ZM, Hafez SA, Basyony AE. Effect of boron and zinc on seed, protein and oil yields of cotton. *Journal of Plant Nutrition*. 2007;30(4):565-581.
9. Hallikeri SS, Halemani HL, Nandagavi RA, Nooli SS. Effect of foliar nutrition on growth and yield of Bt cotton. *Karnataka Journal of Agricultural Sciences*. 2010;23(4):620-622.
10. Katkar RN, Wanjari RH, Pharande AL. Influence of integrated nutrient management on yield, quality and nutrient uptake of cotton in vertisols. *Journal of Soils and Crops*. 2013;23(1):88-94.
11. Paslawar AN, Deshmukh DS, Ingle SN. Response of Bt cotton to multi-micronutrient foliar sprays on yield, nutrient uptake and economics. *Annals of Plant and Soil Research*. 2015;17(2):150-153.
12. Bibi N, Khan NU, Marwat KB, Baloch MS, Khan MJ, Khan IA. Effect of foliar application of boron on yield and yield components of cotton. *Pakistan Journal of Botany*. 2008;40(5):1943-1948.
13. Velmurugan A, Swaminathan C, Djanaguiraman M. Micronutrient fertilization improves reproductive efficiency, boll retention and yield of cotton under rainfed ecosystem. *Journal of Plant Nutrition*. 2021;44(12):1780-1795.
14. Sandeep S, Kumar AR, Reddy MV. Growth, yield and harvest index of Bt cotton as influenced by integrated nutrient management. *Journal of Crop and Weed*. 2014;10(2):112-116.
15. Blaise D, Kranthi KR, Singh JV. Effect of nutrient management on productivity, quality and nutrient uptake of Bt cotton. *Journal of Cotton Research and Development*. 2016;30(1):86-92.
16. Ayyadurai P, Arulmozhiselvan K, Senthilvalavan S. Influence of secondary and micronutrients on yield, nutrient uptake and harvest index of cotton in an Inceptisol. *Journal of Pharmacognosy and Phytochemistry*. 2019;8(4):210-215.
17. Kasap Y, Killi F. Effect of zinc application on growth and yield of cotton. *Journal of Agronomy*. 2004;3(4):245-248.
18. Nalayini P, Ramasamy M, Vaiyapuri K. Effect of foliar nutrition on growth and yield of cotton. *Madras Agricultural Journal*. 2009;96(1-6):174-178.
19. Solanke AV, Deshmukh DS, Ingle SN. Impact of foliar application of micronutrients on phenology, growth and yield of Bt cotton. *Journal of Soils and Crops*. 2015;25(1):112-117.

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