AATCC Review

26 November 2024: Received
11 February 2025: Revised
07 March 2025: Accepted
10 March 2025: Available Online

https://aatcc.peerjournals.net/

Original Research Article

Open Access

Studies on the effect of foliar application of different chemicals on quality and leaf nutrient status of Guava (*Psidium guajava* L.) cv. Hisar Safeda

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ABSTRACT

Guava (Psidium guajava) is native to tropical America and belongs to the Myrtaceae family with C.N. 2n= 22. Guava is an important fruit crop of the world and is also known as "Apple of Tropics". A field study was carried out at the Experimental Orchard, College of Agriculture, Kaul, Kaithal in the year 2023-2024 on 12 year old guava trees cv. Hisar Safeda to determine the effect of foliar application of different chemicals on yield and quality of guava. Different treatments were taken i.e. T_1 : $CaNO_3$@ 0.5%, T_2: $CaNO_3$@ 1.0%, T_3 : $CaNO_3$@ 1.5%, T_4 : K_2SO_4@ 0.5%, T_5 : K_2SO_4 @ 1.0%, T_6 : K_2SO_4 @ 1.5%, T_7 : $FeSO_4$ @ 0.2%, T_8 : $FeSO_4$ @ 0.4%, T_9 : $FeSO_4$ @ 0.6%, T_{10} : GA_3 @ 50 ppm, T_{11} : GA_3 @ 75 ppm, T_{12}: GA_3 @ 100 ppm and T_{13}: Control (water spray) with three replications under randomized block design. The results of the study revealed the significant increase in quality and leaf nutrient status of guava fruit. However, the foliar application of K_2SO_4 @ 1.5 % is efficient to improve the ascorbic acid (202.4 mg/100 g pulp), TSS (12.29°B), acidity (0.31 %), TSS/Acid ratio (39.65), total sugar (7.19 %), reducing sugar (4.02 %), non-reducing sugar (3.17 %) and sulphur content (0.28 %). Similarly, $CaNO_3$ @ 1.5 % increased the pectin content (0.98 %) and calcium content (2.19 %). Whereas, $FeSO_4$ @ 0.6 % is beneficial for increasing the iron content (180.2 ppm) in guava leaves.

Keywords: *Hisar Safeda, K_2SO_4, Plant growth regulators, TSS, acidity, ascorbic acid, sugar, leaf nutrient status.*

Introduction

Guava (*Psidium guajava* L.) belongs to the family Myrtaceae and is one of the most important tropical as well as sub-tropical fruits in the country. Guava is also known as "apple of tropics" and "poor man's apple". It is classified under the genus *Psidium* covering about 150 species (Hayes, 1970) but only *Psidium guajava* L. has been commercially exploited. It was introduced in India in the 17th century by Portuguese and became a commercial crop. It is a more income generating crop without much care and input as it is sturdy in nature and prolific in bearing even on marginal lands. It is the highly productive, delicious and nutritious fruit of tropical as well as sub-tropical regions.Guava stands out as a rich source of sugars, ascorbic acid (Vitamin C) and pectin. Guava offers a wealth of nutrients including vitamin C (200-400 mg), dietary fibers (2.8-5.5 g), protein (0.9-1.0 g), fat (0.1-0.5 g), carbohydrates (9.5-10 g), calcium (9.1–17 mg) and iron (0.3-0.7 mg) (Kamath *et al.,* 2008). Micronutrients emerge as vital elements in the growth and development of plants, playing crucial roles in production (Balodae*t al.,* 2011). Foliar application is a safer and easier way to apply micro nutrients as plants need low amount of these nutrients. Foliar fertilization offers the benefit of lowering application rates for micronutrients, uniformity in the distribution of fertilizer materials and quick response to applied nutrients (Parmar *et al*., 2014). Among these micronutrients, potassium is most important. Potassium plays an important role in starch metabolism, acts as a co-factor for many enzymes and affects photosynthesis, nucleic acid metabolism and protein biosynthesis. Potassium is also involved in regulating the protein and carbohydrate metabolism (Baloda *et al.*, 2023). By application of K_2SO_4, sugars, total soluble solid as well as vitamin C content of fruit increased and acidity is reduced. Plant growth regulators like GA_3 play an essential role in plant growth, flower induction, fruit set, fruit growth, yield and quality (Lal *et al.*, 2013). The function of GA_3 is to induce flowering and increases the fruit setting and fruit retention percentage (Suman *et al.*, 2021). GA_3 and K_2SO_4 helps in accelerating the translocation of metabolites from plant parts to the developing fruits.$CaNO_3$ increased the pectin content and calcium content (Kumar *et al.,*2010). Whereas $FeSO_4$ is beneficial for increasing the iron content in guava leaves.Keeping in view, this experiment has been planned to study the "Studies on the effect of foliar application of different chemicals on yield and quality of Guava (*Psidium guajava* L.) cv. Hisar Safeda".

Materials and Methods

Experimental details

The present investigation was conducted at Experimental Orchard, College of Agriculture, Kaul, Kaithal in the year 2023-2024 on 12 year old guava trees cv. Hisar Safeda to determine the effect of foliar application of different chemicals on quality and leaf nutrient status of guava. Different treatments were taken i.e. T_1 : $CaNO_3$@ 0.5%, T_2: $CaNO_3$@ 1.0%, T_3 : $CaNO_3$@ 1.5%, T_4 : K_2SO_4@ 0.5%, T_5 : K_2SO_4 @ 1.0%, T_6 : K_2SO_4 @ 1.5%, T_7 : $FeSO_4$ @ 0.2%, T_8 : $FeSO_4$ @ 0.4%, T_9 : $FeSO_4$ @ 0.6%, T_{10} : GA_3 @ 50 ppm, T_{11} : GA_3 @ 75 ppm, T_{12} : GA_3 @ 100 ppm and T_{13}: Control (water spray) with three replications under randomized block design. The treated fruits were analyzed for TSS (°B), Acidity (%), TSS/Acid ratio, Total sugar content (%), Reducing sugar content (%), Non - reducing sugar content (%), Pectin content (%), Ascorbic acid (mg/100 g pulp) and Leaf sample analysis for N, P, K, Ca, S and Fe content.

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DOI: https://doi.org/10.21276/AATCCReview.2025.13.01.614

Observations for evaluation

TSS (°B) : The total soluble solids (TSS) were measured by hand refractometer in the range of 0-32°Brix. The juice was extracted from selected fruits by squeezing through muslin cloth with the hands from each replication and reading was noted by just putting the drop of juice on the prism of the hand refractometer. The refractometer was calibrated with the help of distilled water after each reading and the value was expressed in °Brix.

Acidity (%) :

Titratable acidity was estimated by using the method given in AOAC (1990).

Reagents prepared

The following reagents were prepared for further use:

1. Sodium hydroxide 0.1 N
2. Phenolphthalein indicator 1 per cent

Procedure

Mashing of 5g of fruit pulp was done using a small amount of distilled water. 2ml of the filtrate was pipette out into a beaker and titrated against N/10 sodium hydroxide using phenolphthalein as an indicator. Light pink colour endpoint is reached. Acidity was expressed in terms of per cent citric acid equivalent after applying the following formula:

$$\text{Acidity (\%)} = \frac{\text{Titrate value x Normality of NaOH x Equivalent weight of citric acid}}{\text{Juice taken (ml) x 1000}} \times 100$$

TSS/Acid ratio

The ratio of total soluble solids to acid was calculated by dividing the total soluble solids value by the acidity.

$$\text{TSS/Acid ratio} = \frac{\text{Total soluble solids}}{\text{Acidity}} \text{ x } 100$$

Total sugar content (%)

Hulme and Narain (1931) advocated the method for the estimation of sugars.

Reagents

i) Potassium ferricyanide solution

a. Potassium ferricyanide 8.25 g
b. Anhydrous sodium carbonate 10.6 g
c. Final volume adjusted 500 ml

ii) Potassium iodide solution

a. Potassium iodide 12.5 g
b. Zinc sulphate 25 g
c. Sodium chloride 125 g
d. Final volume adjusted 500 ml

iii) 5 per cent acetic acid solution

a. Glacial acetic acid 50 ml
b. Final volume adjusted 1000 ml

iv) Sodiumthiosulphate solution (N/ 100)

a. Sodium thiosulphate 2.482 g
b. Final volume adjusted 1000 ml

v) Starch (indicator)

a. Soluble starch 1 g
b. Sodium chloride 20 g
c. Final volume adjusted 100 ml

Extraction

0.2 ml juice was taken in a test tube with pipette and final volume was adjusted to 20 ml (100 times dilution) with the help of distilled water. These were covered with aluminium foil and kept in boiling water bath for 30 minutes.

Total sugar content (%)

In a test tube, 5.0 ml of aliquot was taken, following which 4 ml of HCl (hydrochloric acid) was added to it and kept in a boiling water bath for 15 minute by covering it with aluminium foil. It was neutralized using adding anhydrous Na_2CO_3 (sodium carbonate) till effervesce stopped completely. The Final volume was made to 50 ml using volumetric flask with the help of distilled water. From this, 5.0 ml of aliquot was taken from it and the same procedure was repeated as used in reducing sugars.

Reducing sugar content (%)

In a test tube, 5 ml of aliquot was taken and 5 ml of potassium ferricyanide was added to it. After that, the test tube was covered with aluminium foil and kept in a water bath for 15 minutes. Test tubes were cooled down by keeping them under running tap water, and thereafter, 5 ml of potassium iodide and 3 ml of acetic acid were added to it so that it might turn into orange-yellow coloured solution. This solution was titrated against sodium thiosulphate using starch solution as indicator up to the time the milky white colour appeared. The reading from the burette was recorded at this point and at the same time a blank was run parallel. The results were calculated by using the subsequent formula and expressed in gram of sugars per 100 g fresh weight.

X= [(ml of sodium thiosulphate used in blank – ml of sodium thiosulphate used in unknown) + 0.05] x 0.338 = mg of sugar per 5 ml extract.

$$\text{Reducing sugars (\%)} = \frac{\text{X' x dilution factor}}{\text{5 x 1000}} \times 100$$

Non-reducing sugar content (%)

Non-reducing sugars was determined by subtracting reducing sugars from total sugars.

Pectin content (%)

Ranganna (1979) narrated the method for the estimation of total pectin as calcium pectate in fresh fruits.

Reagents

1. 1N Acetic acid

Glacial acetic acid 30 ml
Volume 200 ml

2. 1N Calcium chloride

Anhydrous calcium chloride 27.5 g
Volume 500 ml

3. 1N Sodium hydroxide

Sodium hydroxide 20 g
Volume 500 ml

4. 1% Silver nitrate

Silver nitrate 1 g
Volume 100 ml

Extraction

For the estimation of pectin content, 25 g of fresh fruit mashed samples were taken in a flask and 200 ml distilled water was added to it and placed on a hot plate for an hour. The water lost during boiling was restored back simultaneously. The flask was then further cooled and the final volume was made up to 250 ml. The contents of flask were then filtered through Whatman filter paper No. 4.

Estimation

To 50 ml part of the filtrate, 50 ml of distilled water and 5.0 ml of 1N NaOH was added and kept overnight. The following day, 25 ml of acetic acid solution was added and after 5 minutes again 12.5 ml of 1N calcium chloride solution was added using string. After permitting it to stand for an hour, it was boiled for a minute and filtered through oven-dried, previously weighed Whatman filter paper No. 4. After that, the precipitates were dried at 100°C overnight, cooled in desiccators and weighed. The amount of pectin was indicated as the percent calcium pectate.

$$\text{Calcium pectate (\%)} = \frac{\text{Weight of calcium pectate x volume of content}}{\text{Volume of filtrate x weight of sample for estimation}} \times 100$$

Ascorbic acid (mg/ 100 g pulp)

Ascorbic acid was estimated by the method mentioned in AOAC (1990).

Reagents

a) Metaphosphoric acid solution (3%)

Metaphosphoric acid (HPO_3) 15 g
Glacial acetic acid 40 ml
Final volume adjusted 500 ml

b) 2, 6 dichlorophenol indophenol dye

2, 6-dichlorophenol indophenol dye 50 mg
Sodium bicarbonate 42 mg
Volume adjusted 200 ml

c) Standard ascorbic acid solution

50 mg of ascorbic acid ($C_6H_8O_6$) was dissolved in 50 ml metaphosphoric acid (3%).

Estimation

Grinding of 5g of fruit pulp was done using 25 ml of 3 per cent metaphosphoric acid and filtered through muslin cloth. A 2ml of filtrate was titrated against 2, 6-dichlorophenol dye until a distinctly rose pink colour appeared. Concurrently, 1.0 ml of standard ascorbic acid was also titrated against the dye. The results were manifested as mg of ascorbic acid per 100 g of fruit pulp. It was determined by the given mathematical formula:

$$\text{Ascorbic acid (mg/100g fruit pulp)} = \frac{\text{Titrate value x total volume}}{\text{Standard reading x ml of sample}} \times 100$$

Leaf sample analysis for N, P, K, Ca, S and Fecontents

N, P, K,Ca, S and Fe were determined. For nutrient analysis oven dried plant material from each tagged plant was grinded separately with a grinder. Nitrogen (Colorimetric or Nessler's reagent method, Lindner, 1944), phosphorus (Vanadomolybdo-phosphoric acid yellow colour method, Koeing and Johnson, 1942), potassium (Flame photometer) and Zn (using atomic absorption spectrophotometer),sulphur (Cheisin and Yein method), calcium (Cheng and Bray method) and iron content (using atomic absorption spectrophotometer) in sample were analyzed.

Results and Discussion

Foliar application of K_2SO_4,GA_3 and $FeSO_4$ significantly affected the quality and leaf nutrient status of guava *viz.,* TSS (°B), Acidity (%), TSS/Acid ratio, Total sugar content (%), Reducing sugar content (%), Non - reducing sugar content (%), Pectin content (%), Ascorbic acid (mg/100 g pulp) and Leaf sample analysis for N, P, K, Ca, S and Fe content.

It is evident from the data presented in Table 1, the TSS was increased significantly by the foliar application of $K_2SO_4$and GA_3at various concentrations on guava. Among different foliar applications, the maximum TSS (12.29°B)was recorded in treatment T_6*i.e.* K_2SO_4 @ 1.5 % which was statistically at par with treatments T_5*i.e.* K_2SO_4 @ 1.0 % (12.07°B), T_{12}*i.e.*GA_3 @ 100 ppm (12.03°B) and T_{11}*i.e.*GA_3 @ 75 ppm (11.79°B). However, the minimum TSS (10.61°B) was recorded in treatment T_{13}*i.e.* control.The results are similar by the findings of Kher *et al.* (2005), Bikash*et al.* (2007), Garasiya*et al.* (2013), Manivannan*et al.* (2015) in guava, Chandra *et al.* (2015) in aonla, Osama *et al.* (2015) in mango and Pandey *et al.* (1999) and Yadav *et al.* (2021) in ber. On the other hand, the acidity of the fruits was minimum(0.31 %) was recorded underT_6*i.e.* K_2SO_4 @ 1.5 %which was statistically at par with treatments T_5*i.e.* K_2SO_4 @ 1.0 % (0.33 %) concentration whereas, maximum acidity (0.51 %) was recorded in control. The results are similar by the findings of Agnihotri *et al.* (2013), Manivannan*et al.* (2015), Sandeep and Amarjeet, (2017) in guava and Chandra *et al.* (2015) in aonla and Singh and Bons (2020) in sapota. Simultaneously, foliar application of K_2SO_4resulted in higher TSS/Acid ratio over the control (Table 1). The maximum TSS/Acid ratio (39.65) was observed in treatment T_6*i.e.* K_2SO_4 @ 1.5 % whereas, minimum TSS/Acid ratio (20.80) was observed in treatment T_{13}*i.e.* control.The outcomes of the present study are in accordance with the results of Kher *et al.* (2005), Bikash*et al.* (2007), Garasiya*et al.* (2013), Manivannan*et al.* (2015) in guava, Osama *et al.* (2015) in mango and Chandra *et al.* (2015) in aonla and Pandey *et al.* (1999) and Yadav *et al.* (2021) in ber.

Table 1 : Effect of different chemicals on TSS (oB), acidity (%) and TSS/Acid ratio of guava

Treatments	TSS (°B)	Acidity (%)	TSS/Acid ratio
T_1 $CaNO_3$ @ 0.50 %	11.65	0.48	24.27
T_2 $CaNO_3$ @ 1 %	11.26	0.41	27.46
T_3 $CaNO_3$ @ 1.5 %	11.10	0.36	30.83
T_4 K_2SO_4@ 0.50 %	11.51	0.44	26.16
$T_5K_2SO_4$@ 1 %	12.07	0.33	36.58
$T_6K_2SO_4$@ 1.5 %	12.29	0.31	39.65
T_7FeSO_4 @ 0.2 %	10.85	0.50	21.70
T_8FeSO_4 @ 0.4 %	10.89	0.49	22.22
T_9FeSO_4 @ 0.6 %	11.23	0.48	23.40
T_{10} GA_3 @ 50 ppm	11.50	0.47	24.47
T_{11} GA_3 @ 75 ppm	11.79	0.44	26.80
T_{12} GA_3 @ 100 ppm	12.03	0.39	30.85
T_{13} Control – Water Spray	10.61	0.51	20.80
CD @ 5%	0.51	0.01	1.4

The data presented in Table 2 depicts that foliar application of different chemicals at different concentrations influenced the total sugar content of guava. The maximum total sugar content (7.21 %) was observed in treatment T_6*i.e.* K_2SO_4 @ 1.5 % which was statistically at par with treatments T_5*i.e.* K_2SO_4 @ 1.0 % (7.18 %), T_{12}*i.e.*GA_3 @ 100 ppm (7.15 %) and T_{11}*i.e.*GA_3 @ 75 ppm

(6.98 %). However, the minimum total sugar content (6.10 %) was observed in control whereas, treatments T_7 and T_1 ($FeSO_4$ @ 0.2 % and $CaNO_3$ @ 0.50 %) were recorded statistically at par over the control with values 6.04 % and 6.27 % respectively. However, the reducing sugar content of guava was maximum reducing sugar content (4.02 %) was recorded in treatment T_6*i.e.* K_2SO_4 @ 1.5 % which was statistically at par with treatments T_5*i.e.* K_2SO_4 @ 1.0 % (3.99 %), T_{12}*i.e.*GA_3 @ 100 ppm (3.92 %), T_{11}*i.e.*GA_3 @ 75 ppm (3.85 %), T_2*i.e.* $CaNO_3$ @ 1 % (4.01 %) and $CaNO_3$ @ 1 % (3.92 %). However, the minimum reducing sugar content (3.22 %) was recorded in control and treatment T_1 *i.e.* $CaNO_3$ @ 0.50 % (3.29%) and $FeSO_4$*i.e.* @ 0.2 % (3.07) was observed at par over control. It is apparent from the table 2 that the foliar application of different chemicals have a great impact on the non-reducing sugar content in guava. The highest non-reducing sugar content (3.19 %) was recorded in treatment T_6*i.e.* K_2SO_4 @ 1.5 % and T_5*i.e.* K_2SO_4 @ 1.0 % treatment which was followed by treatments T_4*i.e.* K_2SO_4 @ 0.5 % (3.16 %), T_{12}*i.e.* GA_3 @ 100 ppm (3.23 %), T_{11}*i.e.* GA_3 @ 75 ppm (3.12 %)while, the lowest non-reducing sugar content (2.88 %) was recorded in control and the treatments T_1CaNO_3 @ 0.50 % (2.98), $T_7$and T_8*i.e.* $FeSO_4$ @ 0.2 % (2.98) and @ 0.4% (2.97 %) were found at par with control. The outcomes of the present study are in accordance with the results of Khere*t al.* (2005), Garasiya*et al.* (2013), Manivannan*et al.* (2015), Sandeep and Amarjeet, (2017) in guava.

Table 2 : Effect of different chemicals on total, reducing and non-reducing sugar (%) in guava

Treatments	Total sugar content (%)	Reducing sugar content (%)	Non-reducing sugar content (%)
T_1 $CaNO_3$ @ 0.50 %	6.27	3.29	2.98
T_2 $CaNO_3$ @ 1 %	6.56	3.92	2.73
T_3 $CaNO_3$ @ 1.5 %	6.83	4.01	2.82
T_4 K_2SO_4@ 0.50 %	6.76	3.60	3.16
$T_5K_2SO_4$@ 1 %	7.18	3.99	3.16
$T_6K_2SO_4$@ 1.5 %	7.21	4.02	3.17
T_7FeSO_4 @ 0.2 %	6.04	3.07	2.97
T_8FeSO_4 @ 0.4 %	6.16	3.18	2.98
T_9FeSO_4 @ 0.6 %	6.49	3.38	3.11
T_{10} GA_3 @ 50 ppm	6.61	3.49	3.12
T_{11} GA_3 @ 75 ppm	6.98	3.76	3.22
T_{12} GA_3 @ 100 ppm	7.15	3.92	3.23
T_{13} Control – Water Spray	6.10	3.22	2.88
CD @ 5%	0.34	0.14	0.13

The data concerning the pectin content (%) and ascorbic acid content (mg/100 g pulp) is shown in Table 3. Fruits had a substantially higher pectin content over the control. The maximum pectin content (0.98 %)was observed in T_3*i.e.* $CaNO_3$ @ 1.5 %, closely followed by treatment T_2*i.e.*$CaNO_3$ @ 1 % (0.96 %), T_5*i.e.* K_2SO_4 @ 1 % (0.94 %) T_6*i.e.* K_2SO_4 @ 1.5 % (0.95 %) and T_{12} *i.e.* GA_3 @ 100 ppm (0.94 %) . However, the minimum pectin content (0.75 %) was observed in control. The present results are in line with the findings of Kumar *et al.* (2010) and Sharma and Tiwari (2015) in guava. It is clear from the data presented in table 3 that ascorbic acid content was significantly increased with foliar application of different chemicals at different concentrations on guava. Treatment T_6 *i.e.* K_2SO_4 @ 1.5 % had the highest ascorbic acid content (202.8 mg/100 g pulp) followed by treatments T_3 $CaNO_3$ @ 1.50 % (196.1 mg/100 g pulp) T_5 K_2SO_4 @ 1 % (198.9 mg/100 g pulp), T_{11} GA_3 @ 75 ppm (195.3 mg/100 g pulp) T_{12} GA_3 @ 100 ppm (198.7 mg/100 g pulp)However, the treatment T_{12}*i.e.* control had the lowest ascorbic acid content (178.5 mg/100 g pulp).The present results are in line with the findings of Tiwari*et al.* (2017) in strawberry, Lal*et al.* (2013), Rajput *et al.* (2015) and Lal and Das, (2017) in guava and Kumar *et al.* (2017) in cape gooseberry and Yadav*et al.* (2021) in ber.

Table 3 : Effect of different chemicals on pectin (%) and ascorbic acid content (mg/100g pulp) in guava

Treatments	Pectin content (%)	Ascorbic acid (mg/100 g pulp)
T_1 $CaNO_3$ @ 0.50 %	0.90	190.4
T_2 $CaNO_3$ @ 1 %	0.96	191.7
T_3 $CaNO_3$ @ 1.5 %	0.98	196.1
T_4 K_2SO_4@ 0.50 %	0.85	191.4
$T_5K_2SO_4$@ 1 %	0.94	198.9
$T_6K_2SO_4$@ 1.5 %	0.95	202.4
T_7FeSO_4 @ 0.2 %	0.79	179.2
T_8FeSO_4 @ 0.4 %	0.80	181.6
T_9FeSO_4 @ 0.6 %	0.82	186.4
T_{10} GA_3 @ 50 ppm	0.84	188.9
T_{11} GA_3 @ 75 ppm	0.89	195.3
T_{12} GA_3 @ 100 ppm	0.94	198.7
T_{13} Control – Water Spray	0.75	178.5
CD @ 5%	0.04	9.6

Table 4 depicts the leaf nutrient status of guava. A brief appraisal of the data clearly indicates that all the treatments were found significant in altering the leaf N, P, K, Ca, S and Fe content over the control. Maximum N content (1.98%) was recorded in treatment T_3 *i.e.* $CaNO_3$ @ 1.5 % followed by treatment T_2*i.e.* $CaNO_3$ @ 1.00 % (1.94 %). However, the treatment T_{13}*i.e.* control had the minimum (1.51 %). Highest P content (0.24 %) was recorded in treatment T_{12} *i.e.* GA_3 @ 100 ppm followed by treatments T_3 *i.e.* $CaNO_3$ @ 1.5 % (0.22 %), T_5 *i.e.* K_2SO_4 @ 1.5 % (0.23 %) and T_5*i.e.* K_2SO_4 @ 1 % (0.22 %) However, the treatment T_{13} *i.e.* control had the minimum (0.16 %). Highest K content (1.80 %) was recorded in treatment T_6 *i.e.* K_2SO_4 @ 1.5 % followed by treatments T_5 *i.e.* K_2SO_4 @ 1 % (1.78 %) and T_4 *i.e.* K_2SO_4 @ 0.5 % (1.74%). However, the treatment T_{13} *i.e.* control had the minimum K content (1.38 %). The maximum calcium content (2.19%) was obtained in treatment T_3*i.e.* $CaNO_3$ @ 1.5 % followed by treatments T_2 *i.e.* $CaNO_3$ @ 1.0 % (2.15 %) and T_3 *i.e.* $CaNO_3$ @ 0.5 % (2.10 %) was recorded. The minimum calcium content (1.49 %)was observed in treatment T_{13}*i.e.* control. Highest S content (0.28 %) in treatment T_6 *i.e.* K_2SO_4 @ 1.5 % followed by treatments T_5 *i.e.* K_2SO_4 @ 1 % (0.26 %), T_8 *i.e.* $FeSO_4$ @ 0.4 % (0.26 %) and T_9*i.e.* $FeSO_4$ @ 0.6 % (0.27 %). However, the treatment T_{13} *i.e.* control had the minimum amount of sulphur (0.14 %). Fe (ppm) content was found maximum in T_9 *i.e.* $FeSO_4$ @ 0.6 % (180.2 ppm) was statistically at par in comparison treatments T_8 *i.e.* $FeSO_4$ @ 0.4 % (174.6 ppm) and T_7 *i.e.* $FeSO_4$ @ 0.2 % (174.6 ppm). The lowest concentration of was found in control (141.6 ppm). Similar results were reported by Wali and Sharma (1997) in Kinnow, Nirmaljit *et al.* (2005) in Kinnow leaves, Prasad *et al.* (2017) in Kinnow mandarin, Lal *et al.* (2000) in guava, Jeyabhaskaran and Pandey (2008) in Banana and Sharma *et al.* (2009) in ber.

Table 4 : Effect of different chemicals on leaf nutrient content in guava cv. Hisar Safeda

Treatments	N (%)	P (%)	K (%)	Ca (%)	S (%)	Fe (ppm)
T_1 $CaNO_3$ @ 0.50 %	1.92	0.19	1.46	2.10	0.17	148.6
T_2 $CaNO_3$ @ 1 %	1.94	0.2	1.54	2.15	0.18	146.1
T_3 $CaNO_3$ @ 1.5 %	1.98	0.22	1.55	2.19	0.17	147.3
T_4 K_2SO_4 @ 0.50 %	1.58	0.21	1.74	1.90	0.23	162.6
$T_5K_2SO_4$ @ 1 %	1.57	0.22	1.78	1.81	0.26	158.4
$T_6K_2SO_4$ @ 1.5 %	1.57	0.23	1.8	1.78	0.28	160.2
T_7FeSO_4 @ 0.2 %	1.65	0.19	1.64	1.58	0.21	174.6
T_8FeSO_4 @ 0.4 %	1.7	0.19	1.66	1.60	0.26	177.8
T_9FeSO_4 @ 0.6 %	1.69	0.18	1.67	1.60	0.27	180.2
T_{10} GA_3 @ 50 ppm	1.72	0.19	1.48	1.81	0.20	166.2
T_{11} GA_3 @ 75 ppm	1.77	0.21	1.51	1.87	0.21	163.4
T_{12} GA_3 @ 100 ppm	1.79	0.24	1.52	1.85	0.23	164.9
T_{13} Control–Water Spray	1.51	0.16	1.38	1.49	0.14	141.6
CD @ 5%	0.07	0.02	0.06	0.08	0.02	6.3

Conclusion

GA_3, K_2SO_4 and $FeSO_4$ play an important role in growth, and development and cause efficient quality and leaf nutrient status improvement. Results revealed that K_2SO_4 @ 1.5 %improved the TSS, acidity, TSS/Acid ratio, total sugars, reducing sugars, non-reducing sugars, ascorbic acid content and S content over control. However, $CaNO_3$ @ 1.5 % improved pectin content and Ca content in leaf nutrient status of guava. $FeSO_4$ @ 0.6 % is beneficial for increasing the iron content in guava leaves. So, there is need to disseminate the improved technologies of foliar application of guava among the farmers with effective extension methods like front line demonstration and others etc.

References

1. A.O.A.C., 1990.*Official Methods of Analysis*.15th Edn. Association of Official Analytical Chemist, Washington, D.C.

2. Agnihotri, A., Tiwari, R. and Singh, O.P. (2013).Effect of crop regulators on growth, yield and quality of guava. *Annals of plant and soil research*, 15(1), 54-57.

3. Baloda, S., Sharma, J.R., Sehrawat, S.K., Ahlawat, V.P., Bhatia, S.K. and Dahiya, D.S. (2011). Present status of guava research and future thrusts in India. *Haryana Journal of Horticultural Sciences,* 40(3-4), 105–116.

4. Baloda, S., Sharma, J. R., Sehrawat, S. K., Sharma, S., Rani, S., & Mehta, A. (2023). Effect of Soil Application of Zinc Sulphate on Growth, Yield and Quality of Guava cv. L-49. *International Journal of Plant & Soil Science*, 35(20), 781-787.

5. Bikash, D., Vishal, N., Jana, B.R., Kumar, S. and Dey, P. (2007).Evaluation of different methods of crop regulation in guava grown under rainfed plateau conditions of eastern India.*Indian Journal of Horticulture*, 64(3), 294-99.

6. Chandra, R., Manju, B., Rawat, S.S. and Singh, K.K. (2015).Effect of foliar application of various growth regulators on yield and quality of aonla cv. NA-7.*International Journal of Tropical Agriculture*, 33(3), 158-62.

7. Garasiya, V.R., Patel, N.M., Bhadauria, H.S. and Wankhade, V.R. (2013).Studies of plant growth substances on the yield components of winter season guava cv. L-49 (Sardar).*International Journal of Agriculture Science*, 9(1), 114-16.

8. Hayes, W.B. 1970. Fruit growing in India, kitabistan, Allahabad, 297.

9. Hulme, A.C. and Narain, R. (1931).The ferricynide method for determination of reducing sugars.A modification of Hegedom-Jenson Hanes Technique.*Biochemistry Journal*, 25, 1051-1061.

10. Jawed, M.D., Lekhi, R., Vasure, N., Jatav, R. and Khan, S. (2016). Effect of foliar spray of zinc sulphate and gibberellic acid on growth and quality of guava G-27 (*Psidium guajava* L.). *Asian Journal of Horticulture*, 11(1), 68-71.

11. Jeyabhaskaran, K.J. and Pandey, S.D. (2008).Effect of foliar sprays of micronutrients in banana under high soil pH condition. *Indian Journal of Horticulture*, 65, 102-105.

12. Kamath, J.V., Rahul, N., Kumar, C.A. and Lakshmi, S.M. (2008).*Psidiumguajava*L: A review. *International Journal of Green Pharmacy,* 2(1), 9-12.

13. Kher, R., Bhat, S. and Wali, V.K. (2005).Effect of foliar application of GA_3, NAA on physico-chemical characteristics of guava cv. Sardar. *Haryana Journal of Horticulture*, 34(1/2), 31-32.

14. Koenig, R. and Johnson, C. (1942). Colorimetric determination of phosphorus in biological materials.*Industrial & Engineering Chemistry Analytical Edition*, 14(2), 155-156.

15. Kumar, R., Singh, S.P., Tiwari, A., Maji, S. and Patodar, V.L. (2017). Effect of gibberellic acid (GA_3) on fruit yield and quality of Cape gooseberry (*Physalis peruviana* L.) A rajesh. *International Journal of Advanced Biological Research*, 7(4), 724-727.

16. Kumar, S., Singh, A.K. and Yadav, A.L. (2010).Effect of foliar application of GA_3, NAA, KNO_3 and borax on fruit quality of rainy season guava cv. L-49. *Plant Archives,* 10(1), 317-319.

17. Lal, G., Sen, N.L. and Jat, R.G. (2000).Yield and leaf nutrient composition of guava as influenced by nutrients.*Indian Journal of Horticulture*, 57(2), 130-132.

18. Lal, N., Das, R.P. and Verma, L.R. (2013).Effect of plant growth regulators on flowering and fruit growth of guava (*Psidium guajava* L.) cv. Allahabad Safeda. *Asian Journal of Horticulture*, 8(1), 54-56.

19. Lal, N. and Das, R.P. (2017).Effect of plant growth regulators on yield and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda. *International Journal of Current Microbiological Application in Science*, 6(5), 857-863.

20. Lenka, J., Acharya, G.C., Sahu, P., Dash, D.K., Samant, D., Panda, K.N. and Panda, R.K. (2019).Effect of foliar nutrition of micronutrients and plant growth regulators on yield and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda. *International Journal of Chemical Sciences*, 7(5), 1327-1333.

21. Lindner, R.C. (1944). Rapid analytical method for some of the more common inorganic constituents of plant tissues.*Plant physiology*, 19(1), 76-89.

22. Manivannan, M.I., Irulandi, S. and Shoba, K. (2015). Studies on the effect of pre-harvest application of plant growth regulators and chemicals on yield and quality of guava (*Psidium guajava* L.) cv. L-49. *International Journal of Agricultural Sciences*, 11(1), 138-140.

23. Nirmaljit, K., Josan, J.S., Monga, P.K. and Arora, P.K. (2005).Chemical regulation of over bearing in Kinnow mandarin.*Indian Journal of Horticulture*, 62(4), 396-397.

24. Osama, H.M., Amro, S.M., Saber, S. and Bakeer, M.M. (2015). Effect of growth regulator on fruiting and fruit quality of mango trees. cv. Keitt. *IOSR Journal of Agriculture and Veterinary Science*, 8(12), 87-95.

25. Pandey, V. (1999). Effect of 'NAA' and 'GA_3' spray of fruit retention, growth, yield and quality of ber*(Zizyphus mauritiana* Lamk.) cv. Banarasi Karaka. *The Orissa Journal of Horticulture,* 27, 69-73.

26. Parmar, J.M., Karetha, K.M. and Rathod, P.J. (2014). Effect of foliar spray of urea and zinc on growth and flowering attributes of guava (*Psidium guajava*) cv. Bhavanagar Red. *Advance Research iv Journal of Crop improvement*, 5(2), 140-143.

27. Prasad, H., Tomar, C.S., Kumari, M., Sajwan, P. and Solanki, S.P.S. (2017).Effect of 2, 4-D, urea, zinc sulphate and combinations on growth and nutrient status of the Kinnow mandarin. *International Journal of Chemical Studies*, 5(1), 167-170.

28. Rajput, R.P., Senjaliya, H.J., Vala, G.S. and Mangroliya, G.S. (2015). Effect of various plant growth regulators on yield and quality of guava (*Psidium guajava* L.) cv. L-49. *International Journal of Agriculture Science*, 11(1), 179- 82.

29. Ranganna, S., (1979).*Handbook of Analysis and Quality Control for Fruit and Vegetables Products*, 2nd Edn. Tata McGraw Hill Publication Company Limited, 7 West Patel Nagar, New Delhi,pp9- 10 and 105-106.

30. Sandeep, K and Amarjeet, K. (2017).Effect of growth regulators on yield and quality of winter guava cv. Allahabad Safeda. *International Journal of Advance Research*, 5(9), 98-103.

31. Sharma, J.R., Sharma, S.K., Panwar, R.D., Gupta, R.B. and Bhatia, S.K. (2009). Fruit retention, yield and leaf nutrient content of ber as influenced by foliar application of nutrients and growth regulators. *Haryana Journal of Horticultural Sciences*, 38(3/4), 203-206.

32. Singh, G. and Bons, H.K. (2020). Influence of naphthalene acetic acid on fruit setting, fruit quality and yield of sapota (*Manilkara achras* Mill.). cv. Kalipatti under subtropical conditions. *Indian Journal of Experimental Biology*,58(1), 661-666.

33. Suman, A., Singh, A.K., Kanth, N. and Kumar, A. (2021). Effect of foliar feeding of micronutrients and plant growth regulators on flowering and physical parameter of Guava (*Psidium guajava* L.) cv. Allahabad Safeda under agroecological: Condition of north Bihar. *The Pharma Innovation Journal*, 10(9), 483-486.

34. Tiwari, A.K., Saravanan, S. and Lall, D. (2017). Influence of different plant growth regulators on vegetative growth and physico-chemical properties of strawberry (*Fragaria x ananassa* duch) cv. chandler. *Plant Archives*, 17(1), 367-370.

35. Wali, P. and Sharma, O.S. (1997). Effect of soil and foliar application of zinc on yield and quality in Kinnow: A mandarin hybrid. *Haryana Journal of Horticultural Sciences*, 26, 213-215.

36. Yadav, S., Singh, J.P., Gupta, S. and Yadav, J.S. (2021). A study on foliar feeding of GA_3 and NAA on fruit drop, retention, yield and quality of ber fruit (*Ziziphus mauritiana* Lamk.) cv. "Banarasi Karaka". *Biological Forum – An International Journal*, 13(3), 608-612.