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RESEARCH ARTICLE

# Enhancement of Yield and Quality of Guava cv. Lucknow-49 by Foliar Application of Nutrients under High-Density Planting System.

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## ABSTRACT

In view of the importance of foliar application of macro and micro nutrients to increase the yield and quality of guava under high density planting system, an experiment was laid out in a randomized complete block design consisting of nine treatment combinations with three replications. [(Control - Fertigation alone), (NPK (19:19:19)), (NPK + Zn), (NPK + Ca), (NPK + B), (NPK + Zn + Ca), (NPK + Zn + B), (NPK + Ca + B), (NPK + Zn + Ca + B). Among the treatments, fruit weight (225.22 g), fruit volume (215.35 ml),number of fruits per plant (80.35), fruit yield per plant(17.67 kg plant-1), TSS(10.60 0Brix), titratable acidity (0.196 %) and pectin content (1.31 %) was found to be significantly higher with the foliar application of NPK @ 1% + Zn @ 0.5 % + B @ 0.4%. The foliar spray of NPK @ 1% + Ca@ 0.2% + B@ 0.4% significantly increased the fruit diameter (7.85 cm), and ascorbic acid content (159.84 mg 100g-1). Thus, foliar spray of NPK, zinc and boron maintained more number of fruits per plant and improved the fruit set leading to an 18% increase in yield. Whereas, the addition of calcium to the plants increased the ascorbic acid content of the fruit and pectin that enhanced the shelf life of the fruit.

**Keywords:** *Guava; Foliar spray; Yield; Pectin; Ascorbic acid*

## INTRODUCTION

Guava (*Psidium guajava* L.) commonly known as "Poor man's apple" is a native crop of Central America and is widely cultivated in South Africa, Hawaii, India and Mexico. The fruits of guava is of high nutritive value hence is also known as the "Super fruit". In India, guava holds the fifth position among the major fruit crops next to mango, citrus, banana and apple with the area of 290 thousand hectares and the production of 4359 thousand metric tonnes(NHB, 2020). In Tamil Nadu, guava is cultivated in an area of 9.69 thousand hectares with the production of 155.06 thousand metric tonnes(NHB, 2018).It is cultivated intensively by high-density planting system with major operations like canopy management and fertigation. In high-density plantation, the yield must be triple the time as compared to the traditional system of cultivation. The continuous exploitation of the soil by the cultivation of perennial fruit trees depletes the nutrients of the soil over a period of years. The disadvantage of soil application of the nutrients is that it is required in large quantities, which leads to wastage of nutrients by leaching and some nutrients become unavailable to the plants. Therefore, the plants may not be able to produce enough number of new shoots which will affect the flowering, fruiting and ultimately the yield and quality. Thus the foliar application of the nutrients during the flowering and fruit set stage will easily supply the nutrients for early flowering, fruit set and development which enhances the fruit yield and quality.

The yield obtained in the high-density planting system of guava can produce triple the yield when proper canopy and fertilizer management are practiced. Micronutrients are as important as macronutrients to have better growth, yield and quality of fruit crops. The soil-applied nutrients may be immobile and may get dissociated and turn into unavailable forms to the plants (Keshavan *et al.,* 2011). Foliar application of nutrients will supply sufficient amount of nutrients for the better development of flowers and fruits when compared to the nutrients supplied through soil application. Murali *et al.* (2015) reported that the biometric traits and the yield characters get enhanced by the foliar application of nutrients during the flowering stage coupled with the pruning. Baranwal *et al.* (2017) reported that foliar application of boron and zinc before first flowering and again after fruit set

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increased the yield of guava. The practice of pruning followed by foliar application of nutrients witnessed an increase of 30% in the yield of cashew (Aneesa Rani *et al.*, 2011). Hence, a study was proposed with the hypothesis that, foliar application of some macronutrients and micronutrients after pruning enhance the number of current season shoots that would increase the number of flowers. Foliar spray of these nutrients after the flower formation can reduce the flower drop, fruit drop and improve the fruit set ultimately resulting in higher yield. With this perspective, the experiment was conducted with the objective to study the effect of nutrients through foliar spray on yield and quality of guava cv. Lucknow-49.

## MATERIAL AND METHODS

A field experiment was carried out at the Orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during 2019-2020. The particulars of the field experiment and analytical procedures carried out during the investigation are as follows.

Well grown uniform-sized six years old well-trained guava plants (cv. Lucknow-49 grown at a spacing of 3m between the plants and 1m between the rows were selected for this study. The experiment consists of nine treatment combinations with three replications. $T_1$ [(Control Fertigation alone)], $T_2$ [NPK (19:19:19)], $T_3$ [NPK + Zn], $T_4$ [NPK + Ca], $T_5$ [NPK + B], $T_6$ [NPK + Zn + Ca], $T_7$ [NPK + Zn + B], $T_8$ [NPK + Ca + B], $T_9$ [NPK + Zn + Ca + B]. The concentration of all 19 (19:19:19 of N:P:K) @ 1%, Zinc Sulphate @ 0.5%, Calcium chloride @ 0.2% and Boric acid @ 0.4% were sprayed based on the treatment combinations at two stages, *i.e.*, first spray at bud emergence stage (15 days after pruning) and the second spray is at fruit set stage (45 days after the first spray) and fertigation of 75:75:75 g of NPK/plant was given to the plants. The experiment was laid out in a randomized complete block design and the observations were randomly taken from five trees which were selected from each replication per treatment.

The fruit weight was taken from the average of ten fruits from each treatment and was expressed in grams. Fruit diameter was measured by using the measuring tape and is expressed in centimeter (cm). Using the water displacement method, volume of the fruit was calculated and was expressed in milliliter(ml). Yield per plant was recorded after weighing fully matured fruits and expressed in kilograms per plant (kg $plant^{-1}$). Number of fruits per plant was recorded by counting the number of fruits at the time of harvest and expressed in numbers.

Total Soluble Solids (TSS) of fruits was determined using Carl–Zeiss hand refractometer and the results were expressed in $^{o}$Brix and titratable acidity was estimated using the AOAC (1975) method and expressed in per cent of citric acid equivalents. Ascorbic acid content of the pulp was estimated as per the method of AOAC (1975) and expressed in mg/100g. Total sugars was estimated as per the method suggested by Hedge *et al.* (1962) and expressed in percentage. Reducing sugars was estimated as per the method suggested by Somogyi (1952) and expressed in percentage. The difference between the estimated total and reducing sugars was computed as non- reducing sugar content was arrived and expressed in percentage. Pectin content was estimated by the method developed by Ranganna (1986) and was expressed in percent. Statistical analysis of data was done by adopting the standard procedures of Gomez and Gomez (1984) and critical differences were worked out at five per cent probability level. All the statistical analyses was done using the software AGRES.

## RESULTS AND DISCUSSION

Foliar application of nutrients influenced the fruit yield and quality of guava and the results of various combinations of the foliar application of macronutrients and micronutrients are discussed.

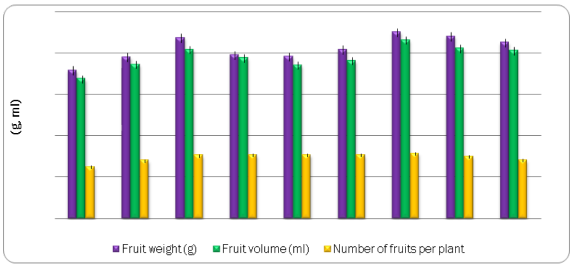


**Fig.1. Effect of the foliar application of nutrients on fruit weight, volume and number of fruits per plant of guava cv. Lucknow-49.**

The fruit physical parameters like fruit weight of 225 g and fruit volume of 215.35 ml were found to be significantly higher in the treatment with foliar application of NPK (19:19:19) at 1% along with Zinc sulphate @ 0.5 % and Boron @ 0.4%. The foliar application of NPK (19:19:19) @ 1% + Calcium chloride @ 0.2 % and Boron @ 0.4% recorded the fruit weight of 220 g. The lowest fruit weight of 179 g and fruit volume of 168.55 mL was observed in the control (Fig.1.). The increased fruit weight and the fruit volume may be due to the role of zinc which acts as a precursor for the production of auxin that enhances the growth of the plants in terms of leaf area and the number of leaves that enhances the photosynthetic efficiency of the plant. Higher photosynthetic efficiency aids in the accumulation of more photosynthates ultimately increasing the fruit weight and volume. Bhardwaj *et al.* (2019) reported that the foliar application of urea along with zinc has resulted in higher fruit weight in guava. The present study corroborates with the reports of Rawat *et al.* (2010) where the foliar application of zinc (0.4 %) alone or boric acid (0.4 %) has increased fruit size and weight of guava cv. Lucknow – 49. Similar results were reported by Parmar *et al.* (2014) in guavaand in banana, water-soluble fertilizers has resulted in early cropping and higher bunch weight (Kavino *et al., 2002*).The fruit yield per plant of about 17.67 kg (Table. 1)and the lowest yield per plant of 13.91 kg

**Table 1. Effect of foliar application of nutrients on yield and quality attributes of guava cv. Lucknow-49.**

| Treatment | Fruit Diameter (cm) | Fruit yield plant$^{-1}$(kg) | Ascorbic acid (mg g$^{-1}$) | Total sugars (%) | Reducing sugars (%) | Non Reducing sugars (%) | Pectin (%) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 7.03$^{cd}$ | 11.13$^{d}$ | 119.88$^{d}$ | 5.41$^{d}$ | 3.62$^{e}$ | 1.79$^{d}$ | 0.76$^{g}$ |
| $T_2$ | 7.18$^{c}$ | 15.24$^{cb}$ | 99.90$^{e}$ | 6.19$^{b}$ | 3.95$^{d}$ | 2.24$^{a}$ | 0.94$^{f}$ |
| $T_3$ | 7.07$^{c}$ | 14.81$^{c}$ | 128.76$^{c}$ | 5.89$^{c}$ | 3.85$^{d}$ | 2.05$^{abc}$ | 0.96$^{ef}$ |
| $T_4$ | 7.06$^{c}$ | 15.11$^{bc}$ | 133.20$^{bc}$ | 6.39$^{ab}$ | 4.27$^{c}$ | 2.12$^{ab}$ | 1.05$^{cd}$ |
| $T_5$ | 6.82$^{d}$ | 14.97$^{bc}$ | 86.58$^{f}$ | 6.65$^{a}$ | 5.15$^{a}$ | 1.50$^{e}$ | 1.09$^{bc}$ |
| $T_6$ | 7.20$^{c}$ | 15.61$^{d}$ | 126.54$^{cd}$ | 5.22$^{d}$ | 3.41$^{e}$ | 1.81$^{d}$ | 1.12$^{b}$ |
| $T_7$ | 7.91$^{a}$ | 17.67$^{b}$ | 98.42$^{e}$ | 6.60$^{a}$ | 4.75$^{b}$ | 1.85$^{dc}$ | 1.31$^{a}$ |
| $T_8$ | 7.95$^{a}$ | 16.43$^{a}$ | 159.84$^{a}$ | 6.28$^{b}$ | 4.19$^{c}$ | 2.09$^{ab}$ | 1.02$^{de}$ |
| $T_9$ | 7.51$^{b}$ | 14.94$^{bc}$ | 139.86$^{b}$ | 6.60$^{a}$ | 4.59$^{b}$ | 2.01$^{bcd}$ | 1.12$^{b}$ |
| **SE(d)** | **0.104** | **0.336** | **3.198** | **0.12** | **0.104** | **0.104** | **0.031** |
| **C.D.** | **0.222** | **0.719** | **6.839** | **0.257** | **0.222** | **0.222** | **0.066** |

was registered in control. The number of fruits per plant was found to be higher (80.35) in the plants sprayed with NPK (19:19:19) 1% along with Boron 0.4%.Total soluble solids (10.60 $^{0}$Brix), total sugars (6.65 %), reducing sugars (5.15 %) and non-reducing sugars (2.24 %) were also found to be higher in the fruits sprayed with NPK (19:19:19) at 1% along with Zinc sulphate 0.5 % and Boron 0.4% (Fig. 2. & Table 1.) when compared to the control the lowest

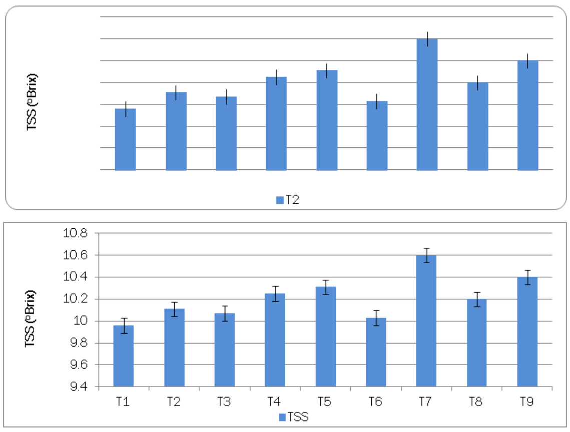


**Fig.2. Effect of the foliar application of nutrients on total soluble solids of guava cv. Lucknow-49.**

TSS (9.60$^{0}$ Brix), total sugars (5.41 %), reducing sugar (3.62 %) was recorded.Gaur *et al.* (2014) reported that the boron sprayed at the fruiting stage transports the trans-membrane sugars to the fruits that would have increased the TSS content in the fruits and reducedtitratable acidity. This was due to the conversion of starch into sugars,whichwas hastened by zinc and boron and suppressthe conversion of sugars to acids. Similar results were reported by Jeyakumaret *al.* (2003). Thus reducing the titratable acidity of the fruit sprayed with NPK (19:19:19) 1% along with Zinc sulphate 0.5 % and Boron 0.4% (Rawat *et al.,* 2010). Similar findings were reported by Awasthi and Lal (2009), Yadav *et al.* (2018),Rajput and Chand, (1976) in guava. The pectin content was found to be higher (1.31%) in the fruits sprayed with NPK (19:19:19) 1% along with Zinc sulphate 0.5 % and Boron 0.4% whereas the lowest pectin (0.76%) content was observed in control. The increased pectin content may be due to the role of boron in the production of cellulose and pectin in the fruits (Lee and Kim, 1991) by improving the translocation of photosynthesis for pectin production (Whiting, 1970).

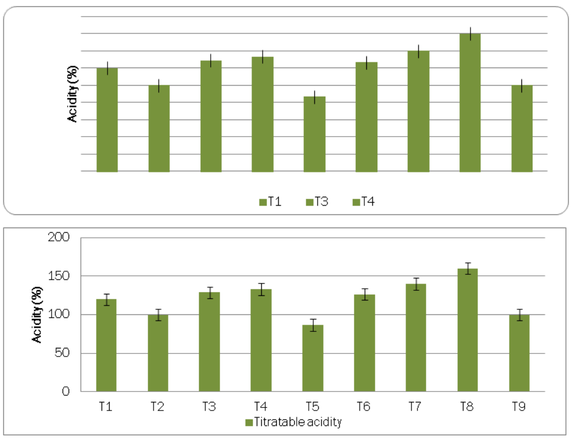


**Fig.3. Effect of the foliar application of nutrients on titratable acidity of guava cv. Lucknow-49.**

On the other hand foliar application of NPK (19:19:19) @ 1% + calcium chloride @ 0.2 % + boron @ 0.4% has resulted in a higher fruit diameter of 7.95 cm and ascorbic acid of 159.84 mg100g$^{-1}$ (Table. 1). The lowest fruit diameter was observed in the plants sprayed with NPK (19:19:19) 1% along with boron 0.4% and this necessitates the importance of calcium for the cell wall strengthening and development. The lowest ascorbic acid content (86.25 mg 100g$^{-1}$) was found in the treatment NPK (19:19:19) 1% + Boron 0.4% which indicates that the foliar spray of calcium is necessary to improve the ascorbic acid content. Calcium delays the oxidation of the ascorbic acid and thus the calcium enhances the ascorbic acid content of the fruits (Ruoyi*et al.,* 2005). Zinc has played a major role in enhancing fruit size and volume (Haque *et al.,* 2000) by increasing the production of auxin and enhanced the photosynthetic efficiency in plants. This study revealed that zinc and boron are essential micronutrients in combination with nitrogen, phosphorus and potassium for improving the yield and quality characteristics in guava.

## CONCLUSION

Foliar application of nutrients at the appropriate growth stagehad a greater influence on fruit yield and quality of guava cv. Lucknow – 49 under high-density planting system. There was an increase in yield to the tune of 18% over the control with foliar application of NPK @1% + zinc @ 0.5% + boron @ 0.4% at flowering stage and fruit set stage.Increased fruit weight, volume, pectin content, ascorbic acid, sugars and TSS in this treatment has enhanced the quality of fruits.

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