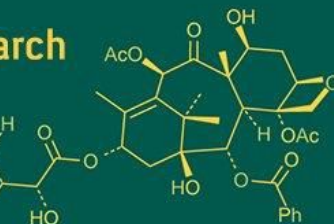


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(9): 1430-1432
www.biochemjournal.com
Received: 05-07-2025
Accepted: 07-08-2025

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Standardization and optimization of composite micronutrient formulation on fruit yield and quality of Acidlime cv. Balaji

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DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i9Sr.5704>

Abstract

The experiment entitled Standardization and Optimization of composite micronutrient formulation on fruit yield and quality of Acidlime was carried out at Citrus Research Station, Tirupathi, Dr. Y.S.R.H.U during the year 2024–2025. The experiment was laid out in a randomized complete block design with three replications comprising of eight treatments. The treatment combination of T₆ (RDF + Soil application of micronutrient @ 150g/plant) significantly enhanced fruit weight (34.22 g), No. of fruit per tree (695), yield (23.77kg/tree), (6.60per hectare). Good Quality parameters also recorded with same treatment, with juice content (45.03%), TSS(7.45°Brix), ascorbic acid (30.09mg/100ml), reducing sugar(0.88%), TSS Acid ratio(0.99), shelf life (22.33days) and minimum rind thickness (1.11mm) among other combination. Application of RDF and micronutrient @ 100g/plant (T₄) shows more acidity (7.62%), and high levels of non reducing (0.89%) was recorded with the application of RDF and micronutrient @ 125g /plant (T₅).

Keywords: Acidlime, micronutrient, soil application, zinc, copper, iron, boron, manganese

Introduction

Citrus is one of the most important fruit crops grown under tropical and subtropical conditions, contributing significantly to nutritional security and rural livelihoods. In India, citrus occupies 1.09 million hectares (11.3% of fruit area) with an annual production of 16.07 million metric tonnes and a productivity of 14.7 MT per hectare (NHB, 2021). Among citrus crops, acid lime (*Citrus aurantifolia* Swingle) is ranked third in commercial importance after mandarins and sweet orange. Its attractive aroma, acidic flavor and wide processing potential make it an economically significant fruit in both domestic and export markets. The crop is particularly concentrated in the semi-arid tracts of Andhra Pradesh and Telangana, where calcareous soils are prevalent.

Acid lime (*Citrus aurantifolia* Swingle) is considered as most important fruit crop. It is mainly cultivated for its multi - fold nutritional and medicinal values. Its attractive appearance, penetrating aroma of peel and excellent taste gives a remarkable position to acid lime which is grown widely throughout the world (Babu, 2001) ^[1]. The fruit is highly valued for its nutritional and medicinal properties, being rich in vitamin C, carotenoids, organic acids and essential minerals. Its therapeutic attributes, including appetizing, antioxidant, and anti-helminthic properties, further enhance its importance (Rangel, 2010) ^[6].

Acid lime (*Citrus aurantifolia* Swingle) exhibits continuous vegetative and reproductive flushes throughout the year, unless regulated for synchronized flowering. The crop flowers thrice annually—during January–February (Ambe bahar), June–July (Mrig bahar), and September–October (Hasth bahar)—with corresponding fruiting periods in June–July, November–December, and April–May, respectively. As reported by Tagad *et al.* (2018) ^[10], flowering intensity is highest in Ambe bahar (47%), followed by Mrig (36%) and Hasth (17%).

Despite its potential, acid lime productivity is often constrained by micronutrient deficiencies associated with soil conditions. Micronutrients such as zinc and iron play critical roles in physiological and reproductive processes including protein synthesis, pollen germination, chlorophyll formation, fruit set and quality development. Deficiency of zinc leads to disorders

such as rosette and poor fruit set; boron deficiency results in hard fruit and cracking, while iron deficiency is widespread in calcareous soils, causing chlorosis and reduced photosynthetic efficiency. Cu is required by lower plant forms in minute amounts, it is particularly toxic in higher concentrations, manganese are also indispensable for enzymatic activities, nitrate assimilation and lignification. Keeping in this view, the present investigation was carried out to study the Standardization and Optimization of composite micronutrient formulation on fruit yield and quality of Acidlime.

Materials and Methods

The present experiment was conducted in the acidlime cv. Balaji at Citrus research station, Tirupathi, with a spacing of 6 X 6 meters. The experiment was carried out during 2024-2025 in Randomized Block Design (RBD) 12 year orchard was 1600, 600, 800 grams N:P₂O₅: K₂O comprising of 8 treatments, replicated thrice with two plants per replication. The treatment details are given below.

Treatments	Treatment details
T ₁	composite micronutrient formulation@ 25 g/plant
T ₂	composite micronutrient formulation@ 50 g/plant
T ₃	composite micronutrient formulation@ 75 g/plant
T ₄	composite micronutrient formulation@ 100 g/plant
T ₅	composite micronutrient formulation@ 125 g/plant
T ₆	composite micronutrient formulation@ 150 g/plant
T ₇	Market formulation - agromin soil max @ 40 g/plant
T ₈	T8 Control

In this experiment, treatments were imposed with different levels of composite micronutrient formulation viz., applied through soil during the month of feb. The yield parameters, fruit weight weighed on top pan electric balance, fruits per tree were counted at each harvesting and then sum up which was expressed as number of fruits per tree, yield per tree (kg) and yield tonnes per hectare.

The quality parameters, TSS ° Brix recorded using refractrometer, juice content was estimated and expressed in Percentage. The acidity was calculated as percent citric acid as per method of Ranganna (1986) using following formula.

$$\text{Titrate acidity \%} = \frac{\text{Titre} \times \text{Normality of alkali} \times \text{vol. made up} \times \text{equivalent wt. of acid}}{\text{Volume of sample taken for observation} \times \text{wt. of sample taken} \times 10}$$

$$\text{Ascorbic acid (mg/100 g) calculated by} = \frac{\text{Titrate} \times \text{Dye} \times \text{Volume Value factor made up}}{\text{Aliquot of extract} \times \text{Weight of taken for estimation sample taken for estimation}} \times 100$$

Reducing sugar was estimated with DNSA method and non reducing sugar with formula Non-reducing sugar rind thickness was measured by a pair of screw gauge, seeds per fruit were counted and average number of seeds per fruit was worked out and shelf life of fruit was considered as number of days from harvesting to marketable fruits or optimum consuming stage (till the decaying of fruits started).

Results and Discussion

The maximum fruit weight (34.22 g), Number of fruit per tree (695), yield (23.77kg/tree), yield t(6.60 tonnes per hectare) with the applicarion treat RDF +and micronutrient @150g/plant(T₆). This might be due to soil application of composite micronutrients has been shown to significantly enhance fruit yield parameters by improving key physiological and biochemical processes in plants and the availability of micronutrients such as zinc, boron, iron, manganese, copper contributes to increased fruit length, width, and weight through their roles in cell division, auxin synthesis and carbohydrate metabolism. These micronutrients also promote better flowering and fruit set, resulting in a higher number of fruits per tree and increased fruit yield per hectare (Darshan *et al.*, 2022) [2]. And similar findings with Dabhi *et al.* (2022) [3] For maximum fruit weight, Yadav *et al.* (2020) [12] for maximum fruit yield per tree and Kavinprashanth *et al.* (2021) [5] for maximum number of fruit per tree.

The maximum TSS (7.45 °Brix), juice content (45.03%), ascorbic acid (30.09 mg/100 ml), reducing sugar (0.88%), TSS Acid ratio (0.99), shelf life (22.33days) and minimum rind thickness (1.11mm) were recorded with RDF and Soil

application of micronutrient @ 150g/plant (T₆). And maximum acidity (7.62%) was recorded in T₄(RDF + Soil application of micronutrient @ 100g/plant), non reducing (0.89%) in T₅(RDF + Soil application of micronutrient @ 125g/plant) and it might due to the soil application of micronutrients has shown a significant influence on enhancing the quality parameters of acid lime fruits. Micronutrients such as zinc (Zn), iron (Fe), and boron (B), copper (Cu) when applied through soil, improve root absorption efficiency and facilitate systemic nutrient transport, thereby enhancing physiological functions related to fruit development. Zinc plays a critical role in auxin synthesis and enzyme activation, contributing to increased total soluble solids (TSS), reducing sugars and improved TSS acid ratio. Iron enhances chlorophyll synthesis and energy metabolism, which supports higher juice content and non-reducing sugar accumulation. Boron improves cell wall integrity and reproductive development, leading to elevated ascorbic acid levels and moderated acidity.

Additionally, balanced soil nutrition improves fruit firmness and rind structure, resulting in reduced rind thickness and also enhanced shelf life. These findings align with the research conducted by Wathore *et al.* (2024) [11], which demonstrated that soil-applied micronutrients significantly improved fruit quality traits in acid lime cv. Sai Sharbathi. Farooq *et al.* (2023) [4] studied the effect of exogenous application of macro and micronutrients improves fruit quality of 'Pineapple' sweet orange and observed highest TSS (8.62 ° Brix),reducing sugars (2.75%),non-reducing sugars (3.77%) which are treated with combined application of 2500 g NPK in two splits, foliar spray of 0.3% boric acid,0.6% zinc sulphate.

Table 1: Effect of composite micronutrient on fruit yield parameters.

Treatment Details	Fruit Weight (g)	No.of Fruit Per Tree	Yield kg/ tree	Yield tonnes per hectare
T1	31.87	595	18.95	5.26
T2	32.53	620	20.17	5.60
T3	32.86	650	21.31	5.92
T4	33.14	646	21.40	5.94
T5	33.20	671	22.29	6.19
T6	34.22	695	23.77	6.60
T7	31.68	586	18.57	5.16
T8 Control	31.48	576	18.14	5.04
Mean	32.62	629	20.57	5.71
S.Em±	0.13	7.50	0.32	0.09
CD (P=0.05)	0.39	21.67	0.93	0.26

Table 2: Effect of composite micronutrient on quality parameters of Acidlime

Treatments	TSS (°Brix)	Juice Content %	Acidity %	Ascorbic acid mg / 100ml	Reducig sugar %	Non -Reducing sugar %	TSS: Acid ratio	Rind Thickness (mm)	Shelf life (Days)
T1	7.13	40.06	7.30	29.90	0.83	0.77	0.97	1.31	19.00
T2	7.15	39.98	7.45	29.90	0.81	0.77	0.95	1.34	19.33
T3	7.22	40.39	7.52	29.93	0.84	0.88	0.95	1.22	20.33
T4	7.28	41.84	7.62	30.00	0.84	0.83	0.94	1.18	20.33
T5	7.41	43.64	7.22	30.05	0.85	0.89	0.97	1.16	21.33
T6	7.45	45.03	7.10	30.09	0.88	0.71	0.99	1.11	22.33
T7	7.09	35.97	7.23	29.88	0.80	0.77	0.96	1.20	17.34
T8 Control	7.10	33.68	7.32	29.87	0.80	0.76	0.92	1.36	17.00
Mean	7.232	40.07	7.46	29.95	0.83	0.80	0.96	1.25	19.62
S.Em±	0.030	0.465	0.040	0.021	0.005	0.017	0.004	0.021	0.362
CD @ 5%	0.088	1.34	0.117	0.061	0.016	0.049	0.012	0.061	1.046

Conclusion

The present investigation on the influence of Standardization and Optimization of composite micronutrient formulation on fruit yield and quality of Acidlime revealed that The treatment T₆ (RDF + soil application of micronutrients @ 150 g/plant) recorded the highest values for both yield and quality parameters in acid lime (*Citrus aurantifolia* Swingle). Maximum fruit length(cm), fruit width(cm), fruit weight(g), number of fruits per tree and overall yield per hectare were achieved under this treatment. Similarly, superior fruit quality was observed in terms of TSS⁰Brix, juice content, ascorbic acid, reducing sugar, TSS acid ratio and shelf life, along with reduced acidity and rind thickness and notably the highest non reducing sugars were noticed in T₅ (RDF+soil application of micronutrients @ 125 g/plant).

References

- Babu R. Lime and lemons. In: Handbook of horticulture. New Delhi: ICAR; 2001. p. 212.
- Darshan D, Hota D, Devi R, Shukla JK. Micronutrients and plant growth regulators affecting the yield and quality of fruit crops: A review. Emerg Life Sci Res. 2022;8:92-103.
- Dabhi DM, Gurjar TD, Joshi NK, Patel MV, Kumar M, Dabhi DM. Effect of micronutrients on yield of acid lime (*Citrus aurantifolia* Swingle) cv. Kagzi lime. Int J Plant Soil Sci. 2022;34(23):1201-1207.
- Farooq M, Khan AS, Shaheen T, Hussain M, Almas AU, Anwar R, Naveed-Ur-Rehman R, Ali S, Hassan MU. Exogenous application of macro and micronutrients improves plant growth, productivity and quality of pineapple sweet orange. Pak J Bot. 2023;55(4):1305-1312.
- Kavinprashanth R, Paramaguru P, Aneesarani MS, KBS K. Impact of foliar application of growth regulators and micronutrients on yield and quality of acid lime (*Citrus aurantifolia* Swingle). J Pharmacogn Phytochem. 2021;10(1):2091-2093.
- Rangel CN, Carvalho LMJD, Fonseca RBF, Soares AG, Jesus EOD. Nutritional value of organic acid lime juice (*Citrus latifolia* T.) cv. Tahiti. Food Sci Technol. 2011;31:918-922.
- Rajkumar MPY. Response of acid lime (*Citrus aurantifolia* Swingle) cv. Phule Sharbati to micronutrients [dissertation]. Rahuri: Mahatma Phule Krishi Vidyapeeth; 2023.
- Singh Y, Thakur N, Meena NK. Studies on the effect of foliar spray of Zn, Cu and B on growth, yield and fruit quality of sweet orange (*Citrus sinensis* L.) cv. Mosambi. Int J Chem Stud. 2018;6(5):3260-3264.
- Srivastava AK, Singh S. Citrus nutrition research in India: Current status and future strategies. Indian J Agric Sci. 2008;78(1):3.
- Tagad SS, Patil MB, Patil SG, Deshpande DP. Effect of foliar application of plant growth regulators and micronutrients on growth and yield parameters of acid lime (*Citrus aurantifolia* L.) cv. Sai Sarbati. J Pharmacogn Phytochem. 2018;7(5):741-744.
- Wathore SD. Effect of micronutrient on growth, yield and fruit quality of acid lime (*Citrus aurantifolia* Swingle) cv. Sai Sharbathi [dissertation]. Rahuri: MPKV; 2024.
- Yadav DK, Meena YK, Deewan P, Gupta D. Effect of foliar application of micronutrients on yield and quality of pomegranate. Int J Bioresour Stress Manag. 2022;13(9):914-920.