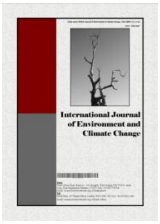

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Study of Mineral Nutrient Accumulation in Different Cultivars of Guava Fruits

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Authors' contributions

This work was carried out in collaboration among all authors. Author DK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MP and FA managed the analyses of the study. Author FA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Guava, is one of the most promising fruit crops of India and is considered to be one of the exquisite nutritionally valuable and remunerative crops. We are unaware of any report describing macro and micronutrient dynamics in fruit at different growth stages of guava. Micronutrients play an important role in production and their deficiency lead in lowering the productivity. For conducting this experiment fruit of variety Allahabad Safeda, L-49, Lalit, Shweta, Arka Kiran, Salithong, Kimchu were collected at different stages like Marble, Stone hardening & Harvest stage for estimation of primary nutrient (N, P, K), secondary nutrient (Ca, Mg) & micronutrient (Fe, Mn, Zn, Cu). The nutrient content particularly N, K, Mg, and Mn are highest in variety of Allahabad Safeda, whereas, P and Ca are highest in variety Lalit. Micronutrient Fe recorded highest in Salithong while Zn and Cu were accumulated maximum in Arka Kiran and Kimchu respectively. Recommendation of fertilizer at various growth stages is paramount for precise nutritional management for which the requirement of different nutrition is essential.

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Keywords: Guava; macronutrient; micronutrient; cultivars; management.

1. INTRODUCTION

Guava (Psidium guajava L.), the apple of the tropics, is one of most popular fruit grown in tropical, sub-tropical and some parts of arid regions of India and it belongs to family Myrtaceae. It is the fourth most important fruit of India after mango, banana and citrus in terms of area and production [1].

Guava micronutrient play an important role in production and its deficiency leads in lowering the productivity Guava plants also shows micronutrient deficiency and could be responsible for lesser yield and quality. 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 plant, quality produce and uptake of nutrients. Nutrients play a significant role to complete the life cycle of plant so, without fulfilling all the essential nutrient like primary nutrients such as nitrogen(N),phosphorus (P) and potassium (K), secondary nutrients like calcium(Ca) and magnesium (Mg) and micronutrient such as copper (Cu), zinc (Zn),manganese (Mn) and iron(Fe), the plant cannot produce optimum yield and quality. Adequate nutrients directly influence metabolic activities, physiological activities during the entire growth period and maintain good health of the plants. It also helps in the structural building of plant tissues and synthesis of several enzymes, hormone and also crucial for human health benefit [2] and [3]. Guava is highly responsive to fertilization [4,5] and [6]. Mineral nutrition is an important factor which influence guava flowering that sets the beginning of fruit production. Fruit production is directly linked to the assimilation of nutrients in sink organs [7] So, correct and balanced soil nutrient balance is crucial for healthy growth and high crop productivity [8]. The precise fertilizer management is one of the major components of any production system. Hence, the determination of nutritional needs for efficient production of high-quality fruit is an important aspect of nutrient management for the growers. The mineral content of the plant parts is used in assessing nutrient deficiencies, excesses, or imbalances within the crop [9]. The cumulative amount of nutrients taken up by a tree in one year equals the nutrient content in the yearly net primary production of the tree [10]. According to literature survey, very meagre information is available on variation in nutrient content among different varieties of litchi. In order to avoid misleading soil fertility program, reference value used for interpreting the results of plant analysis should reliably reflect differences in nutrient content among very closely related plants. This is especially important for establishing and maintaining a proper fertilizer program in an orchard. There are no previous reports available on the mineral nutrient accumulation in fruit at different fruit maturity stages of various varieties of guava in respect of fertilizer recommendation. Hence, this study is very much important for establishing actual need, correct and specific nutrient management for guava orchard.

2. MATERIALS AND METHODS

The experiment was conducted in the laboratory of Department of Horticulture (Fruit & Fruit Technology), Bihar Agricultural College, Sabour and the fruits for this purpose were procured from the trees of various age groups from the horticulture garden of Bihar Agricultural College, Sabour. Geographically Sabour is situated south of river Ganga in between 25.15, 40" North latitude, 87.20, 42" East longitude and at vast altitude of 45.72 meters above the mean sea level in the vast alluvial Gangetic plain of India, South of Ganga river. Sabour has semiarid, subtropical climate with hot desiccating summer and cold winter with an average annual rainfall of about 1040 mm. Most of the precipitation is usually received between the middle of June to middle of October. The fruit sample thoroughly washed first with tap water, then dipped in 0.1 N HCl, distilled water and finally in double distilled water. After air drying, the samples were cut in small pieces and dried in an oven at 68^{o}C till constant weight is obtained. The dried sample has been grinding in grinder and then kept in butter paper bags for chemical analysis. Nitrogen estimation **–** 0.5 g grinded sample were taken in tube, add 5-7 g of digestion mixture (10g K_2SO_4: 0.5 g $CuSO_4$) and digested with 10 ml concentrated H_2SO_4 on digestion unit Kelplus, Digested the material on flame till the solution became whitish green. The digested samples were distilled and titrated against standard HCL (0.1N). The nitrogen percentage is calculated by using the formula. For phosphorus estimation 5 g of digested sample were taken to 50 ml volumetric flask and 5 ml of molybdate reagent was added and made

the volume up to 50 ml with distilled water and shake thoroughly, after 20-30 min read the absorbance at 420 nm. 0.5 gm of grounded sample were taken and digested in diacid mixture (15-20 ml) till the solution becomes clear and set the instrument using prepared standard solution and reading was taken. The digested plant samples were diluted to suitable concentration and reading was taken on flame photometer. For Micronutrients Zn, Cu, Fe and Mn (ppm) the elements will be analysed by using the diacid digested material using Atomic Absorption Spectrophotometer for the estimation of Zn, Cu, Fe and Mn. Available soil nitrogen was estimated by using alkaline $KMnO_4$ method as suggested by Subbaiab and Asija [11]. Available phosphorus content of the soil was extracted with sodium bicarbonate [12] and the blue colour intensity was measured calorimetrically using 660 nm wavelengths [13]. Available micro nutrients in the soil sample were extracted with DTPA(diethylenetriaminepentaacetic acid) [14] and were estimated using Atomic Absorption spectrophotometer. The statistical methods described by Gomez and Gomez [15] were followed to analyse and interpret the data. The experimental design was randomized block design (factorial). Each treatment comprised of a single plant and was replicated three times. The test of significance was tasted at 5 per cent probability level.

3. RESULTS AND DISCUSSION

3.1 Primary Nutrient

The studies on mineral nutrient accumulation in varieties during various stages of growth Table 1. and in Fig. 1 revealed that variety Allahabad Safeda contained maximum nitrogen (1.66%) followed by Salithong (1.26%) and minimum nitrogen was observed in Lalit (1.00%). However, phosphorous content was recorded highest (0.16%) in Lalit whereas the phosphorous content (Fig. 2) in variety L-49 and Salithong remained constant. As far as potassium accumulation in various varieties of guava is concerned, the variety Allahabad Safeda may be due to the inherent capacity of a particular variety of absorbing various nutrients from the soil. This finding is in conformity of the result of Haynes and Goh [16] who have also observed different nutrient content in different varieties in apple mainly Golden Delicious and Grainy Smith. Similarly, Giordano and Mortvedt [17] also suggested that nutrient uptake facility and translocation ability depend on cultivars. However, Kennedy et al. [18], Tsipouridis and Thomidis [19], Kucukyumuk and Irdal [20] and Goncalves et al. [21] find out that the differences in the nutrient concentration in cultivars were due to 7 genetic effect leading to the different nutrient uptake capacity. The differences in nutrient content in different variety were also reported by Haq and Rab [22] in litchi variety.

3.2 Secondary Nutrient

The secondary macronutrient mainly calcium and magnesium Table 1, Fig. 4 and Fig. 5) in the present study were found to be variability depending on with the variety. The maximum content of calcium (0.39%) was found in Lalit that was comparable with variety Allahabad Safeda. whiles the minimum in in Kimchu (0.18%). Magnesium content also varied among the varieties, wherein Allahabad Safeda and Lalit had maximum magnesium content (0.06%) and variety Salithong recorded lowest concentration (0.03%). These differences were observed due to tree growth, fruit yield and ability of absorption of mineral nutrition of the root of a particular cultivars or hybrids. The wide variation in concentration of nutrients might be due to inherent capacity of a particular variety [9]. The variation in calcium content in fruit skin of litchi also significantly varied among the cultivars as reported by Haq and Rab [22]. Basar [9] also observed variation in calcium and magnesium content among the peach variety of Redhaven, Glohaven and J.H. Hale.

3.3 Micronutrients

Micronutrient mainly iron, manganese, zinc and copper (Table 2 and Figs. 6, 7, 8, 9) also varies among the variety under study. The iron content in different varieties varied from 36.67 ppm to 62.00 ppm with an average value of 45.22 ppm. The manganese content in different varieties varies from 3.26 ppm to 8.85 ppm with an average value of 6.01 ppm. The average content of zinc was 15.22 ppm with a range of 13.99 to 16.93 ppm. While as copper varies from 2.19 to 3.14 ppm with an average of 3.04 ppm. The differences in fruit nutrient concentration can be explained by genotypic variation as explained above. In a study by Campeanuet et al. [23], it was reported that nutrient concentration of apple fruits showed large variation depending on varieties.

Table 1. Effect of varieties on mineral (macro) nutrient content in guava fruit

Treatments	Macro nutrient (%)				
	Primary nutrient			Secondary nutrient	
	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
Allahabad Safeda	1.66	0.15	4.06	0.37	0.06
L-49	1.15	0.14	2.77	0.21	0.05
Lalit	1.00	0.16	2.72	0.39	0.06
Swetha	1.17	0.13	2.82	0.22	0.04
Arka Kiran	1.01	0.11	2.77	0.27	0.04
Salithong	1.26	0.14	3.24	0.20	0.03
Kimchu	1.00	0.13	2.77	0.18	0.05
SEM±	**0.047**	**0.007**	**0.068**	**0.043**	**0.004**
CD at 5%	**0.133**	**0.021**	**0.194**	**0.122**	**0.013**

SEM: Standard error of the mean, CD: critical difference

Table 2. Effect of varieties on mineral (micro) nutrient content in guava fruit

Treatments	Micronutrient (ppm)			
	Iron	Manganese	Zinc	Copper
Allahabad Safeda	40.23	8.85	15.64	2.90
L-49	36.67	6.09	14.64	2.59
Lalit	49.33	7.53	14.51	2.19
Swetha	47.67	5.75	14.52	2.43
Arka Kiran	40.00	5.34	16.93	3.14
Salithong	62.00	5.26	16.28	2.26
Kimchu	40.67	3.26	13.99	5.78
SEM±	**1.55**	**0.218**	**-**	**0.106**
CD at 5%	**4.424**	**0.622**	**NS**	**0.301**

SEM: Standard error of the mean, CD: critical difference, NS: non-significant

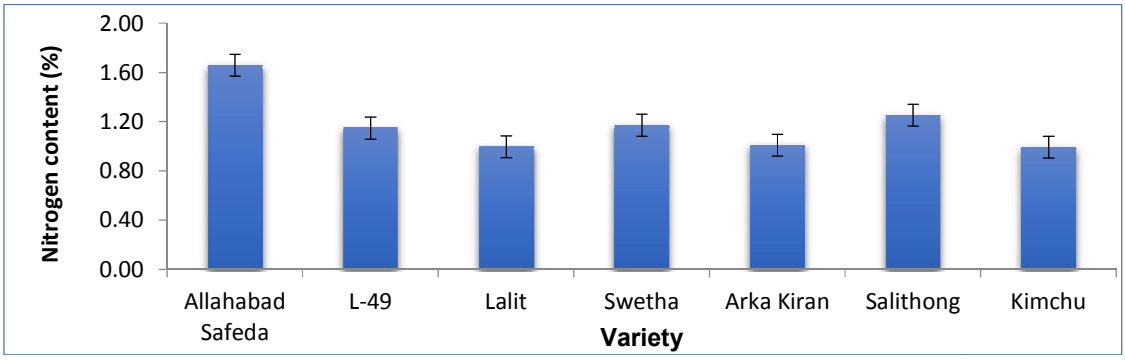

Fig. 1. Nitrogen (%) content in different varieties

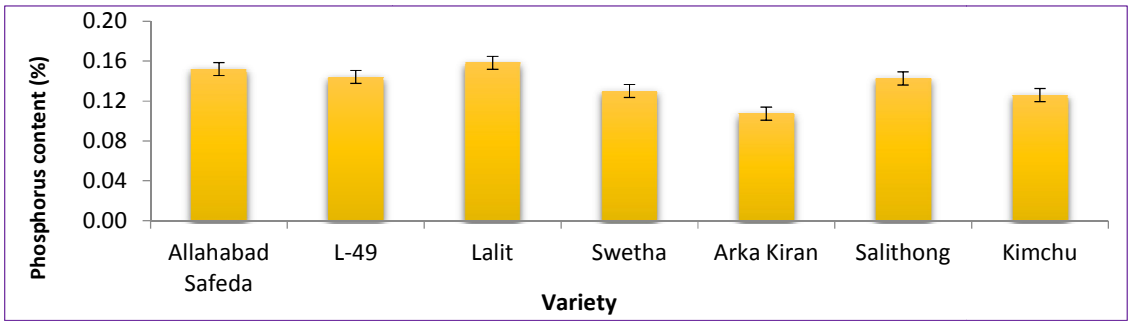

Fig. 2. Phosphorus (%) content in different varieties

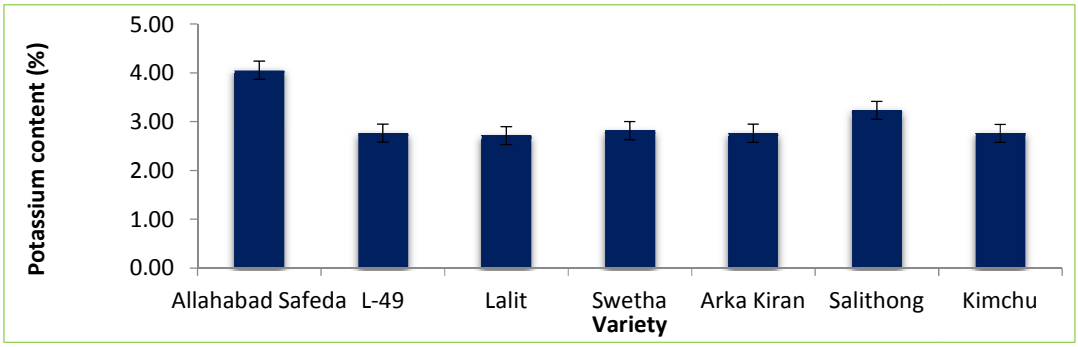

Fig. 3. Potassium (%) content in different varieties

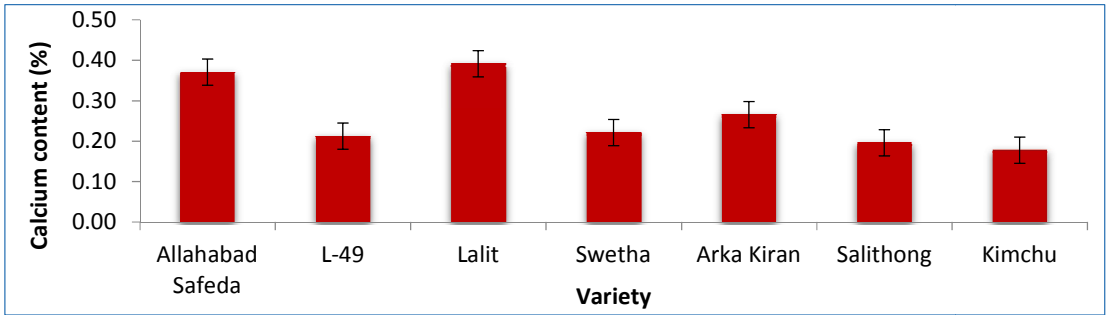

Fig. 4. Calcium (%) content in different varieties

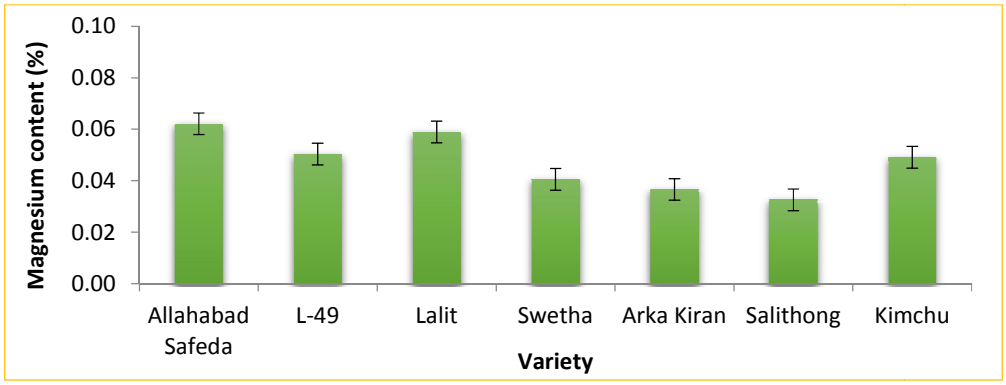

Fig. 5. Magnesium (%) content in different varieties

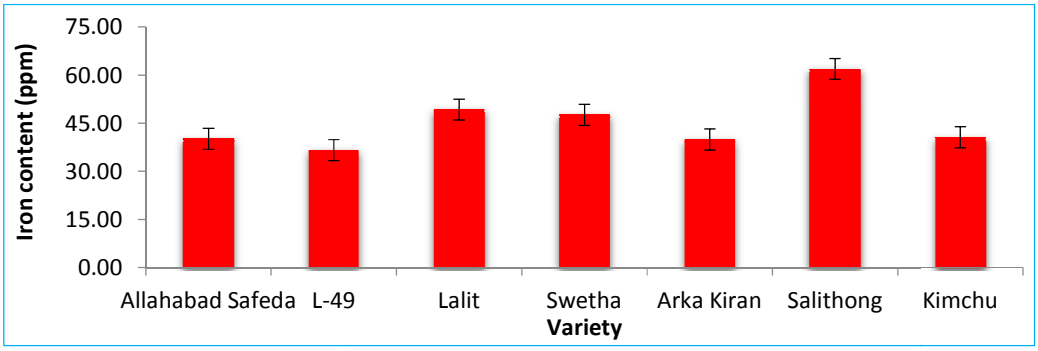

Fig. 6. Iron (%) content in different varieties

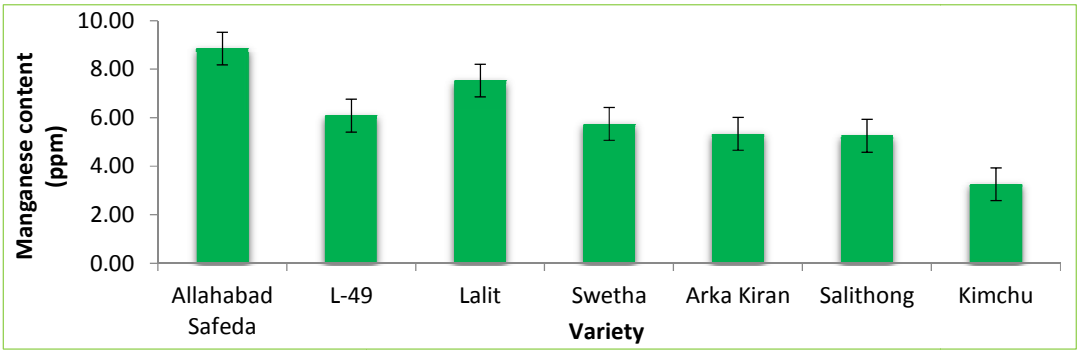

Fig. 7. Manganese (%) content in different varieties

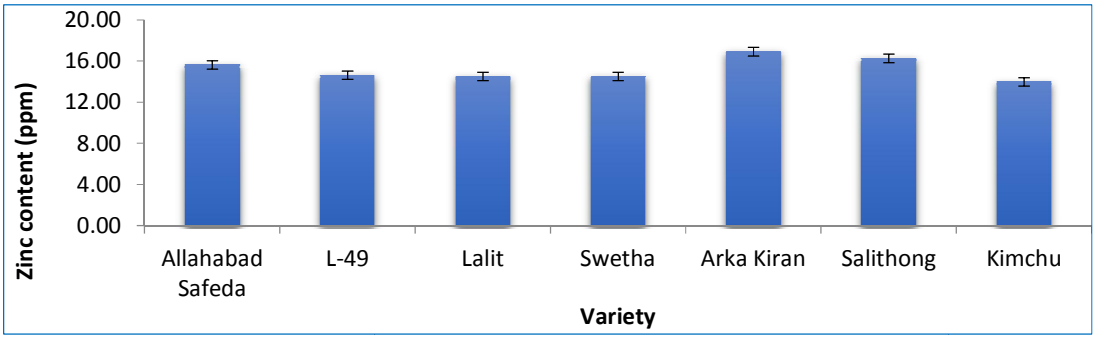

Fig. 8. Zinc (%) content in different varieties

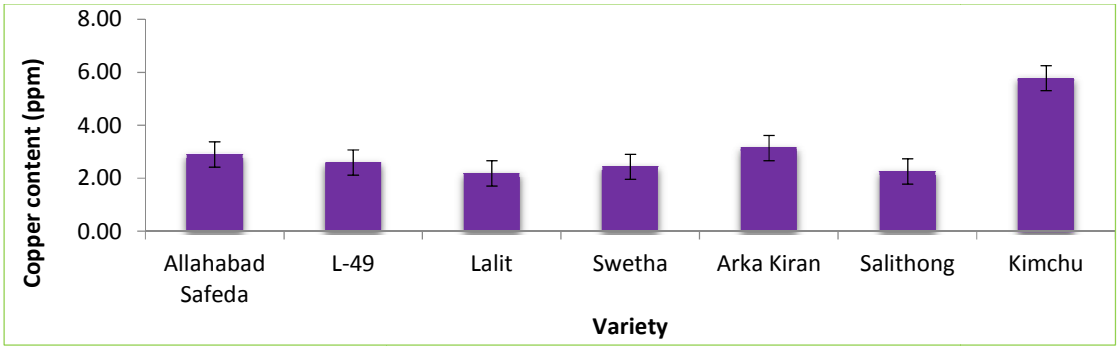

Fig. 9. Copper (%) content in different varieties

4. CONCLUSIONS

As regards the availability of mineral nutrient contents of varieties did not follow a definite trend. The nutrient content particularly. The nutrient content particularly N, K, Mg, and Mn are highest in variety of Allahabad Safeda, whereas, P and Ca are highest in variety Lalit. Micronutrient Fe recorded highest in Salithong while Zn and Cu were accumulated maximum in Arka Kiran and Kimchu respectively. The result obtained reflects that cultivars advancing growth stages had pronounced effect on both macronutrient and micronutrient level of guava fruit. However, the mineral nutrient varies differently among cultivars. The dynamics of nutrient accumulation at different fruit growth stages of cultivar provides important basic information for guiding the timely supply of nutrient otherwise it affects quantity and quality of produce because each growth stage has its own importance regarding development. The description of these landmark stages and influence of varieties against nutrient concentration can be utilized by growers and researcher for future study to guava orchard worldwide.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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