

## **Original Research Article**

### **Effect of foliar spray of micro - nutrients on fruit growth and yield of guava (*Psidium guajava* L.) cv. Lalit**

Comment [I1]: delete

#### **ABSTRACT**

**Aim:** To examine the Effect of foliar spray of micro - nutrients on fruit growth and yield of guava (*Psidium guajava* L.) cv. Lalit

**Study design:** The experimental design Randomized Block Design (RBD).

**Place and Duration of study:** An experiment was carried out during Hasth Bahar flowering seasons of 2021-22 and 2022-23 at Horticulture Research Farm of Babasaheb Bhimrao Ambedkar University.

**Methodology:** There were nineteen treatments with three replications. The variety selected for experiment was Lalit.

Comment [I2]: s

**Result:** However, foliar application of Borax 0.2%+Zinc 0.4% was found to be the best treatment in improving the morphological characteristics of guava such as fruit length (8.59 cm), fruit width (8.6cm), fruit volume (169.09 cm), fruit weight (174.99 g), peel weight (17.13g), pulp weight (155.32g), number of seed per fruit (212.49), seed weight per fruit (2.53g), seed weight kg per plant (1.23 kg), pulp and seed ratio (61.29) and specific gravity (1.03 g cc<sup>-1</sup>) of guava fruit.

Comment [I3]: delete

**Conclusion:** On the basis of the result obtained in the present investigation, it is concluded that the combined foliar application of Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) found superior. Therefore combined spray Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) can be advocated to guava growers for maximum growth and yield parameters of guava.

Comment [I4]: add

Comment [I5]: add

**Keyword:** Lalit, Foliar Application, Morphological Characters, Micro-Nutrient, Guava.

#### **INTRODUCTION**

The tropical fruit crop known as guava (*Psidium guajava* L.) is a member of the *Myrtaceae* family. There are roughly 150 species in there (Hayes, 1970). Its natural range is tropical America, from Mexico to Peru. As a fruit crop, it has progressively gained economic importance throughout several countries. Early in the 17<sup>th</sup> century, it was brought to India, where it has since spread as a commercial crop. Guava is mostly grown in Uttar Pradesh, Madhya Pradesh, Bihar, Gujarat, Karnataka, Andhra Pradesh, and Maharashtra in India. Cultivated approximately two thousand years ago, the trees quickly spread over the world's tropical regions following the Spanish and Portuguese exploration of the new continent. Nowadays, it may be found in many countries' tropical and subtropical areas, including Australia, Israel,

Comment [I6]: superscript

Pakistan, Bangladesh, Burma, Myanmar, New Zealand, Philippines, China, Malaysia, Cuba, Sri Lanka and Venezuela. India is the world's top producer of guava. Total cultivated area is 350 thousand hectares, with an annual production of 5327 thousand MT (Ministry of Agriculture and Farmer's Welfare, 2022-2023) and a productivity of 15.22 metric tones per ha. Due to their adaptability and ability to grow in both poorly drained and poorly alkaline soil, guavas are notable fruits. It grows well in soil that has a pH between 4.5 and 8.5 without watering. Temperatures above 46°C are no match for it. State that guavas grow well in both tropical and subtropical regions (Garur *et al.* 2016). After Barbados cherry (1000–4000 mg/100 g pulp) and Aonla (600 mg/100 g fruit), guava fruit has the third-highest vitamin C content (200–300 mg/100 g of fruit pulp) (Yadav *et al.*, 2011). The guava flowering season occurs naturally in three distinct periods: February-March (Ambe Bahar), June-July (Mrig Bahar), and October-November (Hasth Bahar). The corresponding harvest occurs throughout the rainy, winter, and spring seasons, respectively (Mishra *et al.*, 2020). To find out the effect of foliar micronutrient use on the physical characteristics of winter-season guava (*Psidium guajava* L.) cv. Lalit, a current study was carried out.

Comment [17]: Reference missed

The significance of micronutrients in plant metabolism and the negative consequences of their lack make them a major factor in crop output. They play a significant part in determining the quality and shelf life of harvested vegetables, a phenomena that has traditionally received less attention (Raja, 2009). Applying micronutrients through foliar spraying is possible. Because plants only need trace amounts of it, it is more safely which the leaf's stomata are able to absorb and occasionally via the cuticles. As a way of absorbing availability of nutrients via the leaf's stomata is much more quickly than via roots, this is the technique preferred source to supply plants (Stiles, 1982). In order for the fruit sector to remain competitive in both domestic and international markets, producing fruit of a high standard is becoming increasingly difficult. Thus, the new technology that might be used to produce guava of outstanding quality is the foliar management of micronutrients. According to Singh and Chhonkar (1983), guava responds well to applied micronutrients, especially zinc (Zn), boron (B), copper (Cu), and iron (Fe), which improve growth, production, and fruit quality. The creation of auxin, which promotes cell division and development, requires zinc. Guava bronzing is a serious nutritional condition brought on by a zinc deficiency. For pollen germination and pollen tube expansion, which increase the proportion of fruit setting, boron is far more necessary. For photosynthesis to occur, copper is necessary. Iron is necessary for plants to synthesize chlorophyll and to activate a number of enzymes. Thus, in the subtropical humid agroclimate zone of Utter Pradesh, the aim of the current experiment was to ascertain the effectiveness of micronutrients on plant growth, physicochemical quality of fruits, yield, and yield attributing factors of young guava plants.

## MATERIALS AND METHODS

The current research investigation entitled "Effect of foliar spray of micro-nutrients on fruit growth, yield and quality of guava (*Psidium guajava* L.) cv. Lalit was conducted at Horticulture Research Farm-1 of Department of Horticulture, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar, Rae Bareilly Road, Lucknow-226025 (U.P.), India during the year 2021-2022. The soil of the experiment field was medium black with good drainage and uniform texture with medium NPK status. The detail

treatment was Control (T<sub>1</sub>), Borax 0.1% (T<sub>2</sub>), Borax 0.2% (T<sub>3</sub>), Zinc 0.2% (T<sub>4</sub>), Zinc 0.4% (T<sub>5</sub>), Copper Sulphate (CuSO<sub>4</sub>) 0.2% (T<sub>6</sub>), Copper Sulphate (CuSO<sub>4</sub>) 0.3% (T<sub>7</sub>), Borax 0.1%+Zinc 0.2% (T<sub>8</sub>), Borax 0.1%+Zinc 0.4% (T<sub>9</sub>), Borax 0.2%+Zinc 0.2% (T<sub>10</sub>), Borax 0.2%+Zinc 0.4% (T<sub>11</sub>), Borax 0.1%+Copper Sulphate (CuSO<sub>4</sub>) 0.2% (T<sub>12</sub>), Borax 0.1%+Copper Sulphate (CuSO<sub>4</sub>) 0.3% (T<sub>13</sub>), Borax 0.2%+ Copper Sulphate (CuSO<sub>4</sub>) 0.2% (T<sub>14</sub>), Borax 0.2%+ Copper Sulphate (CuSO<sub>4</sub>) 0.3% (T<sub>15</sub>), Zinc 0.2%+ Copper Sulphate (CuSO<sub>4</sub>) 0.2% (T<sub>16</sub>), Zinc 0.2%+ Copper Sulphate (CuSO<sub>4</sub>) 0.3% (T<sub>17</sub>), Zinc 0.4%+ Copper Sulphate (CuSO<sub>4</sub>) 0.2% (T<sub>18</sub>), Zinc 0.4%+ Copper Sulphate (CuSO<sub>4</sub>) 0.3% (T<sub>19</sub>) were sprayed. The first spraying of micro-nutrients were done before flowering (first week of October) and second after fruit set (second week of November) during 2021 and November 2022. The experiment was conducted on well-established orchard of 18 years old Lalit guava trees which are planted at 6.0 × 6.0 m spacing. The experiment was laid out in R.B.D. with three replications. All minerals were applied through foliar feeding. Observation was recorded for fruit size (length and width), weight, volume, specific gravity, peel weight, pulp weight, no. of seeds per fruit, seed weight per fruit, seed weight per plant, pulp seed ratio and yield. Following the steps outlined by Panse and Sukhatme (1985), the parameters were statistically analyzed using the suitable model of analysis of variance (ANOVA). Using the "F-test" (variation ratio), the significance of the treatment effect was calculated.

#### Method for preparation of nutrient solution

The solutions (including borax, zinc, and copper sulphate) were made in accordance with the necessary nutritional concentrations. Using a balance, the necessary amount of nutrients was measured and then dissolved in distilled water in a measuring cylinder to make a volume of 10 liters.

#### Methods of foliar spray

First spraying of micro-nutrients were done before flowering (first week of October) and second after fruit set (second week of November) during 2021-22.

#### Fruit length (cm)

When the fruit reached the maturity/harvesting stage, its length was measured. The fruit length was measured with calibrated Vernier Callipers and expressed in centimeters. The average fruit length of the ten fruits that were taken from the tagged branches was measured.

#### Fruit width (cm)

When the fruit reached maturity or the harvest stage, the width was measured. With the aid of calibrated Vernier Callipers, the fruit width was measured in centimeters. The average fruit width of the ten fruits that were taken from the tagged branches was measured.

#### Volume of the fruit

Using the water displacement method, the fruit's volume was calculated and expressed in cc.

#### Weight of the fruit (g)

Comment [18]: add

Comment [19]: was

Comment [110]: add

Comment [111]: delete

Comment [112]: were

At the point of full maturity, the average fruit weight was measured. The top loading electrical balance was used to weigh the ten fruits that had been tagged from the branches, and the average fruit weight was recorded in grams.

#### **Pulp weight (g)**

After the pulp was removed from the fruits, its average weight was calculated using physical balance and recorded in grams.

#### **Pulp: seed ratio**

The pulp to seed ratio was computed using the following formula once the pulp and seed had been removed from the fruit individually:

Pulp: seed ratio = pulp weight (g)/ stone weight (g)

#### **Seed number per fruit**

The chosen fruits were placed in water for a few days, after which the seeds were taken out and counted.

#### **Seed weight per fruit (g)**

The seed is weighed individually once the pulp has been removed.

#### **Specific gravity (w/v)**

By dividing the fruit's weight by its volume, the specific gravity was determined.

### **RESULTS AND DISCUSSION**

The data on pooled mean basis is presented in Table 1 and graphically illustrated in Fig.1. The result of present study indicated that the combined application of Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) produced the fruits with larger size in respect of fruit length (8.59 cm), width (8.63 cm) volume (169 cm), weight (174 cm), the maximum fruit pulp weight (155.32gm) and peel weight (17.13 g) which was statistically at par with Borax 0.2%+Zinc 0.2% (T<sub>10</sub>). The minimum Fruit fruit length (5.69 cm), width (6.17 cm), volume (108.07 cm), weight (98.40 cm), the minimum fruit pulp weight (68.48 g) and peel weight (25.38 g) which was found in control (T<sub>1</sub>).Fruit size increased as a result of increased cell division and growth rates as well as increased intercellular space from the use of growth agents at greater concentrations. The guava fruit's increased size is caused by endogenous auxin. The fruit's explosive growth occurred with the highest concentration of auxin possible. Guava fruits have grown bigger and more rounded, possibly as a result of a combination of micronutrients (copper, zinc, and boron) that appear to directly speed up the process of cell elongation and division, which would have boosted fruit size and weight. The results are in conformity with those reported by guava (Sachin *et al.*, 2019). Similar results have also been reported by Rajput and Chand (1976), Singh *et al.*, (2004), and Pal *et al.*, (2008) in guava.

Comment [I13]: in

Comment [I14]: Reference missed

Minimum no. of seed per fruit (212.49), seed weight (2.53 g) were recorded in the treatment of Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) followed by Borax 0.2%+Zinc 0.2% (T<sub>10</sub>). The maximum seed no. of seed per fruit (379.16), weight (4.53 g) and peel weight (25.38 g) were observed in the harvested from untreated plants

(Table 2 and Fig 1). The pulp/seed ratio (61.29) were observed in Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) spray treatment followed by Borax 0.2%+Zinc 0.2% (T<sub>10</sub>). Where minimum fruit pulp weight (68.48 g) and pulp/seed ratio (15.08) were observed in control (Table 2 and Fig 1). Pulp /seed ratio is the ratio between the weight of pulp and weight of seed. The pulp weight depends on the fruit and seed size, but is affected by the plant nutrition. Boron produced fruits with smaller seed. This may be due to their involvement in IAA metabolism which reduces seed size. The decrease in seed weight may be due to the fact that auxins induced parthenocarpic effect to some extent there by results lesser seed weight. It pertains to the fact that application of boron enhanced the pulp weight and reduced the seed weight which as a consequence gave high pulp/seed ratio. The results are in close conformity with the finding of Kaur, S. (2017) in litchi Adak *et al.*, (2013) in apricot, Meena *et al.*, (2005) in guava, Kumar *et al.*, (2017) in anola and support the present result.

Comment [I15]: Table 2 not added in the paper

The data pertaining to specific gravity of guava as presented in Table 2 and Fig.1. Clearly indicated that the foliar application of growth regulators and nutrients significantly increased specific gravity of guava fruit over control (T<sub>1</sub>) The critical observation of the data showed that maximum specific gravity (1.03) was found in treatment Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) followed by (1.02) Borax 0.2%+Zinc 0.2% (T<sub>10</sub>). The minimum specific gravity was noticed in control (T<sub>1</sub>) The results are in close conformity with the finding of Banik *et al.*, (1997) in mango.

Comment [I16]: Reference missed

Comment [I17]: Table 2 not available in the paper

A perusal of pooled mean basis data in Table 2 and Fig.1 show that significantly response in the fruit yield was found in treated plants as compared to control the maximum fruit yield (85.50 kg per tree) was recorded in Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) followed by Borax 0.2%+Zinc 0.2% (T<sub>10</sub>). While minimum fruit yield was recorded in control (T<sub>1</sub>). The fruit yield increased gradually with the increase in the dose of combined foliar spray of zinc sulphate, borax, and copper sulphate. This is because plants receive boron from the borax treatment. By forming a complex molecule, boron was thought to cause the inactivation of unnecessary growth hormone. It is uncertain if this element had a direct or indirect impact on the improved physiological activities of the plant after it was discharged. Fruit from these actions will eventually have greater length and breadth, which will increase fruit production. Further findings showed that applying both nutrients (B & Zn) at the same time improved the fruit production. It may be the result of a considerable rise in fruit length, fruit diameter, and seed cavity diameter, which may be related to their stimulatory influence on auxins synthesis and plant metabolism. These results are in close conformity with the finding of Kumar *et al.*, (2019) in guava.

Comment [I18]: Delete

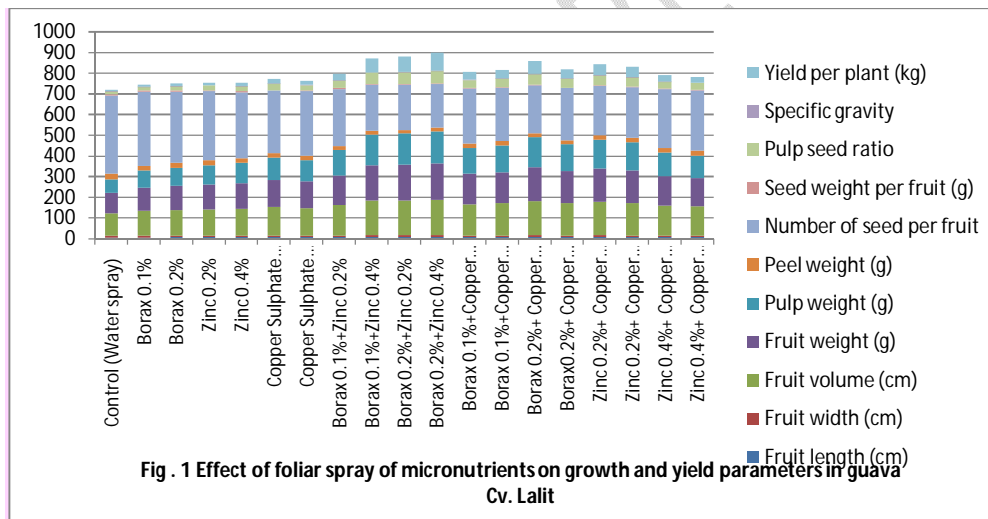
**Table 1. Effect of foliar spray of micronutrients on growth and yield parameters in guave****Cv. Lalit**

Comment [I19]: add

Treatments	Fruit length (cm)	Fruit width (cm)	Fruit volume (ml)	Fruit weight (g)	Pulp weight (g)	Peel weight (g)
Control (Water spray) - T <sub>1</sub>	5.690	6.177	108.077	98.403	68.487	25.385
Borax 0.1% - T <sub>2</sub>	6.007	6.363	120.570	110.977	83.173	23.505
Borax 0.2% - T <sub>3</sub>	6.257	6.530	124.790	115.460	88.503	22.820
Zinc 0.2% - T <sub>4</sub>	6.440	6.703	128.257	119.947	93.583	22.360
Zinc 0.4% - T <sub>5</sub>	6.567	6.840	130.313	123.170	97.257	22.075
Copper Sulphate (CuSO <sub>4</sub> ) 0.2% - T <sub>6</sub>	6.780	7.080	138.333	132.130	107.227	21.300
Copper Sulphate (CuSO <sub>4</sub> ) 0.3% - T <sub>7</sub>	6.673	6.923	134.207	127.537	102.123	21.685
Borax 0.1%+Zinc 0.2% - T <sub>8</sub>	7.200	7.533	147.563	143.893	121.177	19.420
Borax 0.1%+Zinc 0.4% - T <sub>9</sub>	8.210	8.400	166.747	169.223	148.890	17.640
Borax 0.2%+Zinc 0.2% - T <sub>10</sub>	8.383	8.533	167.667	171.837	151.853	17.375
Borax 0.2%+Zinc 0.4% - T <sub>11</sub>	8.593	8.637	169.093	174.990	155.323	17.130
Borax 0.1%+Copper Sulphate (CuSO <sub>4</sub> ) 0.2% - T <sub>12</sub>	7.340	7.700	150.513	147.500	124.913	19.395
Borax 0.1%+Copper Sulphate (CuSO <sub>4</sub> ) 0.3% - T <sub>13</sub>	7.470	7.830	153.870	151.580	129.340	19.160
Borax 0.2%+ Copper Sulphate (CuSO <sub>4</sub> ) 0.2% -T <sub>14</sub>	8.057	8.280	164.157	164.957	144.143	18.030
Borax0.2%+ Copper Sulphate (CuSO <sub>4</sub> ) 0.3% - T <sub>15</sub>	7.637	7.947	155.190	153.637	131.833	18.800

Comment [I20]: table data must be in two decimals

Zinc 0.2%+ Copper Sulphate (CuSO4) 0.2% - T <sub>16</sub>	7.983	8.143	161.023	161.023	139.913	18.250
Zinc 0.2%+ Copper Sulphate (CuSO4) 0.3% - T <sub>17</sub>	7.860	7.993	157.290	157.290	135.813	18.540
Zinc 0.4%+ Copper Sulphate (CuSO4) 0.2% - T <sub>18</sub>	7.050	7.377	145.123	140.063	116.463	20.200
Zinc 0.4%+ Copper Sulphate (CuSO4) 0.3% - T <sub>19</sub>	6.917	7.217	140.627	135.727	111.703	20.505
C.D. (P=0.05)	0.196	0.253	4.442	3.890	5.081	0.584
SE(m)	0.068	0.088	1.542	1.351	1.764	0.203



## CONCLUSION

On the basis of the result obtained in the present investigation, it is concluded that the combined foliar application of Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) found superior. Therefore combined spray Borax 0.2%+Zinc 0.4% (T<sub>11</sub>) can be advocated to guava growers for maximum growth and yield parameters of guava.

Comment [I21]: add

Comment [I22]: add

## REFERENCES

- Adak T, Kumar K, Ganeshamurthy A N & Pandey G. Yield sustainability through micronutrient management in Guava. *Journal of Horticultural Sciences*, 2023;18(2).
- Anonymous. National Horticulture Board database. Ministry of Agriculture, Government of India; 2021.
- Banik BC, SK Sen and TK Bose. Effect of zinc, iron and boron in combination with urea on growth, flowering, fruiting and quality of mango cv. Fazli. *Environ. Eco-B. C.K.V., Kalyani*, 1997;15( 1 ) : 122-125.
- Chaudhry M, Singh M, Chandel VS Roy, A & Dongariyal A. Effect of Foliar Feeding of Nutrients on Growth and Yield of Aonla [(*Emblica officinalis* Gaertn.) cv. Chakaiya]. *International Journal of Current Microbiology Applied Sciences*, 2018;7(1): 2648-2653.
- Gangwar V, Prakash S, Kumar A, Kumar V, Kumar Y, Tiwari B & Kumar D. Influence of foliar application of NAA and zinc on yield and quality attributes of guava (*Psidium guajava* L.) cv. L-49. *International Journal of Plant & Soil Science*, 2023;35(18): 17-23.
- Gaur R, Sharma V, Chhapekar SS, Das J, Kumar A, Yadava SK and Ramchiary N.. Comparative analysis of fruit metabolites and pungency candidate genes expression between Bhut Jolokia and other *Capsicum* species. *PLoS One*, 2016; 11(12): e0167791
- Hayes WB, *Fruit Growing in India*. Kitabistan publication house, Allahabad, Uttar Pradesh; 1970 pp. 297
- Kaur S. Effect of micronutrients and plant growth regulators on fruit set, fruit retention, yield and quality attributes in litchi cultivar Dehradun. *Chemical Science Review and Letters*, 2017; 6(22):982-986.
- Kumar A, Kumar V, Tripath SK, & Kumar M. (2019). Effect of foliar application of micro nutrients on physical quality parameters of guava (*Psidium guajava* L.) Cv. Ialit. *Annals of Horticulture*, 2019; 12(2): 130-133.
- Laishram O & Baruah K, Foliar nutrition of zinc on growth and development of ber, cv. Thailand apple.
- Meena RP, Mohammed S & Lakhawat SS. Effect of foliar application of urea and zinc sulphate on fruit quality and yield of pruned guava trees (*Psidium guajava* L.) cv.'Sardar' under high density planting system. 2005.
- Mishra DS, Singh S, Singh AK, Appa Rao VV and Yadav V.. Crop regulation in fruit crops for improving fruit yield, quality and income. *Hort Flora Research Spectrum*. 2020; 9(3 & 4): 61-73.
- Mondal T, Sarkar T, Alam M, Sarkar S K, Rathod K H and Bauri FK. Effect of foliar application of micronutrients on plant growth, yield and fruit quality of Thai guava (*Psidium guajava* L.). *J. Crop and Weed*, 2023;19(1): 88-94.
- Pal Anju, RK Pathak, Krishna Pal and S Tejbir. Effect of foliar application of nutrients on yield and quality of guava (*Psidium guajava* L.) fruits cv. Sardar. *Prog. 2008;Res.*, 3(1) : 89- 90.
- Panse and Sukhatme. *Statistical methods for agricultural research*. ICAR, New Delhi, 1985;8: 308-318.

Comment [123]: Extra reference

Comment [124]: Extra reference

Comment [125]: Extra reference

Comment [126]: Extra reference

Raipuriya S, Sharma TR, Sharma R, Ramakrishnan RS & Pandey CS. Influence of Foliar Spray of Plant Growth Regulator and Nutrients on Yield and Yield Attributing Traits on Guava (*Psidium guajava* L.) cv. Apple Colour. *Journal of Experimental Agriculture International*, 2024;46(7): 517-525.

Comment [127]: Extra reference

Raja M E. Importance of micronutrients in the changing horticultural scenario in India. *Journal of Horticultural Sciences*, 2009;4(1): 1-27.

Rajput CBS and S Chand. Effect of boron and zinc on the physico-chemical composition of guava fruit (*Psidium guajava* L.). *National Agri. Soc. Ceylon*, 1976;13 : 49-53.

Comment [128]: Extra reference

Singh PN and Chhonkar VS.. Effect of zinc, boron and molybdenum as foliar spray on chemical composition of guava fruit. *Punjab Hort. J.* 1983; 23: 34-37.

Singh R, OP Chaturvedi and R Singh. Effect of preharvest spray of zinc, boron and calcium on the physicochemical quality of guava fruit (*Psidium guajava* L.). *International Seminar on Recent Trend on Hi-Tech Hort. and P.H.T.*, Kanpur, February 2004; 4-6: 2004-204.

Yadav HC, Yadav AL, Yadav DK, Yadav PK and Yadav RS. Effect of foliar application of micronutrients and GA3 on fruit yield and quality of rainy season guava (*Psidium guajava* L.) cv. L49. *Plant Arch.* 2011;11:147-149.

Comment [129]:

UNDER PEER REVIEW