

Original Research Article

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A Study on Effect of Foliar Application of Micronutrients on Growth, Fruit Set and Yield of Guava Cv. Allahabad Safeda

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ABSTRACT

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The present experiment was carried out during July 2019 to December 2019 in Central horticulture research farm of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design with 15 treatment replicated thrice. The treatments were T₁ (control), T₂ (Copper sulphate @ 0.2 %), T₃ (Copper sulphate @ 0.4 %), T₄ (Ferrous sulphate @ 0.2 %), T₅ (Ferrous sulphate @ 0.4 %), T₆ (Zinc Sulphate @ 0.2 %), T₇ (Zinc Sulphate @ 0.4%), T₈ (CuSO₄ @ 0.2 % + FeSO₄ @ 0.2 %), T₉ (CuSO₄ @ 0.4 % + FeSO₄ @ 0.4 %), T₁₀ (CuSO₄ @ 0.2 % + ZnSO₄ @ 0.2 %), T₁₁ (CuSO₄ @ 0.4 % + ZnSO₄ @ 0.4 %), T₁₂ (FeSO₄ @ 0.2 % + ZnSO₄ @ 0.2 %), T₁₃ (FeSO₄ @ 0.4 % + ZnSO₄ @ 0.4 %), T₁₄ (CuSO₄ @ 0.2 % + FeSO₄ @ 0.2 % + ZnSO₄ @ 0.2 %), T₁₅ (CuSO₄ @ 0.4 % + FeSO₄ @ 0.4 % + ZnSO₄ @ 0.4 %). From the present investigation it is found that treatment T₁₁ (CuSO₄ @ 0.4% + ZnSO₄ @ 0.4%) was found superior in terms of Plant height, Crown height, plant girth and T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) was found superior in terms of number of flowers, number of fruit set percentage, number of fruit, average fruit weight, fruit yield per plant, length of fruit, width of fruit and pulp thickness.

Introduction

Guava (*Psidium guajava* L.) is an important fruit crop of tropical and sub-tropical region of the world. It belongs to the family Myrtaceae. It is classified under genus *Psidium* which contains 150 species, but only *Psidium guajava* has been exploited commercially. It is the fifth most important fruit in area after mango, citrus, banana, and apple and fifth most important fruit in production after banana, mango, citrus and papaya.

This fruit originated in tropical America and seems to have been growing from Mexico to Peru. The trees were domesticated more than 2000 years ago. It was spreaded rapidly through the worlds' tropics by Spanish and Portuguese soon after the discovery of the new world. Now it is cultivated in tropical and subtropical parts of several countries like India, Hawaii, Brazil, Mexico, Thailand, New Zealand, Philippines, Indonesia, China, Malaysia, Cuba, Sri Lanka, Venezuela, Australia, Burma, Myanmar, Israel, Pakistan and Bangladesh. India is the leading producer of guava in the world.

In India it has been introduced in early 17th century and gradually become a commercial crop all over the country particularly in Maharashtra, Uttar Pradesh, Karnataka, Bihar, Orissa, Punjab, Uttarakhand, Gujarat, Madhya Pradesh and West Bengal. Guavas produced in Prayagraj region of Uttar Pradesh are best in the world.

Guava (*Psidium guajava* L.) is an important tropical and commercial fruit rich in dietary fibre, calcium, phosphorus and iron. In India, guava occupies an area of 2.64 lakh hectares with annual production of 40.53 lakh tonnes and productivity 15.3 MT/ha (Horticultural Statistics at a glance, 2018). In Uttar Pradesh, the area under guava crop is 49.53 thousand hectares with total production of 9.28 lakh tonnes and productivity 18.75 MT/ha (Horticultural Statistics at a glance, 2018).

Guava claims superiority over several other fruits because of its commercial and nutritional values. It is a rich and cheap source of vitamin C and pectin (a polysaccharide substance) (Agnihotri *et al.*, 2002). It ranks third in vitamin C content (260 mg/100 g) after barbados cherry and aonla. Guava contains 2 to 5 times more vitamin C than fresh orange juice. Besides it, is an excellent source of pectin (0.5-1.8%) but has low energy (66 cal /100g).

The ripe fruits contain 12.3-26.3% dry matter, 77.9-86.9% moisture, 0.51-1.02% ash, 0.10-0.70% crude fat, 0.82-1.45% crude protein and 2.0-7.2% crude fiber. The fruit is also rich in minerals like phosphorus (22.5-40.0 mg/100g pulp), Calcium (10.0-30.0 mg/100g pulp) and Iron (0.60-1.39 mg/100g pulp) as well as vitamins like Niacin (0.20-2.32 mg/100g pulp), Panthotenic acid, Thiamine (0.03-0.07 mg/100 g pulp), Riboflavin (0.02-0.04 mg/100 g pulp) and vitamin-A (Mitra and Bose, 2001).

Guava has earned the popularity as “Poor man’s apple” available in plenty to every person at very low price during the season. It is no inferior to apple for its nutritive value. It is pleasantly sweet and refreshingly acidic in flavour and emits sweet aroma. It is wholly edible along with the skin. Several delicious preserved products like Jam, Jelly, Cheese, Puree, Ice cream, canned fruit and Sherbat are prepared from ripe fruits of guava. Guava juice wine and guava pulp wine are also prepared from guava fruits.

Guava does equally well under tropical and sub-tropical climatic conditions. Under tropical climate due to availability of continuous heat and humidity, it produces fruits almost continuously. However in subtropical climate, there are three distinct periods of growth and fruiting. These three distinct periods are, Ambe bahar- February to March flowering and fruit ripens in July-August, Mrig bahar- June to July flowering and fruit ripens October to December and Hasta bahar- October to November flowering and fruit ripens in February to April (Shukla *et al.*, 2008). In north Indian guava flowers twice is year, first in April-May for rainy season crop and then in August- September for winter season crop. The yield of guava fruit is higher in Rainy season but quality of fruit is poor due to higher water content, less vitamin C and sugars, fruit are insipid and do not keep well. However, winter season yield is less than rainy season guava but quality is better than rainy season guava.

Foliar application of fertilizer is advantageous over soil application. It helps in uniform distribution of fertilizers, low application rates and quick response to applied nutrients (Kumar *et al.*, 2015). Micronutrients like Fe, Cu and Zn are not only essential but also equally important like other macronutrients. These micronutrients help the plant uptake of major nutrients and play active roles in the

plant metabolism like cell wall development, photosynthesis, chlorophyll formation, enzyme activity, nitrogen fixation and oxidation-reduction reaction. Guava responds significantly to applied micronutrients, especially zinc (Zn), boron (B), copper (Cu) and Iron (Fe) for improving growth, yield and quality. Micronutrient especially Copper, Iron and Zinc are responsible for metabolic activities in fruit physiology. Application of micronutrients should be at first growth phase and before flowering.

Copper is one of the micronutrients needed in very small quantities by plants. Copper activates some enzymes in plants which are involved in lignin synthesis and it is essential in several enzyme systems. It is also required in the process of photosynthesis and assist in plant metabolism of carbohydrates and proteins.

Iron increases the chlorophyll content of leaves, reflecting the colour of leaves. Iron plays critical role in metabolic process such as DNA synthesis, respiration and photosynthesis.

Zinc takes part in chlorophyll synthesis, involved in biosynthesis of plant growth hormone and plays positive role in photosynthesis and nitrogen metabolism. Zinc is essential for auxin and protein synthesis, seed production and proper maturity. It also increase the fruit size as well as yield.

Materials and Methods

The Experiment was conducted in Randomized Block Design (RBD) with one control and 14 treatments at the central research farm of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences Prayagraj during 2019-2020. Total number of treatments were 14 + 1 *viz.* T₁ (control), T₂ (Copper sulphate @

0.2 %), T₃ (Copper sulphate @ 0.4%), T₄ (Ferrous sulphate @ 0.2 %), T₅ (Ferrous sulphate @ 0.4 %), T₆ (Zinc Sulphate @ 0.2 %), T₇ (Zinc Sulphate @ 0.4%), T₈ (CuSO₄ @ 0.2 % + FeSO₄ @ 0.2 %), T₉ (CuSO₄ @ 0.4 % + FeSO₄ @ 0.4 %), T₁₀ (CuSO₄ @ 0.2 % + ZnSO₄ @ 0.2 %), T₁₁ (CuSO₄ @ 0.4 % + ZnSO₄ @ 0.4 %), T₁₂ (FeSO₄ @ 0.2 % + ZnSO₄ @ 0.2 %), T₁₃ (FeSO₄ @ 0.4 % + ZnSO₄ @ 0.4 %), T₁₄ (CuSO₄ @ 0.2 % + FeSO₄ @ 0.2 % + ZnSO₄ @ 0.2 %), T₁₅ (CuSO₄ @ 0.4 % + FeSO₄ @ 0.4 % + ZnSO₄ @ 0.4 %).

Climatic condition in the experimental site

The area of Prayagraj district comes under subtropical belt in the south east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46° C-48° C and seldom falls as low as 4° C- 5° C. The relative humidity ranges between 20 to 94 %. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

Results and Discussion

The efforts have been made in this chapter to compare and interpret the result of various experiment carried out during the course of investigation with the findings of the other research works. The data recorded on various characters during “Mrig bahar” 2019-20, the course of investigation have been presented in this chapter along with table (Table 1). The present investigation entitled “A study on effect of foliar application of micronutrients on growth, fruit set, yield and quality of Guava Cv. Allahabad Safeda”. The experiment was conducted in Randomized Block Design with 1 control + 14 treatments, and three replications.

The results of the experiment are summarized below.

In terms of plant height, the maximum plant height was recorded in T₁₁ (CuSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (183.06 cm) followed by T₁₀ (CuSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (170 cm) and the minimum was recorded in T₁ (control) with (130.96 cm). This study is supported by the findings of Saha *et al.*, (2019), Singh *et al.*, (2018), Guvvali *et al.*, (2017) and Yadav *et al.*, (2017) who reported that application of CuSO₄ and ZnSO₄ shows the maximum vegetative growth of the plant viz. plant height.

In terms of crown height, the maximum crown height was recorded in T₁₁ (CuSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (117.20 cm) followed by T₁₀ (CuSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (107.76 cm) and the minimum was recorded in T₁ (control) with (77.70 cm). Singh *et al.*, (2018), Guvvali *et al.*, (2017) and Yadav *et al.*, (2017) who reported that application of Copper sulphate and Zinc sulphate shows the maximum vegetative growth of the plant viz. crown height.

In terms of plant girth the maximum plant girth was recorded in T₁₁ (CuSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (17.90 cm) followed by T₁₀ (CuSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (17.60 cm) and the minimum was recorded in T₁ (control) with (16.13 cm). This study substantiates with the studies of (Singh *et al.*, (2018), Guvvali *et al.*, (2017) and Yadav *et al.*, (2017) who reported that application of Copper sulphate and zinc sulphate shows the maximum vegetative growth of the plant viz. plant girth.

In terms of number of flowers the maximum numbers of flower per plant was recorded in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (89.00) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @

0.2%) with (82.00) which was superior over T₁ (control) with (54.00) number of flowers. This study affirms with the studies carried by Saha *et al.*, (2019), kumar *et al.*, (2017), Yadav *et al.*, (2017) and Venu *et al.*, (2014) who reported that application of CuSO₄ @ 0.4, FeSO₄ @ 0.4%, ZnSO₄ @ 0.4% shows the maximum number of flowers per plant.

In terms of number of fruit the maximum numbers of fruit per plant was recorded in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (62.00) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (56.00) which was superior over T₁ (control) with (29.00) number of fruit. This study is supported by the findings of Saha *et al.*, (2019), C.J. *et al.*, (2017) and Yadav *et al.*, (2017) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum number of fruits per plant.

In terms of fruit set percentage the maximum fruit set percentage was recorded in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (69.97) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (68.32) which was superior over T₁ (control) with (53.17). This study corroborates with the studies of Saha *et al.*, (2019), C.J. *et al.*, (2017) and yadav *et al.*, (2017) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum number of fruit set per plant.

In terms of fruit, weight the maximum fruit weight (g) was recorded in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (180.33 g) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (179.06 g) which was superior over T₁ (control) with (140.40 g). This study is supported by the findings of Saha *et al.*, (2019) and C.J. *et al.*, (2017) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum average fruit weight of fruit.

Table.1 Effect of different treatments on various parameters of Guava

Notation	Treatment combination	Plant height (cm)	Crown height (cm)	Plant Girth (cm)	No. of flowers per plants	Fruit set percentage	No. of fruit per plant	Average fruit weight (g)	Fruit yield/plant (g)	Length of fruit (cm)	Width of fruit (cm)	Pulp thickness (mm)
T ₁	Control	130.96	77.70	16.13	54.00	53.17	29.00	140.40	4,071.80	5.76	5.96	13.70
T ₂	Copper sulphate @ 0.2 %	155.33	102.80	16.53	61.00	55.83	36.00	154.33	5,547.50	6.26	6.36	14.23
T ₃	Copper sulphate @ 0.4 %	156.70	101.63	16.66	64.00	63.46	41.00	157.67	6,457.50	6.43	6.56	15.26
T ₄	Ferrous sulphate @ 0.2 %	154.03	96.86	16.33	62.00	63.80	37.00	147.40	5,458.20	6.13	6.03	14.20
T ₅	Ferrous sulphate @ 0.4 %	136.20	80.56	16.73	63.00	64.18	38.00	150.50	5,719.00	6.36	6.26	15.16
T ₆	Zinc Sulphate @ 0.2 %	146.96	87.40	17.03	70.00	63.03	43.00	164.33	7,066.50	6.66	6.63	16.66
T ₇	Zinc Sulphate @ 0.4 %	150.73	98.23	17.00	70.00	64.63	44.00	166.16	7,309.70	6.76	6.76	16.86
T ₈	CuSO ₄ @ 0.2 % + FeSO ₄ @ 0.2 %	169.86	106.13	16.86	64.00	63.06	39.00	154.40	6,009.90	6.53	6.53	15.70
T ₉	CuSO ₄ @ 0.4 % + FeSO ₄ @ 0.4 %	154.03	93.16	17.43	59.00	63.12	36.00	161.30	5,809.20	6.56	6.43	16.26
T ₁₀	CuSO ₄ @ 0.2 % + ZnSO ₄ @ 0.2 %	170.0	107.76	17.60	74.00	63.35	44.00	167.06	7,347.80	6.63	6.50	16.03
T ₁₁	CuSO ₄ @ 0.4 % + ZnSO ₄ @ 0.4 %	183.0	117.20	17.90	76.00	62.12	47.00	172.23	8,095.50	6.76	6.66	16.36
T ₁₂	FeSO ₄ @ 0.2 % + ZnSO ₄ @ 0.2 %	137.70	79.30	17.30	68.00	63.56	41.00	165.66	6,786.00	6.70	6.60	16.30
T ₁₃	FeSO ₄ @ 0.4 % + ZnSO ₄ @ 0.4 %	142.66	87.20	17.30	67.00	63.43	42.00	166.83	7,012.00	6.86	6.83	16.60
T ₁₄	CuSO ₄ @ 0.2 % + FeSO ₄ @ 0.2 % + ZnSO ₄ @ 0.2 %	143.03	88.20	16.86	82.00	68.32	56.00	179.06	10,024.40	7.14	7.06	17.10
T ₁₅	CuSO ₄ @ 0.4 % + FeSO ₄ @ 0.4 % + ZnSO ₄ @ 0.4 %	137.06	81.36	17.06	89.00	69.97	62.00	180.33	11,181.00	7.76	7.42	17.43
	CD	23.50	21.68	0.321	8.955	5.347	4.780	3.271	717.604	0.340	0.450	0.393
	SE (D)	11.41	10.53	0.156	4.349	2.597	2.322	1.589	348.525	0.165	0.218	0.191
	F-Test	S	S	S	S	S	S	S	S	S	S	S

In terms of fruit yield, the maximum fruit yield per plant (kg) was recorded in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (11,181.00 g) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (10,024.40 g) which was superior over T₁ (control) with (4,071.80 g). This study is in accordance with the studies of Saha *et al.*, (2019), C.J. *et al.*, (2017) and Yadav *et al.*, (2017) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum fruit yield per plant.

In terms of fruit length, the maximum fruit length was recorded in in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (7.76 cm) followed by T₁₅ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (7.14 cm) which was superior over T₁ (control) with (5.76 cm). This study substantiates with the studies of Saha *et al.*, (2019) and C.J. *et al.*, (2017) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum length of fruit.

In terms of fruit width, the maximum width of fruit was recorded in in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (7.42 cm) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (7.06 cm) which was superior over T₁ (control) with (5.96 cm). This study is supported by the findings of Saha *et al.*, (2019) and C.J. *et al.*, (2017) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum width of fruit.

In terms of pulp thickness, the maximum pulp thickness was recorded in T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) with (17.43 mm) followed by T₁₄ (CuSO₄ @ 0.2% + FeSO₄ @ 0.2% + ZnSO₄ @ 0.2%) with (17.10 mm) which was superior over T₁ (control) with (13.70 mm). This study is in accordance with the studies of (Tirkey *et al.*, (2018), Sau *et al.*, (2018) and Suman and

Tambe. (2015) who reported that application of CuSO₄, FeSO₄, ZnSO₄ shows the maximum pulp thickness of guava fruit.

On the basis of results obtained, It is concluded that the treatment T₁₁ (CuSO₄ @ 0.4% + ZnSO₄ @ 0.4%) found to be best in terms of plant height, plant crown, plant girth. On the basis of results obtained, It is concluded that the treatment T₁₅ (CuSO₄ @ 0.4% + FeSO₄ @ 0.4% + ZnSO₄ @ 0.4%) first flower opening, number of flower per plant, number of fruit per plant, fruit set percentage, fruit weight and yield per plant. Application foliar spray of micronutrients (CuSO₄, FeSO₄, ZnSO₄) become powerful tools to modify several physiological processes in plants which are extensively and profitably used in horticultural crops. They are also used for increasing plant growth and increase fruit yield per hectare.

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