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Siddharth Kumar
Department of Horticulture, R.S.M (PG) College Dhampur, Bijnor, Uttar Pradesh, India

SL Pal
Department of Horticulture, R.S.M (PG) College Dhampur, Bijnor, Uttar Pradesh, India

Ravi
Department of Soil Science & Agricultural Chemistry, R.S.M (PG) College Dhampur, Bijnor, Uttar Pradesh, India

Om Prakash
Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

Corresponding Author:
Om Prakash
Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh, India

Effect of micronutrients on growth, Phsyco-chemical and yield parameters in guava (*Psidium guajava* L.) cv. Lucknow-49

Siddharth Kumar, SL Pal, Ravi and Om Prakash

Abstract
Guava orchard experiment was conducted at Narseedwala village, tehsil Dhampur, district Bijnor (U.P.) during 2020-21. The trail consisting of sixteen treatment *viz*; T_1 (Borax @ 0.1%), T_2 (Zinc sulphate @ 0.3%), T_3 (Magnesium sulphate @ 0.2%), T_4 (Ferrous sulphate @ 0.2%), T_5 (Borax @ 0.1% + Zinc sulphate @ 0.3%), T_6 (Borax @ 0.1% + Magnesium sulphate @ 0.2%), T_7 (Borax @ 0.1% + Ferrous sulphate @ 0.2%), T_8 (Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2%), T_9 (Zinc sulphate @ 0.3% + Ferrous sulphate @ 0.2%), T_{10} (Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%), T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%), T_{12} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Ferrous sulphate @ 0.2%), T_{13} (Borax @ 0.1% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%), T_{14} (Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%), T_{15} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2%) and T_{16} control (water spray) sprayed at time of fruit set. Among different treatments, significantly maximum increase in annual shoot growth, plant height, stem girth, plant spread, number of fruit/plant, yield kg/plant and fruit quality of guava in terms were recorded in T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%).

Keywords: Guava cv.-Lucknow-49, borax, zinc sulphate, magnesium sulphate, ferrous sulphate

Introduction
Guava (*Psidium guajava* L.) belonged to family Myrtaceae is classified under genus *Psidium*, which contains 150 species, but only *Psidium guajava* has been exploited commercially. It is the native of Tropical America from where it was introduced in17th century in India by Portuguese people. After its introduction to India, it has adapted to India condition so well. Popularly known as 'Apple of Tropics', it is a tropical fruit but also grows very well under sub-tropical conditions. At present in India, it occupies nearly 268,000-hectare area with a production of 36.67 lakh tonnes and productivity 13.7 MT ha^{-1} (NHB, 2014). Guava fruit is considered as one of the delicious and luscious fruit. Nutritive value of guava is very high. Therefore, it is an ideal fruit for nutritional security. Guava is one the cheapest and good source of vitamin C and pectin. Guava fruit contain 82.5% water, 2.45% reducing sugars, 2.33% non-reducing sugars, 0.48% ash, 260mg/100g pulp vitamin C as well as good amount of iron, calcium and phosphorus. The composition of guava fruit varies with cultivars, stage of maturity and season. Nutrients to the plant can be made available by the basal as well as by the foliar application. The foliar feeding of fruit tree has gained much importance in recent years, as nutrients applied through soil are needed in higher quantity because some amount leaches down and some become unavailable to the plant due to complex soil reactions. Foliar application is based on the principle that the nutrients are quickly absorbed by leaves and transported to different parts of the plant to fulfill the functional requirement of nutrition. This method is highly helpful for the correction of element deficiencies to restore disrupted nutrient supply, overcome stress factors limiting their availability and it plays important role in improving fruit set, productivity and quality of fruit and recovery of nutritional and physiological disorders in fruit trees.

Materials and Methods
Guava fruit orchard experiment was situated at Narseedwala Village, Tehsil -Dhampur, District Bijnor (U.P.). Guava orchard experiment was conducted during 2020-2021. Geographically it is situated between 290 18' 21" N latitude and 780 34' 25" E longitudes,

elevation of about 230 m above mean sea level. The climate of the area is tropical, sub humid, characterized by three well defined season *viz*. Monsoon, winter and summer, south west monsoon rain starts normally at third week of June to fourth week of September. The average annual rainfall in the area 905 mm. The detail of treatments were as T_1 Borax (0.1%), T_2 Zinc Sulphate (0.3%), T_3 Magnesium Sulphate (0.2%), T_4 Ferrous Sulphate (0.2%), T_5 Borax +Zinc Sulphate (0.1% + 0.3%), T_6 Borax + Magnesium Sulphate (0.1% + 0.2%), T_7 Borax + Ferrous Sulphate (0.1% + 0.2%), T_8 Zinc Sulphate + Magnesium Sulphate (0.3% + 0.2%), T_9 Zinc Sulphate + Ferrous Sulphate (0.3% + 0.2%), T_{10} Magnesium Sulphate + Ferropus Sulphate (0.2% + 0.2%), T_{11} Borax + Zinc Sulphate + Magnesium Sulphate + Ferrous Sulphate (0.1% + 0.3% + 0.2% + 0.2%), T_{12} Borax + Zinc Sulphate + Ferrous Sulphate (0.1% + 0.3% + 0.2%), T_{13} Borax + Magnesium Sulphate + Ferrous Sulphate (0.1% + 0.2% + 0.2%), T_{14} Zinc Sulphate + Magnesium Sulphate + Ferrous Sulphate (0.3% + 0.2% + 0.2%), T_{15} Borax + Zinc Sulphate + Magnesium Sulphate (0.1% + 0.3% + 0.2%) and T_{16} control (water spray) with pomegranate cultivar-Bhagwa. The statistical analysis of the data in respect of growth, yield and fruit quality attributes was done according to the standard procedure given for Randomized Block Design by panse and Sukhatme (1985). Critical difference was calculated at 5 per cent level of significance.

Results and Discussion

The Guava shoots were treated with micronutrients concentrations which significantly influenced after application of treatments. Highest annual shoot growth (59.00 cm) was observed under T_{11} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) which was statistically at par with treatment T_{14} (Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) and T_{12} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Ferrous Sulphate @ 0.2%) having values 58.12 cm and 57.38 cm, respectively. Minimum annual shoot growth (35.03 cm) was observed under treatment T_{16} (control).

Examination of data reveals that plant height was significantly affected by different micronutrient treatments during the course of study. The maximum increase in plant height (22.19%) was observed in T_{11} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Magnesium @ 0.2% + Ferrous Sulphate @ 0.2%) followed by T_{14} (Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%), T_{12} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Ferrous Sulphate @ 0.2%) whereas, the minimum increase in plant height (11.66%) was recorded in T_{16} (control).

It evident that the application of micronutrients and their combination they caused significant effect on increase in stem girth during the study period. The maximum increase in stem girth (15.78%) was recorded in T_{11} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%), which was statistically at par with T_{14} (Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) and T_{12} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Ferrous Sulphate @ 0.2%) whereas, the minimum increase in stem girth (8.67%) was recorded in T_{16} (control).

It is evident that the application of different concentration of borax, zinc sulphate, magnesium sulphate and ferrus sulphate alone as well as their combination exerted a significant increase in plant spread in guava cultivar Lucknow-49 over the control. The maximum in plant spread (35.23%) was observed in T_{11} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) followed by T_{14} (Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous @ 0.2%), T_{12} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Ferrous Sulphate @ 0.2%) whereas, the minimum increase in plant spread (18.23%) was recorded in T_{16} (control).

The application of different micronutrients and their combination exerted a significant effect on increase in number of fruits/plant. The maximum number of fruits per plant (48.66) was recorded under treatment T_{11} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) which was statistically at par with T_{14} (Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) and T_{12} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Ferrous Sulphate @ 0. 2%).The minimum number of fruits per plant (38.00) was recorded under treatment T_{16} (control).

The maximum fruit yield (10.64kg/tree) was observed under T_{11} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous suphate @ 0.2%) which was statistically at par with T_{14} (Zinc Sulphate @ 0.3% + Magnesium Sulphate @ 0.2% + Ferrous Sulphate @ 0.2%) and T_{12} (Borax @ 0.1% + Zinc Sulphate @ 0.3% + Ferrous Sulphate @ 0.2%) whereas, the minimum fruit yield (5.22kg/tree) was recorded in treatment T_{16} (control).

The different micronutrients application exhibited a significant influence on fruit length during the course of study. Maximum fruit length (68.96 mm) was recorded in T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) whereas, the minimum fruit length (53.40 mm) was observed treatment T_{16} (control).

The fruit breadth as influenced by different micronutrients application. The maximum fruit breadth (71.58 mm) was recorded in T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) which was statistically at par with (69.04 mm) T_{14} (Zinc sulphate @ 0.3@% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) whereas, the minimum fruit breadth (58.57 mm) was recorded under treatment T_{16} (control).

The application of micronutrients exerted significant influence on fruit weight (g) during the course of study. The perusal of data reveals that different micronutrients application had a significant effect on fruit weight ranged from 212.46 g. (T_{11}) – 131.82 g. (T_{16}). Maximum fruit weight (212.46 g) was recorded in T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) whereas, the minimum fruit weight (131.82 g) was recorded in treatment T16 (control) which was lower significantly lower than all other treatments.

It is evident from the data that the application of micronutrients exerted a significant influence on total soluble solid contents of fruits. Maximum total soluble solids (11.85 ^{0}B) were recorded in fruits of the plant's treatment with T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrus sulphate @ 0.2%) which was statistically at par with (11.10 ^{0}B) T_{14} (Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrus sulphate @ 0.2%) and (10.65 ^{0}B) T_{12} (Borax @ 0.1% + Zinc sulphate @ 0.3% +

Ferrus sulphate @ 0.2%) whereas, the minimum total soluble solids (7.85) were observed treatment T16 (control). The data on effect of different micronutrients and their combinations on titratable acidity indicate that the highest titratable acidity (0.53%) was recorded under T_{16} (control) which was statistically similar with treatment T_8 (Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2%). Minimum titratable acidity (0.32%) was found in treatment T_{11} (Borax @ 0.1% + Zinc sulphate 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%).

The data analysis pertaining to total sugars indicate that different micronutrients application significantly affected of guava. Highest total sugars (7.60%) were registered in T_{11} (Borax @ 01.% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) followed by (7.10%) with T_{14} (Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) and (6.60%) T_{12} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Ferrous sulphate @ 0.2%). While, lowest total sugars (4.96%) were recorded under treatment T_{16} (control)

The application of micronutrients exerted significant influence on reducing sugars during the course of study. Highest reducing sugars (4.53%) was induced in fruits under T_{11} (Borax @ 0.1% + Zinc sulphate @ 0.3% + Magnesium sulphate @ 0.2% + Ferrous sulphate @ 0.2%) followed by (4.21%) T_{12} (Borax @ 0.1% + Zinc sulphate 0.3% + Ferrous sulphate @ 0.2%). While, lowest reducing sugars (2.85%) was recorded with T_{16} (control).

Table 1: Effect of micronutrients on growth, yield parameters in guava (*Psidium guajava* L.) cv. Lucknow-49

Treatments detail	Annual shoot growth (cm)	Increase in plant height (%)	Increase in stem girth (%)	Increase in plant spread (%)	Number of fruits/plant	Fruit length (mm)	Fruit breadth (mm)	Fruit weight (g.)	TSS (^{0}B)	Titratable acidity (%)	Reducing sugars (%)	Total sugars (%)	Yield kg/tree
T_1-Borax	41.58	15.95	9.63	31.08	43.00	57.08	60.32	155.18	9.86	0.45	3.29	5.58	6.94
T_2-Zinc sulphate	44.07	18.00	11.64	27.23	44.66	58.00	60.31	151.64	9.76	0.45	3.46	5.98	6.46
T_3-Magnesium sulphate	43.80	16.85	10.33	28.35	43.00	57.83	61.84	154.89	9.56	0.48	3.30	5.60	6.53
T_4-Ferrous sulphate	41.35	16.18	11.44	27.13	42.33	53.92	57.92	131.80	9.36	0.51	3.08	5.44	5.66
T_5-Borax + Zinc sulphate	50.18	18.10	11.92	29.50	43.33	54.09	62.19	163.83	8.83	0.50	4.22	6.20	7.23
T_6-Borax + Magnesium sulphate	50.43	17.12	11.22	27.95	46.33	55.19	64.56	183.06	10.13	0.41	4.16	5.52	8.73
T_7-Borax + Ferrous sulphate	47.14	17.33	12.72	28.59	44.33	56.34	62.57	163.74	9.94	0.39	4.21	5.35	7.26
T_8-Zinc sulphate + Magnesium sulphate	51.03	19.65	13.50	31.29	46.66	57.54	64.12	201.03	10.39	0.52	3.40	6.54	9.60
T_9-Zinc sulphate + Ferrous sulphate	53.09	18.12	13.03	31.62	45.66	56.48	63.62	203.66	8.97	0.44	4.23	6.00	9.24
T_{10}-Magnesium sulphate + Ferrous sulphate	46.36	17.94	13.11	30.18	46.33	57.45	62.88	182.82	9.59	0.45	3.90	5.96	8.61
T_{11}-Borax + Zinc sulphate + Magnesium sulphate + Ferrous sulphate	58.12	22.19	15.78	35.23	48.66	68.96	71.58	212.46	11.85	0.32	4.53	7.60	10.64
T_{12}-Borax + Zinc sulphate + Ferrous sulphate	56.47	20.54	14.75	33.26	47.00	63.20	69.04	197.90	10.65	0.50	4.21	6.60	9.21
T_{13}-Borax + Magnesium sulphate + Ferrous sulphate	55.66	19.20	14.50	32.79	46.33	62.36	67.76	188.66	9.84	0.36	4.00	5.35	8.80
T_{14}-Zinc sulphate + Magnesium sulphate + Ferrous sulphate	57.38	20.90	15.38	33.70	47.33	66.37	70.50	205.33	11.10	0.41	4.11	7.10	9.75
T_{15}-Borax + Zinc sulphate + Magnesium sulphate	55.21	20.16	14.66	33.10	46.00	61.82	67.74	183.21	10.25	0.36	3.90	5.40	8.55
T_{16}-Control	35.03	11.66	8.67	18.23	38.00	53.40	58.57	131.82	7.85	0.53	2.85	4.96	5.22
SE(m)±	0.63	0.39	0.44	0.50	0.57	0.44	0.83	1.35	0.46	0.01	0.12	0.16	0.40
CD at 5%	1.85	1.15	1.28	1.47	1.67	1.28	2.41	3.94	1.34	0.04	0.35	0.48	1.16

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