***Original Research Article***

# Effect of foliar feeding of plant growth regulators and nutrients on leaf nutrient status of Guava (*Psidium guajava* L.) cv. Gwalior-27

---

.

## ABSTRACT

**ABSTRACT:** The investigation entitled "Effect of foliar feeding of plant growth regulators and nutrients on leaf nutrient status of Guava (*Psidium guajava* L.) cv. Gwalior-27" was carried out in the Fruit orchard, Department of Horticulture, R.V.S.K.V.V, CoA, Gwalior district of Madhya Pradesh during mrig-bahar of 2021-22.

The field experiment was laid under FRBD (Factorial randomized block design) which contain 20 treatments and were replicated thrice. There were two factors, first was plant growth regulators contains 5 levels and second, nutrients contain 4 levels and their interactions. The result indicated that all the leaf nitrogen content (%) was affected significantly. The highest N content (2.74%) and leaf calcium content (0.75%) were found with $M_3$ ($Ca(NO_3)_2$ 2%). However, PGR'S and nutrient spray and their interactions had non-significant effect on both leaf P as well as K content. Maximum leaf boron content (90.67 ppm) and leaf zinc content (60.58 ppm) was obtained with $M_1$ (Borax 0.4%), $M_2$ ($ZnSO_4$ 0.5%) respectively.

Therefore, based on the experimental findings it can be concluded that foliar feeding of PGR's and nutrients was an effective way for enhancing the leaf nutrient status of guava. The treatment with nutrients was found to be effective in maximising the leaf N content, leaf boron content, leaf zinc content and leaf calcium content significantly. Although, foliar feeding of various concentrations of PGR's and nutrients independently as well as their interaction effect did not impact any change on the leaf nutrient status of the plant.

**Comment [l1]:** Not clear. Rewrite it

**Comment [l2]:** Orchard

**Comment [l3]:** One paragraph

**Comment [l4]:** What is the name of plant growth regulators

**Comment [l5]:** One paragraph

*Keywords: [PGR's, nutrients, foliar feeding, plant nutrient status, FRBD)*

**Comment [l6]:** delete

**Comment [l7]:** delete

## INTRODUCTION

Guava (*Psidium guajava* L.) the "*apple of the tropics*" and being the member of the family Myrtaceae. It considered as a "magical" fruit because of its array of nutritive value and medicinal uses. It exceeds most of the other fruits in productivity which makes it profoundly remunerative. The fruit composed of minerals like calcium, iron and phosphorus and vitamins A, $B_1$, $B_2$ and C. Due to its broader adaptability in diverse soils and agro-climatic zones, economical, prolific bearing and being highly remunerative with nutritive values, it has attained more popularity among the fruit growers (Das *et al*., 1995).

In India, it was introduced during the early 17th century by Portuguese and gradually became a crop of commercial significance all over the country. India ranks first in production of guava which comprises about 45.22% of the world production. The total area, production and productivity of guava in India is about 308 thousand ha with 45,82,000 million tonnes production and 23.7 mt/ha productivity respectively (Anonymous, 2021).

Among different factors, which affect the production and productivity of guava, nutrient assumes great significance. Management of nutrients in guava refers to sustaining the soil fertility and leaf nutrient supply to an ideal level for sustaining the desired fruit quality. Guava is reported to develop characteristic deficiency symptoms of various macro and micronutrients. Insufficiency of either of these nutrients at critical stage of fruit development, significantly hinder the physiological process of plant thus reduce the productivity and quality of produce and making the plant vulnerable to a number of biotic and abiotic stresses. Micronutrients help in the uptake of major nutrients and play an active role in the plant metabolism begins with cell wall development to respiration, photosynthesis, chlorophyll accumulation, enzyme activity hormone synthesis, nitrogen fixation and reduction (Das 2003). The positive effect of zinc application has been well validated (Chhonkar and Singh 1981) in guava. It is a necessary micronutrient involved in enzymatic systems essential for protein synthesis, seed production and maturity rate in plants (Swietlik, 1999 and 2002). It also plays an important role in starch metabolism in plants (Alloway, 2008). It is well known that Zn acts as a co-factor of many enzymes and influences many biological processes such as photosynthesis, nucleic acids metabolism, and biosynthesis of proteins and carbohydrates (Marschner, 1995). It is also, induces pollen tube growth resulted from its role on tryptophan synthesis as an auxin precursor biosynthesis (Hassan *et al*., 2010). Singh *et al*., (1983) obtained that boric acid has good effect on physico-chemical constitution of guava. The scarcity of boron, second to zinc deficiency, has imparted a major significance to boron amendment. An adequate boron amendment ensures not only ample fruit set, but optimum fruit yield with superior quality in terms of ratio between total soluble solids and acidity (Srivastava and Singh 2005). Fruit calcium is an important factor ascertaining quality. Calcium as a constituent of the cell wall, plays a vital role in forming cross-bridges, which influence cell wall potency and considered as the last barrier before cell separation. The association of calcium in the regulation of fruit development and ripening processes is also well established.

**Comment [l8]:** (Das, 2003)

**Comment [l9]:** (Chhonkar and Singh, 1981)

**Comment [l10]:** (Srivastava and Singh, 2005)

Recent advances in the field of nutrition of various fruit crops have confirmed that leaf nutrient analysis is a laudable tool for detecting deficiencies and toxicity of various essential elements and represents an important tool for determining future fertilization requirements (Korkmaz and Askin 2015). Information regarding nutritional aspect of guava is very limited and less studies has been conducted to find out the effect of leaf nutrients of guava on growth, yield and quality parameters of guava. Therefore, it has become imperative to find out influence nutrients on leaf nutrient status of guava.

**Comment [l11]:** (Korkmaz and Askin, 2015)

## MATERIAL AND METHODS

The experiment was carried out in the Fruit orchard, Department of Horticulture, R.V.S.K.V.V, CoA, Gwalior district of Madhya Pradesh during mrig-bahar of 2021-22 on twenty-seven years old guava trees cv. Gwalior-27 planted at 6 x 6 m distance and trees were maintained under uniform cultural schedule. The experimental was laid out in FRBD (Factorial randomized block design) comprising 20 treatment combinations and were replicated thrice. There were two factors, first is plant growth regulators contains 5 level and second is nutrient which contains 4 levels. The plants were sprayed with different

**Comment [l12]:** Orchard

concentrations of plant growth regulators (propyl gallate 200 & 300 ppm and gibberellic acid 50 & 100 ppm) and nutrients (Borax 0.4%, $ZnSO_4$ 0.5% and $Ca(NO_3)_2$ 2%) and control. Treatments were given thrice i.e., first, before bud initiation, second, at fruit setting stage and third after pre harvest stage. The following treatment combinations have been used presented in Table1 and Table 2. The details of the treatments are as follows:

**Table 1: Factor-A: PGR's**

| Notation | PGR's | Dose |
|---|---|---|
| $P_0$ | Control | Water spray |
| $P_1$ | Propyl gallate | 200 ppm |
| $P_2$ | Propyl gallate | 300 ppm |
| $P_3$ | Gibberellic acid | 50 ppm |
| $P_4$ | Gibberellic acid | 100 ppm |

**Table 2: Factor-B: Nutrients**

| Notation | Nutrient | Dose |
|---|---|---|
| $M_0$ | Control | Water spray |
| $M_1$ | Borax | 0.4 % |
| $M_2$ | $ZnSO_4$ | 0.5 % |
| $M_3$ | $Ca(NO_3)_2$ | 2 % |

### *Leaf nutrient status*

The leaf samples were collected before harvesting and gently washed and then rinsed in 0.1N HCl and distilled water instantly after leaf sampling, dried in oven at 70°C, dried samples were grind in an electric grinder. These samples were used for the analysis of NPK and nutrients status of leaves.

### *Estimation of Nitrogen*

Total nitrogen was estimated by the “Kjeldahal Distillation” method. Two hundred gram of grind material of leaves was taken in “micro-Kjeldahal tube” in which 10-15 ml of conc. $H_2SO_4$ was added. Further 2g of digestion activator (Salt mixture copper sulphate+ potassium sulphate) to the sample were added. The tubes were kept in digestion unit for digestion. After digestion, the material was taken for distillation and after distillation, distillate ammonia-metaborate was titrated against 0.4N $H_2SO_4$ (AOAC 1970).

### *Estimation of phosphorus, potassium and micronutrients:*

One gram oven dried plant sample was taken and digested in 100 ml conical flask with 10 ml of di-acid mixture (2:5) consisting of chemically pure concentrated perchloric acid and nitric acid respectively and digested material was filtered through Whatman No. 40 filter paper in 100 ml. volumetric flask and filtrate was diluted to mark. This was used for estimation of P, K and micronutrients.

### *Phosphorus estimation*:

Ten ml of aliquot from the colorless filtrate was taken in 25 ml, volumetric flask for determination and then 5 ml of ammonium molybdate vanadate mixture was added to it and volume was made up to 25 ml. after shaking well. It was kept for 30 minutes and color intensity was measured in Spectrophotometer 20 at 470 nm wave length, after setting the instrument to zero with blank as described by Jackson (1973).

### *Potassium estimation:*

Ten ml aliquot of the filtrate was taken in 100 ml volumetric flask and it was diluted to mark with distilled water. The potassium content in extract was estimated by flame photometer.

### *Estimation of zinc*

Extract prepared in preceding Para was used for the estimation of zinc (mg $kg^{-1}$) and the reading was taken on the Atomic Absorption Spectrophotometer as described by Lindsay and Norwell (1978) and micronutrient concentrations was calculated and expressed in ppm.

### *Estimation of boron*

The plant sample (0.5 g) was taken in porcelain/platinum dishes. $Ca(OH)_2$ 0.5 g was added to the sample and was ignited in the muffle furnace at 550 °C for 4 hours. White grey ash obtained which was cooled with a little distilled water and then added 5ml 0.1 N HCl. The content was transferred to 25 ml volumetric flask and made up to 25 ml with distilled water.

For analysis of boron, 1 ml aliquot was taken and estimated by spectrophotometer and micronutrient concentrations was calculated and expressed in ppm.

***Estimation of calcium***

Calcium content was estimated by feeding the digested sample into a standard atomic absorption spectroscopy meter having appropriate hallow cathode lamps and values were plotted on graph and micronutrient concentrations was calculated and expressed in ppm respectively.

## RESULTS AND DISCUSSION

### Nitrogen content (%)

Analysis of guava leaf samples showed that application of nutrients significantly increased the nitrogen content of leaves over control as evident in Table 3. and Table 4. Nevertheless, foliar feeding of $M_3$ ($Ca(NO_3)_2$ 2%) recorded the maximum leaf N content (2.74%) while, the minimum leaf N content (2.19%) was recorded with control ($M_0$), but the factor A (plant growth regulators) and their interaction with factor B (nutrients) was found non-significant. The results are found similar with the earlier findings of singh *et al* (2017). They have reported an increase in leaf nitrogen concentration with increased concentration of Nitrogen, which might be due to the intake of good amount of nitrogen by the leaves. These observations are also in line with previous result in guava (Sharma and Bhattacharya 1989).

**Comment [l13]:** Singh *et al*, (2017)

**Comment [l14]:** (Sharma and Bhattacharya, 1989)

### Phosphorus content (%)

The information in Tables 5 and 6 made it abundantly evident that foliar feeding of PGRs and nutrients and their interaction effect had been shown to be statistically insignificant.

### Potassium content (%)

The data presented in Table 5 and Table 6 clearly indicated that foliar feeding of PGR's and nutrients and their interaction effect had no statistically significant influence on leaf K content.

### Boron content (ppm)

The findings in Tables 9 and 10 clearly indicated that leaf boron content increased considerably significantly with the increase in boron concentration during investigation but the effect of factor A (plant growth regulators) individually and their interaction with factor B (nutrients) was not statistically significant. However, maximum boron content (90.67ppm) was seen under $M_1$ (Borax 0.4%), whereas the minimal (67.30ppm) was observed under $M_0$ (control). It is might be due to the increased level of biomass production or the dilution effect, balances out the element's concentration. These findings concur with those made earlier by Dalal *et al* (2011). Also, Shukla (1983) stated a synergistic relationship between zinc and boron content and noted an increment in the zinc content followed by an increase in boron content. Similar findings were also reported by Rajkumar *et al* (2017) who

**Comment [l15]:** Dalal *et al.* (2011)

**Comment [l16]:** Rajkumar *et al.* (2017)

indicated that the doses of boric acid were found most effective to enhance the leaf B status of guava leaves influenced by the external application of borax.

### Zinc content (ppm)

The data showed in Tables 11 and 12 clearly indicated that leaf zinc content increased significantly after the foliar feeding of various concentrations of nutrients but the effect of factor A (plant growth regulators) individually and their interaction with factor B (nutrients) was not statistically significant. It was also observed that the maximum leaf zinc content (60.58ppm) was obtained with $M_2$ ($ZnSO_4$ 0.5%) while minimum leaf zinc content (41.58 ppm) was recorded in treatment $M_0$ (control). Higher content of zinc in leaf was reported with the application of zinc as observed earlier by various workers (Kanwar and Dhingra, 1962; Smith, 1967; Manchanda *et al*., 1971; Nijjar and Brar, 1977; Dalal *et al*., 2011; Rajkumar *et al*., 2017; Sua *et al*., 2018; Vikas *et al* 2020).

### Calcium content (%)

The data presented in Tables 13 and 14 clearly revealed that the maximum calcium content (0.75%) was recorded in $M_3$ ($Ca(NO_3)_2$ 2%)  whereas, minimum calcium (0.57%) was recorded in $M_3$ (control), but the effect of factor A (plant growth regulators) individually and their interaction with factor B (nutrients) was found non-significant. The increase in leaf calcium concentration with rose in the concentration of calcium was earlier reported in guava (Singh *et al*., 2017). The above finding was in agreement with results that there is synergistic relationship found between calcium and boron content and revealed that an increment in the calcium content enhances the boron as well as calcium concentration (Shukla 1983). Hence, spray of calcium and boron alone or in combination are necessary to maintain the optimum calcium content in leaves of guava.

**Comment [I17]:** (Shukla, 1983)

**Table 3. Effect of foliar feeding PGR's and nutrients on Nitrogen content (%) of guava (*Psidium guajava L.*) cv. Gwalior-27**

| PGR's | Nitrogen content (%) |
|---|---|
| $P_0$ Control | 2.33 |
| $P_1$ Propyl gallate 200ppm | 2.37 |
| $P_2$ Propyl gallate 300ppm | 2.40 |
| $P_3$ Gibberellic acid 50ppm | 2.43 |
| $P_4$ Gibberellic acid 100ppm | 2.46 |
| SE(m) ± | 0.066 |
| CD (5%) | NS |
| (B) Micronutrients | |
| $M_0$ Control | 2.19 |
| $M_1$ Borax 0.4% | 2.25 |
| $M_2$ $ZnSO_4$ 0.5% | 2.59 |

| | |
|---|---|
| $M_3$ $Ca(NO_3)_2$ 2% | **2.74** |
| **SE(m) ±** | 0.061 |
| **CD (5%)** | 0.173 |

**Table 4 Interaction effect (A X B) of PGR's and nutrients on Nitrogen content (%) of guava during 1st year, 2nd year and pooled**

| | **Nitrogen content (%)** | | | | |
|---|---|---|---|---|---|
| | **PGR's** | | | | |
| **Micronutrients** | **$P_0$** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** |
| **$M_0$** | **2.07** | **2.12** | **2.10** | **2.29** | **2.38** |
| **$M_1$** | **2.20** | **2.23** | **2.17** | **2.31** | **2.35** |
| **$M_2$** | **2.55** | **2.50** | **2.46** | **2.54** | **2.58** |
| **$M_3$** | **2.72** | **2.61** | **2.60** | **2.73** | **2.72** |
| **SE(M) ±** | 0.132 | | | | |
| **CD (5%)** | NS | | | | |

**Table 5 Effect of foliar feeding PGR's and nutrients on Phosphorus content (%) of guava (*Psidium guajava L.*) cv. Gwalior-27**

| **(A) PGR's** | **Phosphorus content (%)** |
|---|---|
| **$P_0$ Control** | **0.172** |
| **$P_1$ Propyl gallate 200ppm** | **0.174** |
| **$P_2$ Propyl gallate 300ppm** | **0.178** |
| **$P_3$ Gibberellic acid 50ppm** | **0.176** |
| **$P_4$ Gibberellic acid 100ppm** | **0.180** |
| **SE(m) ±** | 0.006 |
| **CD (5%)** | NS |
| **(B) Micronutrients** | |
| **$M_0$ Control** | **0.168** |
| **$M_1$ Borax 0.4%** | **0.186** |

| | |
|---|---|
| $M_2$ $ZnSO_4$ 0.5% | **0.170** |
| $M_3$ $Ca(NO_3)_2$ 2% | **0.170** |
| **SE(m) ±** | 0.006 |
| **CD (5%)** | NS |

**Table 6 Interaction effect (A X B) of PGR's and nutrients on Phosphorus content (%) of guava during 1st year, 2nd year and pooled**

| | Phosphorus content (%) | | | | |
|---|---|---|---|---|---|
| | PGR's | | | | |
| **Micronutrients** | **$P_0$** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** |
| **$M_0$** | **0.163** | **0.167** | **0.164** | **0.170** | **0.174** |
| **$M_1$** | **0.187** | **0.183** | **0.181** | **0.184** | **0.180** |
| **$M_2$** | **0.178** | **0.177** | **0.175** | **0.179** | **0.173** |
| **$M_3$** | **0.169** | **0.169** | **0.169** | **0.172** | **0.173** |
| **SE(M) ±** | 0.010 | | | | |
| **CD (5%)** | NS | | | | |

**Table.7. Effect of foliar feeding PGR's and nutrients on Potassium content (%) of guava (*Psidium guajava L.*) cv. Gwalior-27**

| (A) PGR's | Potassium content (%) |
|---|---|
| **$P_0$ Control** | **1.63** |
| **$P_1$ Propyl gallate 200ppm** | **1.64** |
| **$P_2$ Propyl gallate 300ppm** | **1.70** |
| **$P_3$ Gibberellic acid 50ppm** | **1.71** |
| **$P_4$ Gibberellic acid 100ppm** | **1.75** |
| **SE(m) ±** | 0.034 |
| **CD (5%)** | NS |
| **(B) Micronutrients** | |
| **$M_0$ Control** | **1.63** |
| **$M_1$ Borax 0.4%** | **1.74** |
| **$M_2$ $ZnSO_4$ 0.5%** | **1.71** |

| | |
|---|---|
| **$M_3$ $Ca(NO_3)_2$ 2%** | **1.65** |
| **SE(m) ±** | 0.030 |
| **CD (5%)** | NS |

**Table 8 Interaction effect (A X B) of PGR's and nutrients on Potassium content (%) of guava during 1st year, 2nd year and pooled**

| | **Potassium content (%)** | | | | |
|---|---|---|---|---|---|
| | **PGR's** | | | | |
| **Micronutrients** | **$P_0$** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** |
| **$M_0$** | **1.57** | **1.56** | **1.60** | **1.69** | **1.75** |
| **$M_1$** | **1.74** | **1.68** | **1.68** | **1.78** | **1.71** |
| **$M_2$** | **1.71** | **1.67** | **1.63** | **1.70** | **1.71** |
| **$M_3$** | **1.64** | **1.64** | **1.62** | **1.68** | **1.68** |
| **SE(M) ±** | 0.066 | | | | |
| **CD (5%)** | NS | | | | |

**Table 9 Effect of foliar feeding PGR's and nutrients on Boron content (PPM) of guava (*Psidium guajava L.*) cv. Gwalior-27**

| **(A) PGR's** | **Boron content (ppm)** |
|---|---|
| **$P_0$ Control** | **73.24** |
| **$P_1$ Propyl gallate 200ppm** | **75.14** |
| **$P_2$ Propyl gallate 300ppm** | **74.03** |
| **$P_3$ Gibberellic acid 50ppm** | **77.73** |
| **$P_4$ Gibberellic acid 100ppm** | **78.59** |
| **SE(m) ±** | 1.723 |
| **CD (5%)** | NS |
| **(B) Micronutrients** | |
| **$M_0$ Control** | **67.30** |
| **$M_1$ Borax 0.4%** | **90.67** |
| **$M_2$ $ZnSO_4$ 0.5%** | **79.89** |

| | |
|---|---|
| **$M_3$ $Ca(NO_3)_2$ 2%** | **68.12** |
| **SE(m) ±** | 1.541 |
| **CD (5%)** | 4.412 |

### Table. 10 Interaction effect (A X B) of PGR’s and nutrients on Boron content (ppm) of guava during 1st year, 2nd year and pooled

| | **Boron content (ppm)** | | | | |
|---|---|---|---|---|---|
| | **PGR’s** | | | | |
| **Micronutrients** | **$P_0$** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** |
| **$M_0$** | **59.45** | **63.52** | **64.98** | **73.60** | **74.97** |
| **$M_1$** | **90.32** | **86.07** | **87.11** | **88.01** | **89.82** |
| **$M_2$** | **80.68** | **77.08** | **77.94** | **79.78** | **78.96** |
| **$M_3$** | **68.11** | **66.28** | **66.10** | **69.52** | **70.60** |
| **SE(M) ±** | 3.445 | | | | |
| **CD (5%)** | NS | | | | |

### Table. 11 Effect of foliar feeding PGR’s and nutrients on Zinc content (ppm) of guava (*Psidium guajava L.*) cv. Gwalior-27

| **(A) PGR’s** | **Zinc content (ppm)** |
|---|---|
| **$P_0$ Control** | **47.37** |
| **$P_1$ Propyl gallate 200ppm** | **48.43** |
| **$P_2$ Propyl gallate 300ppm** | **47.53** |
| **$P_3$ Gibberellic acid 50ppm** | **49.73** |
| **$P_4$ Gibberellic acid 100ppm** | **49.62** |
| **SE(m) ±** | 1.023 |
| **CD (5%)** | NS |
| **(B) Micronutrients** | |
| **$M_0$ Control** | **41.58** |
| **$M_1$ Borax 0.4%** | **50.63** |
| **$M_2$ $ZnSO_4$ 0.5%** | **60.58** |

| | |
|---|---|
| **$M_3$ Ca$(NO_3)_2$ 2%** | **42.35** |
| **SE(m) ±** | 0.915 |
| **CD (5%)** | 2.619 |

**Table. 12 Interaction effect (A X B) of PGR's and nutrients on Zinc content (ppm) of guava during 1st year, 2nd year and pooled**

| | **Zinc content (ppm)** | | | | |
|---|---|---|---|---|---|
| | **PGR's** | | | | |
| **Micronutrients** | **$P_0$** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** |
| **$M_0$** | **37.90** | **39.19** | **39.90** | **46.25** | **44.66** |
| **$M_1$** | **51.98** | **50.00** | **49.48** | **50.55** | **51.12** |
| **$M_2$** | **60.32** | **59.30** | **58.76** | **59.44** | **60.10** |
| **$M_3$** | **43.52** | **40.97** | **41.98** | **42.67** | **42.60** |
| **SE(M) ±** | 2.046 | | | | |
| **CD (5%)** | NS | | | | |

**Table. 13 Effect of foliar feeding PGR's and nutrients on Calcium content (%) of guava (*Psidium guajava L.*) cv. Gwalior-27**

| **(A) PGR's** | **Calcium content (%)** |
|---|---|
| **$P_0$ Control** | **0.588** |
| **$P_1$ Propyl gallate 200ppm** | **0.655** |
| **$P_2$ Propyl gallate 300ppm** | **0.650** |
| **$P_3$ Gibberellic acid 50ppm** | **0.683** |
| **$P_4$ Gibberellic acid 100ppm** | **0.658** |
| **SE(m) ±** | **0.015** |
| **CD (5%)** | **NS** |

| | |
|---|---|
| **(B) Micronutrients** | |
| **$M_0$ Control** | **0.574** |
| **$M_1$ Borax 0.4%** | **0.632** |
| **$M_2$ $ZnSO_4$ 0.5%** | **0.670** |
| **$M_3$ $Ca(NO_3)_2$ 2%** | **0.750** |
| **SE(m) ±** | **0.013** |
| **CD (5%)** | **0.037** |

**Table. 14 Interaction effect (A X B) of PGR's and nutrients on Calcium content (%) of guava during 1st year, 2nd year and pooled**

| | **Calcium content (%)** | | | | |
|---|---|---|---|---|---|
| | **PGR's** | | | | |
| **Micronutrients** | **$P_0$** | **$P_1$** | **$P_2$** | **$P_3$** | **$P_4$** |
| **$M_0$** | **0.550** | **0.570** | **0.580** | **0.600** | **0.570** |
| **$M_1$** | **0.640** | **0.640** | **0.630** | **0.640** | **0.610** |
| **$M_2$** | **0.680** | **0.660** | **0.670** | **0.680** | **0.660** |
| **$M_3$** | **0.750** | **0.750** | **0.720** | **0.710** | **0.710** |
| **SE(M) ±** | 0.027 | | | | |
| **CD (5%)** | NS | | | | |

## CONCLUSION

Foliar feeding of PGR's and nutrients given thrice, first, before bud initiation, second, at fruit setting stage and third after pre harvest stage was an effective way for improvement of leaf nutrient status of guava. The treatment of nutrients was found to be effective in maximising the leaf N content, leaf boron content, leaf zinc content and leaf calcium content significantly. Although, foliar feeding of various concentrations of PGR's and nutrients individually as well as their interaction effect was found statistically non-significant.

## REFERENCES

AOAC 1970. Official methods of analysis. Association of official agricultural chemists. 11th Ed., Washington, D.C., USA

Alloway, B. J. 2008. Zinc in Soils and Crop Nutrition. Brussels: *The International Zinc Association.*

Anonymous, (2021). Indian Horticulture Database, National Horticulture Board, Govt., of India.

Das, B.C., Chakraborty, A., Chakraborty, P.K., Maiti, A., Mandal, S., Ghosh, S. (1995). Comparative performance of guava cultivars under red and laterite soils of West Bengal. *Horticultural Journal*, **8**:141-46.

Chhonkar, V.S. and Singh, P.N. 1981. Effect of nitrogen, phosphorus and potash as foliar spray on growth, flowering and fruiting of guava (Psidium guajava L.). Punjab horticultural journal, 23 (1/2): 34-37.

Das, D.K. 2003. Micronutrients: Their behaviours in soils and plants. *Kalyani publication, Ludhiana* pp. 1-2

Dalal, R. P. S., Navjot, A. T., & Brar, J. S. (2011). Effect of foliar application of nutrients on leaf mineral composition and yield of Ber (*Ziziphus mauritiana* Lamk.) under arid conditions. *Annals of Arid Zone*, **50**(1), 53-56.

Hassan, H.S.A., Sarrwy, S.M.A. and Mostafa, E.A.M. (2010). Effect of foliar spraying with liquid organic fertilizer, some micronutrients and gibberellins on leaf minerals content, fruit set, yield, and fruit quality of “Hollywood“ plum trees. *Agriculture and Biology Journal of North America*, **1**: 638-643.

Jackson, M. L. 1973. Soil chemical analysis. Asia Publishing House, New Delhi.

Kanwar, J.S. and Dhingra, D.R. (1962). Effect of micronutrient sprays on the chemical composition of citrus leaves and incidence of chlorosis. *Indian Journal of Agricultural Sciences*, **32**: 309-14.

Kumar, A. (2017). Effect of boron and zinc application on nutrient uptake in guava (Psidium guajava L.) cv. Pant Prabhat leaves. *Int. J. Curr. Microbiol. App. Sci*, *6*(6), 1991-2002.

Lindsay, W.L. and Norvell, W.A. 1978. Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal*, **42**: 421-28

Manchanda, H.R., Randhawa, N.S. and Shukla, U.C. (1971). Effect of foliar application of different micro-nutrients in relation to sources of nitrogen on chemical

**Comment [I18]:** Put the year in the bracket as the rest of references.

**Comment [I19]:** Alphabetical arrangment

**Comment [I20]:** Put the year in the bracket as the rest of references.

**Comment [I21]:** Put the year in the bracket as the rest of references.

**Comment [I22]:** Put the year in the bracket as the rest of references.

**Comment [I23]:** Put the year in the bracket as the rest of references.

composition of sweet orange levels (*Citrus sinesis* Osbeck) var. Blood Red. *Indian Journal of Horticulture*, **28**: 100-107

Marschner, H. C. 1995. Mineral Nutrition of Higher Plants. London: Academic Press.

Nijjar, G.S. and Brar, S.S. 1977. Comparison of soil and foliar applied zinc in Kinnow (mandarin). *Indian Journal of Horticulture*, **34**(2):130-36.

Sharma, R., Bhattacharya, R. K., 1989. Effect of foliar nutrition of zinc on the nutrient concentration of guava leaves. *South Indian Horticulture* **37**(6): 323-325.

Shukla, M.P. 1983. Sulphur, zinc and boron nutrition of Rai (*Brassica juncea*). *Journal of the Indian Society of Soil Science*, **31**: 517-520.

Singh, P. N., Chhonkar, V. S. (1983). Effect of zinc, boron and molybdenum as foliar spray on chemical composition of guava fruit. *Punjab Horticulture Journal*.**23**(1-2): 34–37.

Singh, R.R., Joon, M.S. and Daulta, B.S. (1983). A note on the effects of foliar spray of urea and boric acid on physico-chemical composition of guava fruits cv. Lucknow-49. *Haryana Journal of Horticultural Sciences*, **12** (1-2): 68-70

Singh, N., Kumar, A., Rani, A., & Misra, K. K. (2017). Response of foliar application of calcium chloride and boric acid on fruit quality and leaf nutrient status of guava. *Journal of Hill Agriculture*, **8**(4), 406-409.

Smith, P.F. 1967. Leaf analysis of citrus. In: Fruit nutrition Chap. 8, N.F. Childers Ed. Somerset Press, Somerville, New Jersey, pp. 207-228.

Srivastava, A.K. and Singh, S. (2005). Boron nutrition in citrus-current status and future strategies – review. *Agricultural Reviews*, **26**(3): 173-186.

Sau, S., Sarkar, S., Ghosh, B., Ray, K., Deb, P., & Ghosh, D. (2018). Effect of foliar application of B, Zn and Cu on yield, quality and economics of rainy season guava cultivation. *Current Journal of Applied Science and Technology*, ***28***(1), 1-10.

Swietlik, D. 1999. Zinc nutrition in horticultural crops. In: Horticultural Reviews, ed. J. Janick, pp. 109–118.New York: John Wiley & Sons.

Swietlik, D. 2002. Zinc nutrition of fruit trees by foliar sprays. *Acta Horticulturae* **93**: 123–129.

**Comment [l24]:** Put the year in the bracket as the rest of references.

**Comment [l25]:** Put the year in the bracket as the rest of references.

**Comment [l26]:** Put the year in the bracket as the rest of references.

**Comment [l27]:** Put the year in the bracket as the rest of references.

**Comment [l28]:** Put the year in the bracket as the rest of references.

**Comment [l29]:** Put the year in the bracket as the rest of references.

**Comment [l30]:** Put the year in the bracket as the rest of references.