EFFECT OF FOLIAR APPLICATION OF VARIOUS MICRONUTRIENTS ON FRUIT YIELD AND QUALITY ATTRIBUTES OF GUAVA

(*Psidium guajava*) cv. Allahabad safeda

Abstract

The present investigation "Effect of foliar application of various micronutrients on fruit yield and quality attributes of Guava (*Psidium guajava*) cv. Allahabad safeda" was undertaken at Central Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2022-2023. The experiment was laid out in a Randomized Block Design (RBD) with 10 treatment combinations viz, T_0 (Control), T_1 ($FeSO_4$) 0.4%, T_2 ($ZnSO_4$) 0.5%, T_3 (H_3BO_3) 0.4%, T_4 (KNO_3) 3%, T_5 ($FeSO_4$) 0.4% + ($ZnSO_4$) 0.5%, T_6 ($ZnSO_4$) 0.5% + (KNO_3) 3%, T_7 (KNO_3) 3% + ($FeSO_4$) 0.4%, T_8 (H_3BO_3) 0.4% + (KNO_3) 3%, T_9 ($FeSO_4$) 0.2% + ($ZnSO_4$) 0.25% + H_3BO_3 (0.2%) +(KNO_3) 1.5% with three replications. **The main objective of the experiment was to find out the effect of various levels of micronutrients on yield and quality of guava and to estimate the economics of various treatments.** From the present investigation treatment T_9 ($FeSO_4$) 0.2% + ($ZnSO_4$) 0.25% + (H_3BO_3) 0.2% +(KNO_3) 1.5%, performed best in terms of yield parameters, (fruit weight (130.45g), fruit length (7.93cm), fruit diameter (7.28cm), fruit yield per tree (42.10 kg) and quality parameters T.S.S (10.23^0Brix), Acidity (0.38%), Ascorbic acid (150.03mg/100g), Total sugars (7.86%) of Guava. However, highest B: C ratio was found in Treatment T_5 ($FeSO_4$ (0.4%) +$ZnSO_4$ (0.5%) with 4.61.

***Keywords**: Micronutrients, Guava, Fruit yield, Quality attributes, foliar application*

1.Introduction

Guava (*Psidium guajava*) is a member of the Myrtaceae family and is native to tropical America. It is one of the most common and valuable fruit crops grown in the country's tropical and subtropical regions, and due to its hardiness, the trees can even be grown in marginal lands. Guava fruits are mostly produced in India, Brazil, Mexico, South Africa, Jamaica, Kenya, Cuba, the United States of America, Egypt, Thailand, Columbia, and Pakistan. Guava is the fifth most important fruit crop in India, following mango, citrus, banana, and apple. The major guava producing states are Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, Andhra Pradesh, Rajasthan, Gujarat, Karnataka, and Tamil Nadu**.** Uttar Pradesh, the largest producer, produces the highest quality fruits. However, the fruits are blemished due to their sensitive nature, and biochemical post-harvest alterations soften them, causing deterioration.

The Allahabad-Varanasi region is known for producing the highest quality guava in the country and outside the world. Guava fruit is noted for its "vitamin-C," minerals such as calcium, iron, and phosphorus, as well as its pleasant taste and flavor **Yadav *et al.* (2015)**, and its increased popularity has dubbed it "the apple of the tropics." Guava bears on the growth of the current season and flowers bloom in the axils of fresh leaves; therefore, it reacts well to pruning **Kumar and Rattanpal, (2010)**.

After mango, banana, citrus, and grapes, guava (*Psidium guajava L.*) is India's fifth most important commercial fruit crop. More than three dozen guava cultivars are planted in India, but 'Allahabad Safeda' leads the others due to its appealing fruit size, colour, higher quality, and postharvest life **Yadav *et al.* (2015).** Guava trees often flower twice a year in northern India. The first flowering occurs in April-May, yielding fruits during the rainy season (July-August), while the second flowering occurs in August-September, yielding fruits throughout the winter season (November-January)

Micronutrients like zinc sulphate are essential for the growth and development of fruits, vegetables, and cereals. It is a necessary component for the creation of chlorophyll and thus beneficial in photosynthesis. It is also found in certain enzymes. Zinc stimulates enzymes that are involved in the creation of some proteins. It is involved in the synthesis of chlorophyll and certain carbohydrates, the conversion of starches to sugars, and its presence in plant tissue aids the plant's resistance to low temperatures. Zinc is required for the synthesis of auxins, which aid in growth control and stem elongation.

Foliar application of micronutrients and plant growth regulators is critical for boosting plant quality and is comparatively more effective for rapid plant recovery. Foliar feeding of fruit trees has grown in popularity in recent years, as micronutrients supplied through soil require more micronutrients because some leak away and some become unavailable to the plant due to complicated soil reactions. The spray of micronutrients increases yield parameters such as average fruit weight, fruit length (cm), fruit diameter (cm), and fruit yield (kg/tree) **Awasthi and Lal (2009).**

2.Materials and methods

Experimental site

The experiment entitled **"Effect of foliar application of various micronutrients on fruit yield and quality attributes of Guava (*Psidium guajava*) cv. Allahabad safeda"** was conducted at central research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, during the year 2022-2023.

CLIMATE CONDITION IN EXPERIMENTAL AREA

This region has a sub-tropical climate prevailing in the South-East part of Uttar Pradesh with both the extremes in temperature, *i.e.*, the winter and the summer. In cold winters, the temperature sometimes is as low as 9^0C in December – January and very hot summer with temperature reaching up to 46^0C in the months of May and June. During winter, frosts and during summer, hot scorching winds are also common. The average rainfall is around 1013.4 (mm) with maximum concentration during July to September months with occasional showers in winters.

Table 1. TREATMENT DETAILS

S. No	Notation	Treatment Combination	1st foliar	2nd foliar

			spraying	spraying
1	T_0	**Control**	**flowering stage**	**fruit development stage**
2	T_1	$FeSO_4$ **(0.4%)**		
3	T_2	$ZnSO_4$ **(0.5%)**		
4	T_3	H_3BO_3 **(0.4%)**		
5	T_4	KNO_3 **(3%)**		
6	T_5	$FeSO_4$ **(0.4%) +** $ZnSO_4$ **(0.5%)**		
7	T_6	$ZnSO_4$ **(0.5%) +** KNO_3 **(3%)**		
8	T_7	KNO_3 **(3%) +** $FeSO_4$ **(0.4%)**		
9	T_8	H_3BO_3 **(0.4%) +** KNO_3 **(3%)**		
10	T_9	$FeSO_4$ **(0.2%) +** $ZnSO_4$ **(0.25%) +** H_3BO_3 **(0.2%) +** KNO_3 **(1.5 %)**		

NOTE - 1st foliar spraying during August at flowering stage and 2nd foliar spraying at fruit development stage during October.

2.4 Observations Recorded

Following are the observation that were observed during the experiment: -

- **Yield Parameters**

1. Fruit Weight (g)
2. Fruit length(cm)
3. Fruit Diameter(cm)
4. Fruit Yield(kg/tree)

- **Qualitative Parameters**

1. Total soluble solid (^{0}Brix)
2. Acidity (%)
3. Ascorbic acid (Vitamin-C)
4. Total sugars (%)

- **Economical Parameters**

1. Cost of cultivation (Rs. plant^{-1})
2. Gross return (Rs. plant$^{-1)}$
3. Net return (Rs. plant^{-1})
4. B.C Ratio

3.Results and Discussion

The present investigation entitled "Effect of foliar application of various micronutrients on fruit yield and quality attributes of Guava (*Psidium guajava*) cv. Allahabad safeda" was undertaken at central research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during the year 2022-2023. The experiment was conducted in randomized Block Design (RBD) with ten treatments and three replications. The mean data of all the traits were subjected to statistical analysis and salient features of experimental findings are mentioned below:

3.1: Yield Parameters

Fruit weight (g):

The Data relevant to fruit weight (g) is presented in the Table (2). The data shown that foliar application of various micronutrients have significant effect on fruit weight(g) as compare to control(T_0). T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum fruit weight (g) (130.45), which was followed by fruit weight (128.33) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), Whereas the minimum fruit weight (g) (81.36) was found in control $FeSO_4$, $ZnSO_4$, H_3BO_3, and KNO_3 micronutrients may have boosted guava fruit weight by promoting photosynthesis, improving nutrient availability, controlling hormones, and leveraging nutritional interactions, leading to optimal growth and development. **Awasthi and Lal (2009)** conducted an experiment on guava and reported that, maximum number of fruits per tree, yield, fruit length, fruit diameter and fruit weight with Zinc Sulphate @ I .5 and 2.0 % spray on guava tree. The similar effect were found by **Mishra *et al*., (2003)**, **Singh and Maurya (2003) and Sachin *et al*., (2019).**

Fruit length (cm):

The Data relevant to fruit length (cm) is presented in the Table (2). The data shown that foliar application of various micronutrients have significant effect on fruit length (cm) as compare to control (T_0). T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum fruit length(cm) (7.93), which was followed by fruit length (7.73) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), Whereas the minimum fruit length (cm) (6.78) was found in control. $FeSO_4$, $ZnSO_4$, H_3BO_3, and KNO_3 were applied as foliar micronutrients, and these micronutrients may have contributed to the lengthening of guava fruit by stimulating cell elongation, affecting hormonal control, enhancing plant health, and maybe gaining from synergistic interactions between them. **Ruby and Brahmachari (2001)** noted maximum fruit weight (22.00 g), fruit of volume (20.97 cm3), pulp weight per fruit (16.99 g), fruit length (3.90 cm) and least acidity (0.521%) with application of 0.5% $ZnSO_4$. Maturation period was earliest (13.50 days) with 0.8% Borax in litchi. The similar effect were found by **Awasthi and Lal (2009), Waskela *et al*., (2013) and Sachin *et al*., (2019).**

Fruit diameter (cm):

The Data relevant to fruit diameter (cm) is presented in the Table (2). The data shown that foliar application of various micronutrients have significant effect on fruit diameter (cm) as compare to control (T_0). T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum fruit diameter(cm) (7.28), which was followed by fruit length (7.10) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), Whereas the minimum fruit diameter (cm) (5.28) was found in control. By encouraging cell division and expansion, influencing hormonal regulation, improving nutrient uptake and metabolism, and possibly taking advantage of synergistic effects between the micronutrients, the foliar application of micronutrients such as FeSO4, ZnSO4, H3BO3, and KNO3 may have increased guava fruit diameter.**Awasthi and Lal (2009)** conducted an experiment on guava and reported that, maximum number of fruits per tree, yield, fruit length, fruit diameter and fruit weight with Zinc Sulphate @ I .5 and 2.0 % spray on guava tree. The similar effect were found by **Awasthi and Lal (2009), Singh *et al.* (2012), Sachin *et al.*, (2019) and Waskela *et al.*, (2013).**

Fruit yield per tree (kg):

The Data relevant to fruit yield per tree (kg) is presented in the Table (2). The data shown that foliar application of various micronutrients have significant effect on fruit yield per tree (kg) as compare to control (T_0). T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum fruit yield per tree (kg) (42.10), which was followed by fruit yield per tree (kg) (40.38) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), Whereas the minimum fruit yield per tree (kg) (9.93) was found in control. Micronutrients like $FeSO_4$, $ZnSO_4$, H_3BO_3, and KNO_3 that were applied topically probably enhanced the amount of guava fruit produced per tree (kg) by optimizing nutrient availability, boosting photosynthesis, regulating hormones, and strengthening overall plant health and stress resistance. **Awasthi and Lal (2009)** conducted an experiment on guava and reported that, maximum number of fruits per tree, yield, fruit length, fruit diameter and fruit weight with Zinc Sulphate @ I .5 and 2.0 % spray on guava tree. The similar effect were found by **Dashora *et al.* (2005), Prasad *et al.* (2005) and Singh *et al.* (2017).**

Table 2: Effect of various micronutrients on fruit weight (g), fruit length (cm), fruit diameter (cm) and fruit yield per tree (kg) of Guava:

Treatment notation	Treatment combinations	Fruit weight (g)	Fruit length (cm)	Fruit Diameter (cm)	Fruit yield per tree (kg)
T_0	Control	81.36	6.78	5.28	9.93
T_1	$FeSO_4$ (0.4%)	116.56	6.88	5.32	10.10
T_2	$ZnSO_4$ (0.5%)	106.28	7.66	6.02	15.23
T_3	H_3BO_3 (0.4%)	105.78	7.21	6.11	21.08
T_4	KNO_3 (3%)	124.91	7.02	6.14	26.01
T_5	$FeSO_4$ (0.4%) + $ZnSO_4$ (0.5%)	114.62	7.03	6.80	32.28
T_6	$ZnSO_4$ (0.5%) + KNO_3 (3%)	123.79	7.33	6.38	24.23
T_7	KNO_3 (3%) + $FeSO_4$ (0.4%)	108.05	7.42	6.93	36.01
T_8	H_3BO_3 (0.4%) + KNO_3 (3%)	128.33	7.73	7.10	40.38
T_9	$FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5 %)	130.45	7.93	7.28	42.10
	F-Test	**S**	**S**	**S**	**S**
	SE(d)	**14.627**	**0.384**	**0.697**	**11.828**
	C.D. at 0.5%	**4.625**	**0.121**	**0.220**	**3.740**
	CV	**0.128**	**0.052**	**0.110**	**0.459**

3.2: Qualitative Parameters

Total soluble solid (^{0}Brix):

The Data relevant to total soluble solid (^{0}Brix) is presented in the Table (3). The data shown that foliar application of various micronutrients have significant effect on total soluble solid (0Brix) as compare to control (T_0). Treatment T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum total soluble solid (0Brix) (10.23), which was followed by total soluble solid (0Brix) (9.93) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), Whereas the minimum total soluble solid (0Brix) (7.19) was found in control. Micronutrients like $FeSO_4$, $ZnSO_4$, H_3BO_3, and KNO_3 that were applied topically to guavas likely boosted total soluble solids (0Brix) by encouraging sugar buildup through improved nutrient uptake, balanced nutrition, and hormonal regulation. **El-Sherif *et al*. (2000)** concluded that treatment with potassium sulphate at 1 per cent, 2 (%) or 3 (%) and zinc sulphate at 0.5 per cent, 1 per cent or 2 per cent increased total soluble solids, ascorbic acid, reducing and total sugar with reduction in acid content of guava fruits. The similar effect were found by **Hasan and Jana (2000), Mishra *et al.*, (2003), Yadav *et al.* (2004) and Yadav *et al.* (2015).**

Acidity (%):

The Data relevant to acidity (%) is presented in the Table (3). The data shown that foliar application of various micronutrients have significant effect on acidity as compare to control (T_0). Treatment T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken minimum acidity (0.38). which was followed by to acidity (%) (0.40) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), whereas the maximum acidity (0.90) was found in control. By affecting nutritional balance, hormonal control, and metabolic processes, the foliar application of micronutrients including $FeSO_4$, $ZnSO_4$, H_3BO_3, and KNO_3 probably decreased the acidity (%) in guava. **El-Sherif *et al.* (2000)** concluded that treatment with potassium sulphate at 1 per cent, 2 (%) or 3 (%) and zinc sulphate at 0.5 per cent, 1 per cent or 2 per cent increased total soluble solids, ascorbic acid, reducing and total sugar with reduction in acid content of guava fruits. The similar effect were found by **Hasan and Jana (2000), Mishra *et al.*, (2003) and Singh *et al.* (2017).**

Ascorbic acid (mg / 100 g):

The Data relevant to Ascorbic acid (mg / 100 g) is presented in the Table (3). The data shown that foliar application of various micronutrients have significant effect on Ascorbic acid (mg / 100 g) as compare to control (T_0). Treatment T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum Ascorbic acid (mg / 100 g) (150.3). which was followed by to Ascorbic acid (mg / 100 g) (148.32) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), Whereas the minimum Ascorbic acid (mg / 100 g) (100.12) was found in control. Ascorbic acid (vitamin C) concentration in guava was probably raised by the foliar application of micronutrients such FeSO4, ZnSO4, H_3BO_3, and KNO_3 due to improved nutritional availability, enhanced antioxidant capabilities, and hormonal control. **Yadav *et al.* (2015)** find out the efficacy of foliar spray of micronutrients on physico-chemical characters and yield of guava fruit cv. Allahabad Safeda. The quality of fruits with respect to TSS, sugar and ascorbic acid were obtained maximum with the foliar spray of zinc sulphate + borax 06%. Therefore, obtained better yield and quality of winter season guava cv. Allahabad under Lucknow conditions. The similar effect were found by **Singh and Maurya (2003) and Venu *et al.* (2014).**

Total sugars (%):

The Data relevant to total sugars (%) is presented in the Table (3). The data shown that foliar application of various micronutrients have significant effect on total sugars (%) as compare to control (T_0). Treatment T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) was taken maximum total sugars (7.86), which was followed by total sugars (%) (7.77) in T_8 H_3BO_3 (0.4%) + KNO_3 (3%), whereas the minimum total sugars (%) (6.03) was found in control. By promoting photosynthesis, enhancing nutrient uptake and metabolism, and modulating hormones, the foliar application of micronutrients including $FeSO_4$, $ZnSO_4$, H_3BO_3, and KNO_3 probably boosted total sugars (%) in guava. **El-Sherif *et al.* (2000)** concluded that treatment with potassium sulphate at 1 per cent, 2 (%) or 3 (%) and zinc sulphate at 0.5 per cent, 1 per cent or 2 per cent increased total soluble solids, ascorbic acid, reducing and total sugar with reduction in acid content of guava fruits. The similar effect were found by **Ghosh and Besra (2000), Hasan and Jana (2000) and Singaram and Prabhu (2001).**

Table 3: Effect of various micronutrients on Total soluble solid (^{0}Brix), Acidity (%),

Treatment notation	Treatment combinations	Total soluble solid (^{0}Brix)	Acidity (%)	Ascorbic acid (mg / 100 g)	Total sugars (%)
T_0	Control	7.19	0.90	100.12	6.03
T_1	$FeSO_4$ (0.4%)	8.22	0.82	111.01	6.86
T_2	$ZnSO_4$ (0.5%)	8.84	0.68	116.03	6.01
T_3	H_3BO_3 (0.4%)	9.04	0.84	122.21	6.10
T_4	KNO_3 (3%)	9.08	0.93	126.26	6.64
T_5	$FeSO_4$ (0.4%) + $ZnSO_4$ (0.5%)	8.88	0.74	132.16	6.93
T_6	$ZnSO_4$ (0.5%) + KNO_3 (3%)	9.52	0.68	136.02	7.01
T_7	KNO_3 (3%) + $FeSO_4$ (0.4%)	9.77	0.70	145.24	7.24
T_8	H_3BO_3 (0.4%) + KNO_3 (3%)	9.93	0.40	148.32	7.77
T_9	$FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5 %)	10.23	0.38	150.03	7.86
	F-Test	S	S	S	S
	SE(d)	0.889	0.188	16.724	0.669
	C.D. at 0.5%	0.281	0.059	5.288	0.211
	CV	0.098	0.267	0.129	0.097

Ascorbic acid (mg / 100 g) and Total sugars (%) of Guava:

Economics

Maximum gross returns & Net Return (2105 Rs. $plant^{-1}$, 1623 Rs. $plant^{-1}$) respectively was recorded in treatment T_9 $FeSO_4$ (0.2%) + $ZnSO_4$ (0.25%) + H_3BO_3 (0.2%) + KNO_3 (1.5%) & maximum Cost: Benefit ratio (4.61) was recorded in treatment T_5 $FeSO_4$ (0.4%) +$ZnSO_4$ (0.5%) and the minimum Gross Return, Net Return & Cost: Benefit ratio (496.5 Rs. $Plant^{-1}$, 182.5 Rs. $Plant^{-1}$ & 1.58) respectively was recorded in treatment T_0 (Control).

CONCLUSION:

From the present investigation it is concluded that treatment T_9 ($FeSO_4$ (0.2%) + $ZnSO_4$(0.25%) + H_3BO_3 (0.2%) +KNO_3(1.5%) performed best in terms of yield parameters (fruit weight (130.45g), fruit length (7.93cm), fruit diameter (7.28cm), fruit yield per tree (42.10 kg) and quality parameters (T.S.S (10.23^{0}Brix), Acidity (0.38%), Ascorbic acid (150.03mg/100g), Total sugars (7.86%) of Guava.

However, highest B: C ratio was found in Treatment T_5 ($FeSO_4$ (0.4%) +$ZnSO_4$ (0.5%) with 4.61.

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