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Influence of micronutrient spray on the growth, yield and leaf nutrient status of guava (*Psidium guajava* L.) cv. Lucknow-49

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Abstract
Foliar application of micronutrients escalates efficient use of nutrients, increases in quality and yield along with quick response. An experiment was undertaken to study the effect of foliar application of mineral nutrients *viz*., boron (B), magnesium (Mg) and zinc (Zn) sprayed at different growth stages *viz*., at fruit set and one month after first spray at the experimental HDP field at Horticultural College and Research Institute for Women, Tiruchirappalli during the year 2022–23. The experiment was conducted in a Randomized Block Design with 13 treatments and 4 replications with a spacing of 3 x 1.5 m. Foliar sprays with boron, magnesium and zinc significantly affected the physio-chemical properties of the fruits. The treatments imposed are T_1: Control, T_2: Boric acid 0.25%, T_3: Boric acid 0.50%, T_4: Boric acid 0.75%, T_5: $ZnSO_4$ 0.25%, T_6:$ZnSO_4$ 0.5%, T_7:$ZnSO_4$ 0.75%, T_8: $MgSO_4$ 0.25%, T_9: $MgSO_4$ 0.50%, T_{10}: $ZnSO_4$ 0.75%, T_{11}: Boric acid (0.25%) + $MgSO_4$ (1%) + $ZnSO_4$ (0.25%), T_{12}: Borax (0.50%) + Magnesium Sulphate (2%) + Zinc Sulphate (0.5%), T_{13}: Borax (0.75%) + Magnesium Sulphate (3%) + Zinc Sulphate (0.75%). The maximum Fruit length (7.5 cm), width (8.2 cm), weight (160.2 g), volume (176.2 ml), specific gravity (1.01) and yield per plant (3.877 kg) were significantly high in the treatment T_3 (0.5% boric acid). This study demonstrates the use of Boric acid 0.5% is found valuable for improving the yield and quality of Guava cv. Lucknow-49. It can be concluded from this study that foliar sprays of boron, magnesium and zinc are beneficial for improving fruit quality and leaf nutrient status of guava cv. Lucknow-49.

Keywords: Micronutrient spray, growth, yield, leaf nutrient, *Psidium guajava* L.

Introduction

Guava (*Psidium guajava* L.) being a tropical fruit also grows well in sub-tropical conditions (Bal, 2006) [14] due to its wider adaptability in diverse soils and agroclimatic regions. It is popularly known as the Poor Man's apple because of its low cultivation cost. India, Brazil and Mexico are the main producers of guava in the world. It is an important fruit crop that occupies the fourth position in area and production after mango, banana and citrus. Guava is hardy, prolific, bearer and a remunerative fruit. This evergreen tree occupies an area of 3.15 lakh hectares with an annual production of 45.16 lakh MT (NHB, 2021-22) in India. In Tamil Nadu, the total cultivated area of guava is 12.96 thousand hectares with an annual production of 92.61 thousand tonnes (NHB, 2021-22). The immense nutritive values along with sturdy nature and prolific bearing habit even on marginal land have made guava farmer's first choice. Nutrients to the plant can be made available by the basal as well as by the foliar application. The foliar feeding of fruit trees has gained much importance in recent years, as nutrients applied through the soil are needed in higher quantities because some amount leaches down and some become unavailable to the plant due to complex soil reactions. Foliar application is based on the principle that the nutrients are quickly absorbed by leaves and transported to different parts of the plant to fulfil the functional requirement of nutrition. This method is highly helpful for the correction of element deficiencies to restore disrupted nutrient supply and overcome stress factors limiting their availability and it plays an important role in improving fruit set, productivity and quality of fruits and recovery of nutritional and physiological disorders in fruit trees. The excess use of chemical fertilizers has posed an environmental threat, soil nutrient imbalance and deteriorated the micronutrients and organic carbon content in soil (Kharwade *et al*. 2018) [6].

Therefore, to tackle this problem judicious supply of macro as well as micronutrients is required. The right selection of fertilizer dose, time of application and method of application can positively influence the fruit yield and quality, fetching good price in the market. The effectiveness of fertilizers increases 10 to 20 times when applied through foliage (Zaman and Schumann, 2006) [13] due to low application rates, uniform distribution of nutrients and quick absorption by the leaves. Thus, keeping in view the importance of micronutrients, the present study was undertaken to study the effect of micronutrients on growth, yield and leaf nutrient status in guava.

Materials and Methods

The experimental investigation on the effect of micronutrients on the quality of guava was conducted in the High Density Planting field at Horticultural College and Research Institute for Women, Tiruchirappalli during the year 2022–23. Nine years old uniform guava plants cv. Lucknow – 49 (Sardar) planted at 3 x 1.5 m spacing were selected for the study. Nutrient application and other management practices were followed as per the recommended package of practices for guava plants. The first spraying of micronutrients and plant growth regulators was done before flowering and the second after fruit set during 2022-23. Thus, there were thirteen treatments including control (water spray). The treatment details were T_1: Control, T_2: Boric acid 0.25%, T_3: Boric acid 0.50%, T_4: Boric acid 0.75%, T_5: $ZnSO_4$ 0.25%, T_6:$ZnSO_4$ 0.5%, T_7:$ZnSO_4$ 0.75%, T_8: $MgSO_4$ 0.25%, T_9: $MgSO_4$ 0.50%, T_{10}: $ZnSO_4$ 0.75%, T_{11}: Boric acid (0.25%) + $MgSO_4$ (1%) + $ZnSO_4$ (0.25%), T_{12}: Borax (0.50%) + Magnesium Sulphate (2%) + Zinc Sulphate (0.5%), T_{13}: Borax (0.75%) + Magnesium Sulphate (3%) +Zinc Sulphate (0.75%). The experiment was laid out in a Randomized Block Design and replicated thrice. At harvest, a representative sample of twenty five greenish yellow coloured mature fruits was taken randomly from three trees of each treatment. The parameters *viz*., fruit weight (g), fruit volume (ml), specific gravity, number of fruits per plant, yield per plant, fruit length, fruit diameter and the leaf nutrient analysis were determined by adopting the AOAC (1975) [1] method. The titrable acidity was estimated by titration of the juice against 0.1 N KOH using phenolphthalein as an indicator and expressed as citric acid. The total soluble solids of the fruits were determined with the help of an Erma hand refractometer with a range of 0-32 percent and the values were expressed in degree brix after making the temperature correction at 20°C. Total sugar was estimated by the Anthrone reagent method (Dubois *et al*., 1951) [3]. Leaf samples were collected from the middle of the current season's growth around the periphery of the tree. Samples were cleaned, dried, ground and stored according to the procedure laid down by Chapman (1964) [2]. The digestion of the leaf samples for various nutrient elements was done in a diacid mixture (Nitric acid: Perchloric acid 4:1). Magnesium, Boron and Zinc were determined on Atomic Absorption Spectrophotometer AAS4141 and were expressed on a dry weight basis as percent, mg/kg and mg/kg respectively. The data collected on different crop characters were analyzed statistically in a randomized block design as suggested by Panse and Sukhatme (1985) [9].

Results and Discussion

The fruit weight of guava was recorded as maximum (160.2 g) in the fruits treated with T_3 (boric acid 0.50%) followed by $MgSO_4$ 2% spray (157.2 g) and the lowest value was recorded in T_1 (control) with 128.3 g. The maximum fruit volume (176.2 ml) was observed in the fruits sprayed with boric acid 0.50% and the lowest value was recorded in the untreated fruits with 141.1 ml. Though the fruits harvested from the trees sprayed with boric acid 0.50% recorded the highest specific gravity of guava (1.01) was recorded but there is no significant difference between the treatments. The treatment T_3 (boric acid 0.50%) recorded the highest fruit length (7.5 cm), fruit diameter (8.2 cm), number of fruits per plant (24.2) and thereby higher yield per plant (3.877 kg). The leaf nutrient status in guava showed high Total Mg content (1.82%) in T_9 ($MgSO_4$ 2%) and the lowest value was recorded in T_4 (boric acid 0.75%) with 0.72%. The Boron content was recorded as highest (20.95 mg/kg) when treated with 0.50% boric acid followed by T_4 (boric acid 0.75%) with 18.23 mg/kg and the lowest value was recorded in T_{10} ($MgSO_4$ 3%) with 11.58 mg/kg. The leaf nutrient content showed that the trees sprayed with $ZnSO_4$ 0.5% recorded the highest Zn content (166.54 mg/kg) followed by T_7 ($ZnSO_4$ 0.75%) with 162.50 mg/kg and the lowest value was recorded in T_4 (boric acid 0.75%).

In the present study, among the different concentrations of micronutrient spray, treatment with boric acid 0.50% recorded maximum fruit weight, volume of fruit and specific gravity. The increase in fruit weight might be due to the rapid increase in the size of cells and the increase in the fruit yield might be due to the accumulation of sugars and other soluble solids. Similar results were obtained by Rahul *et al*., (2019) [15]. Among the different concentrations of micronutrients, treatment with boric acid 0.50% recorded maximum fruit length and fruit diameter. This increase in the length and breadth of guava fruit may be due to the mineral nutrients especially boron appears to have a direct role in hastening the process of cell division and cell elongation due to which size and weight would have improved. Sau *et al*. (2017) [11] reported that the foliar feeding of micronutrients significantly improved micronutrient contents (B, Zn and Cu) in guava leaves over control. The results are also in conformity with those of Rajkumar *et al*. (2017) [16] who reported that leaf zinc content was increased significantly after the foliar application of various concentrations of zinc sulphate. El-Sissy and Waaz (2011) [17] reported that the foliar application of Fe, Mn and Zn significantly increases the concentration of these micronutrients as compared to control. Lal *et al*. (2000) [7] reported that the foliar spray of $ZnSO_4$ at 4 g per plant per year significantly increased the Zn content of leaves in guava cultivar Allahabad Safeda. Khan *et al*. (2012) [5] also reported that the combined application of boric acid (0.3%) and zinc sulphate (0.5%) at the fruit set stage effectively improved the B and Zn levels in the leaves of Feutrell's early mandarin.

Table 1: Effect of different concentrations of micronutrients on fruit weight (g), volume of fruit (ml), specific gravity, number of fruits/plant and yield/plant (kg)

Treatments	Fruit weight (g)	Volume of fruit (ml)	Specific gravity	No. of fruits/ plant	Yield/ plant (kg)
T_1-Control	128.3	141.1	0.93	15.5	1.989
T_2-Boric acid 0.25%	145.6	160.2	0.94	21.0	3.058
T_3-Boric acid 0.50%	160.2	176.2	1.01	24.2	3.877
T_4-Boric acid 0.75%	155.4	172.3	1.00	22.1	3.434
T_5-Zinc sulphate 0.25%	142.5	156.8	0.92	20.8	2.964
T_6-Zinc sulphate 0.50%	154.5	170.0	0.98	22.5	3.476
T_7-Zinc sulphate 0.75%	150.4	168.1	0.97	20.5	3.083
T_8-Magnesium sulphate 1%	148.3	163.1	0.94	23.5	3.485
T_9-Magnesium sulphate 2%	157.2	172.9	0.97	24.5	3.851
T_{10}-Magnesium sulphate 3%	155.2	169.3	0.98	23.4	3.632
T_{11}-0.25% of Boric acid + 0.25% $ZnSO_4$ + 1% $MgSO_4$	151.5	166.7	0.96	23.5	3.560
T_{12}-0.50% of Boric acid + 0.5% $ZnSO_4$ + 2% $MgSO_4$	154.0	169.4	1.00	22.5	3.465
T_{13}-0.75% of Boric acid + 0.75% $ZnSO_4$ +3% $MgSO_4$	148.5	165.3	0.98	20.3	3.015
SEd	3.21	2.80	NS	0.12	2.82
CD (0.05)	6.40	4.61	NS	0.27	5.64

Table 2: Effect of different concentrations of micronutrients on fruit length (cm), fruit diameter (cm), Mg (%), B (mg/kg) and Zn (mg/kg)

Treatments	Fruit length (cm)	Fruit Diameter (cm)	Total Mg (%)	Total B (mg/kg)	Total Zn (mg/kg)
T_1-Control	6.2	7.2	0.75	12.50	30.60
T_2-Boric acid 0.25%	7.3	7.8	0.85	16.10	42.50
T_3-Boric acid 0.50%	7.5	8.2	0.72	20.95	33.82
T_4-Boric acid 0.75%	7.1	8.0	0.72	18.23	30.52
T_5-Zinc sulphate 0.25%	6.9	7.6	0.94	14.20	125.32
T_6-Zinc sulphate 0.50%	6.8	7.4	0.87	13.21	166.54
T_7-Zinc sulphate 0.75%	6.6	7.2	0.85	12.5	162.50
T_8-Magnesium sulphate 1%	7.2	7.8	1.62	12.20	65.35
T_9-Magnesium sulphate 2%	7.0	7.6	1.82	12.01	75.52
T_{10}-Magnesium sulphate 3%	7.0	7.4	1.75	11.58	72.56
T_{11}-0.25% of Boric acid + 0.25% $ZnSO_4$ + 1% $MgSO_4$	6.8	8.0	1.32	15.40	102.50
T_{12}-0.50% of Boric acid + 0.5% $ZnSO_4$ + 2% $MgSO_4$	6.7	7.8	1.41	18.32	110.52
T_{13}-0.75% of Boric acid + 0.75% $ZnSO_4$ +3% $MgSO_4$	6.4	7.6	1.31	16.52	105.62
SEd	0.62	0.67	0.23	2.35	8.62
CD (0.05)	1.30	1.51	0.45	4.7	17.24

Conclusion

The study demonstrated that among various micronutrient treatments, spraying guava trees with boric acid at 0.50% concentration yielded superior results in terms of fruit weight, volume, and specific gravity. This treatment not only enhanced cell size rapidly but also increased fruit yield through enhanced sugar and soluble solids accumulation. The significant improvements in fruit length and diameter observed can be attributed to the role of boron in promoting cell division and elongation processes. These findings are consistent with previous studies, highlighting the efficacy of micronutrient foliar applications in enhancing nutrient contents in guava leaves, particularly boron and zinc. Future research should continue exploring optimal concentrations and application timings to further maximize guava fruit quality and yield.

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