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Effect of foliar application of secondary and micronutrient combinations on reducing sugar, non-reducing sugar, total sugar and sugar to acid ratio pertaining to Guava cv. Allahabad Safeda

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Abstract
Foliar application of secondary and Micronutrient in Guava is gaining more importance in recent years in a different part of the world because due to Guava orchards have chronically affected by nutritional deficiency in the large area since imbalanced nutrient the quality of fruit is reducing. Thus, a percent study on the effect of foliar application of secondary and micronutrients on Reducing sugar, non-reducing sugar, total sugar and sugar to acid ratio of guava cv. Allahabad Safeda is undertaken with fourteen treatments combination and replicated thrice which was carried out at Regional Horticultural Research and Extension Centre, Bangalore from August 2014 to March 2015. The results showed that there was significantly influenced by the foliar application of secondary and micronutrients on the application of RDF+ Foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @ 0.5+MAP 0.5% was recorded the maximum reducing and non- reducing sugar (3.58% and 5.93%). Total sugar and sugar to an acid ratio (9.51 and 26.26) respectively. While the minimum in reducing and non- reducing sugar (2.29% and 4.33%). Total sugar and sugar to an acid ratio (6.62 and 12.84) was recorded in RDF+ Foliar spray of Zn+DAP @ 0.5% treatment respectively.

Keywords: Guava, fruit weight, fruit length, fruit diameter, fruit volume, diameter of seed cavity, pulp thickness, pulp wight

Introduction
Guava (*Psidium guajava* L.) called as “apple of tropics” Though it is native to tropical America its cultivation has expanded to all tropical countries and become especially important in India (Samson 1980) [5]. It belongs to the natural order myrtal and family myrtaceae. The Guava is one of the most common and important fruit crop cultivated all over India. lt is fourth most important fruit crop in area and production after mango, banana and citrus. lt is classified under genus *Psidium* which contains 150 species, but only *Psidium guajava* exploited commercially. It was introduced in 17th century in India by Portuguese people. In India Guava is mainly grown in Bihar, Uttar Pradesh, Karnataka, Madhya Pradesh, Gujarat, Andhra Pradesh and Maharashtra. The area under guavacrop in India is 268.2 thousand per ha. with the total production of 3667 thousand metric tonnes having productivity 13.7 metric tonnes per ha. The area under guava in Maharashtra is 40000 ha. with the total production of 324 thousand MT having productivity 8.1 MT per ha. Madhya Pradesh is leading state in productivity with 37.6 tonnes per ha. (Annon, 2014).

For higher production timely nutrient application is mandatory. Role of major as well as minor nutrients is well understood. But, major nutrients are applied with a care were as the micronutrients are not much given importance. The requirement of both nutrients is also supposed to be more. It has been observed that, standardization of nutrient application of major nutrients as per requirement is carried on an adhoc basis. Micronutrient play an important role in production and its deficiency leads in lowering the production, productivity and quality of fruits. Recent years Guava orchards of India showing micronutrient deficiency and could be responsible for lesser yield and quality compare to international market. Foliar feeding of nutrients to fruit plants has gained much importance in recent years which is quite economical and obviously an ideal way of evading the problems of nutrients availability and supplementing the fertilizers to the soil. Nutrients like nitrogen, phosphorus and potassium play a vital role in promoting the plant vigour and productivity, whereas micronutrients like zinc, boron, copper and iron perform a specific role in the growth and development of a plant, quality produce and uptake of nutrients.

Micronutrient especially Copper, Boron, Iron and Zinc are responsible for metabolic activities in fruit physiology. The application of micronutrients should be at first growth phase and before flowering. Copper is one of the micronutrients needed in very small quantities by a plant which activates some enzymes in plants cell which are involved in the synthesis of lignin. 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 a critical role in the metabolic process such as DNA synthesis, respiration and photosynthesis. Boron is a constituent of the cell membrane and essential for cell division. It acts as a regulator of potassium/calcium ratio in the plant helps in nitrogen absorption and translocation of sugar in plants. It also increases nitrogen availability to the plant. Zinc takes part in chlorophyll synthesis, involved in the biosynthesis of plant growth hormone and plays a positive role in photosynthesis, nitrogen metabolism, auxin, protein synthesis, seed production and proper maturity. It also increases the fruit quality, size as well as yield. Keeping in view the importance of foliar application of secondary and micronutrient combinations for improving fruit quality parameters like Reducing sugar, non-reducing sugar, total sugar and sugar to acid ratio pertaining to Guava cv. Allahabad Safeda was conducted.

Materials and Methods

The present investigation was conducted at Regional Horticultural Research and Extension Centre, Bengaluru during August 2014 to March 2015. Geographically positioned between $12^0 58'$ latitude North, $77^0 11'$ longitude East and altitude 930 meters above than mean sea level and it is situated in the Eastern dry zone of Karnataka. The climatic conditions were moderate and suitable for Guava production. The soil type of the experimental site was red sandy loam with good water holding capacity and slightly acidic in reaction (pH 6.3). The experiment was conducted on well-established orchard of 4 years old Allahabad Safeda guava trees which are planted at 6 x 3 m spacing and exposed to identical conditions of weather, having identical soil and cultural operations. All the plants were supplied with uniform application of manures, fertilizers, profalatic plant protection measures and irrigation at regular intervals. The experiment was laid out in Randomized Complete Block Design (RCBD) with fourteen treatments replicated thrice. Recommended dose of fertilizer applied 100:40:75 g NPK and 25 Kg FYM per tree. The treatments details given in Table 1. The foliar application of these treatments as per the plan was made at 8 sprays per season at an interval of 15 days.

Table 1: Treatment details

Treatments No.	Treatments
T_1	RDF+ foliar spray of MAP 0.5%
T_2	RDF+ foliar spray of Zn+Mg+Mn @ 0.5%
T_3	RDF+ foliar spray of Zn+Mg+Mn @ 0.5% +MAP 0.5%
T_4	RDF+ foliar spray of Zn+Mg+Mn @ 0.75%
T_5	RDF+ foliar spray of Zn+Mg+Mn @ 0.75% +MAP 0.5%
T_6	RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.25%
T_7	RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.25%
T_8	RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.5%
T_9	RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.5%
T_{10}	RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.25% +MAP 0.5%
T_{11}	RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.25% +MAP 0.5%
T_{12}	RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.5% +MAP 0.5%
T_{13}	RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.5% +MAP 0.5%
T_{14}	RDF+ foliar spray of Zn+DAP @0.5% (Control)

Observations recorded on Reducing sugar, non-reducing sugar, total sugar and sugar to acid ratio: Sugars present in the guava fruit samples were estimated, following the method described by Ranganna (1986) [3].

Reducing sugar (%)

Preparation of sample: Five grams of pulp was homogenized using a pestle and mortar with 25 ml distilled water and volume made up to 100 ml with distilled water. The solution was then filtered through Whatman No. 1 filter paper and the filtrate was used for analysis.

Procedure: Ten ml of Fehling's solution [Fehling's A (5 ml) + Fehling's B (5 ml)] with 25 ml of distilled water was taken in a conical flask, heated to boil and titrated against the filtrate sample using methylene blue as an indicator. The end point of titration was brick red colour.

Calculation

$$\text{Reducing sugar (\%)} = \frac{\text{Factor X Volume made up}}{\text{Titre value X Weight of sample}} \text{ X } 100$$

Non reducing sugar (%)

Calculation: Non reducing sugar (%) = Total sugar – reducing sugar

Total sugar (%)

Preparation of sample: 25 ml of the filtrate (prepared for reducing sugar estimation) was hydrolyzed with 10 ml of 1:1 HCL at room temperature for 24 hours. The hydrolyzed sample was neutralized with 20 per cent NaOH and the volume was made up to 100 ml with distilled water.

Procedure: Ten ml of Fehling's solution [Fehling's A (5 ml) + Fehling's B (5 ml)] with 25 ml of distilled water was taken in a conical flask, heated to boil and titrated against the sample using methylene blue as an indicator. The end point of titration was brick red colour.

Calculation

$$\text{Total sugar (\%)} = \frac{\text{4 X Factor X Volume made up}}{\text{Titre value X Weight of sample}} \text{ X } 100$$

Sugar- acid ratio

The sugar to acid ratio of the pulp was arrived at by dividing the value of total sugars by that of acidity and this was recorded as a measure of fruit quality.

Results and Discussion

The data on effect of foliar application of secondary and micronutrients on Reducing sugar, non-reducing sugar, total sugar and sugar to acid ratio of guava cv. Allahabad Safeda.

Reducing sugars (%): The significant difference was noticed in reducing sugars and the data are furnished in Table-2. The highest level of reducing sugars (3.58%) in treatment T_{13} (RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @ 0.5% + MAP 0.5%), which was significantly on par with T_9 (3.37%). However, T_7 (3.34%) and T_{11} (3.35%) were at par with RDF+ foliar spray of Zn+Mg+Mn @ 0.75% along with Cu +Fe @ 0.5% (T_9). While, the lowest level of reducing sugars (2.29%) was recorded in T_{14} (control- RDF+ foliar spray of Zn+DAP @ 0.5%).

Non-reducing sugars (%): The non- reducing sugar content of fruits showed significant differences (Table-2). The highest per cent of non- reducing sugar (5.93%) was recorded in T_{13} (RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @ 0.5% + MAP 0.5%), which was significantly on par with T_9 (5.75%). However, T_5 (5.52%), T_7 (5.51%), T_{10} (5.53%), T_{11} (5.56%) and T_{12} (5.53%) were at par with RDF+ foliar spray of Zn+Mg+Mn @ 0.75% along with Cu +Fe @ 0.5%. While, the lowest level of non- reducing sugar (4.33%) was recorded in T_{14} (control- RDF+ foliar spray of Zn+DAP @ 0.5%).

The significant improvement in reducing sugar might be due to formation and translocation of carbohydrate, which improves the fruit quality. Similar result was obtained by Saraswat *et al*. (2006) [6] in litchi.

The higher percentage of reducing sugar, non-reducing sugar and total sugar might be due to efficient translocation of photosynthates in the fruits by regulation of zinc substances, reported by Vipin and Rajesh (2014) [7] in guava.

Total sugars (%): The total sugar content of fruits showed significant differences (Table-2). The highest level of total sugars (9.51%) in treatment T_{13} (RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @ 0.5% + MAP 0.5%), which was followed by T_9 (9.13%). However, the lowest level of total sugars (6.62%) was recorded in T_{14} (control- RDF+ foliar spray of Zn+DAP @ 0.5%).

Sugar to acid ratio: The sugar to acid ratio of the fruits differed significantly between the treatments (Table-2). The maximum sugar to acid ratio (26.26) was observed in T_{13} (RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @ 0.5% + MAP 0.5%), which was followed by T_9 (23.02), T_7 (21.31) and T_{11} (22.78) were at par. While, the lowest sugar to acid ratio (12.84) was observed in T_{14} (control- RDF+ foliar spray of Zn+DAP @ 0.5%).

Zinc sprays was highly helpful in the process of photosynthesis and mobilization of food material leading to the accumulation of quality constituents like carbohydrate which ultimately promoted the quality attributes and quick metabolic transformation of starch and pectin into soluble compounds and rapid transformation of sugars from leaves to developing fruits reported by Saraswat *et al*. (2006) [6] in litchi.

The perceptible increase in total sugar contents through the foliar feeding of zinc sulphate might be due to the active synthesis of tryptophan in the presence of zinc, the precursor of auxin, which in turn causes an increase in the rate of chlorophyll synthesis which ultimately accelerates the photosynthetic activity, as reported by Rawat *et al*. (2010) [4] in guava.

The increase in total sugars can be attributed to the accumulation of oligosaccharides and polysaccharides in higher amount. It was reported that these micronutrients in association with retardant might have increased the activity of hydrolyzing enzyme, which convert complex polysaccharides in to simple sugars, reported by Amit *et al*. (2014) [1] in guava.

Table 2: Effect of foliar application of secondary and micronutrient combinations on quality parameters of guava cv. Allahabad Safeda

Treatments	Reducing sugar (%)	Non- reducing sugar (%)	Total sugar (%)	Sugar to acid ratio
T_1	2.33	4.39	6.73	13.42
T_2	2.35	4.43	6.79	13.95
T_3	2.75	4.48	7.23	15.52
T_4	2.74	4.52	7.26	16.05
T_5	2.98	5.52	8.51	18.26
T_6	2.93	4.71	7.64	16.98
T_7	3.34	5.51	8.86	21.31
T_8	2.96	4.70	7.67	18.58
T_9	3.37	5.75	9.13	23.02
T_{10}	3.01	5.53	8.54	19.55
T_{11}	3.35	5.56	8.91	22.78
T_{12}	3.03	5.53	8.56	20.75
T_{13}	3.58	5.93	9.51	26.26
T_{14}	2.29	4.33	6.62	12.84
S. Em.±	0.07	0.09	0.06	0.63
C.D. at 5%	0.21	0.28	0.18	1.85

T_1- RDF+ foliar spray of MAP 0.5%
T_2- RDF+ foliar spray of Zn+Mg+Mn @ 0.5%
T_3- RDF+ foliar spray of Zn+Mg+Mn @ 0.5% +MAP 0.5%
T_4- RDF+ foliar spray of Zn+Mg+Mn @ 0.75%
T_5- RDF+ foliar spray of Zn+Mg+Mn @ 0.75% +MAP 0.5%
T_6- RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.25%
T_7- RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.25%
T_8- RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.5%
T_9- RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.5%
T_{10}- RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.25% +MAP 0.5%
T_{11}- RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.25% +MAP 0.5%
T_{12}- RDF+ foliar spray of Zn+Mg+Mn @ 0.5% + Cu +Fe @0.5% +MAP 0.5%
T_{13}- RDF+ foliar spray of Zn+Mg+Mn @ 0.75% + Cu +Fe @0.5% +MAP 0.5%
T_{14}- Control - RDF+ foliar spray of Zn+DAP @0.5%

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