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A survey on nutrient status of guava (*Psidium guajawa* L.) orchards in Hisar district of Haryana

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Abstract
A field survey was conducted to study the nutrient status of guava orchards in Hisar district of Haryana during June 2021 to February 2022. In total 24 orchards of guava were selected for the study. The bench mark survey of guava fruit crops was carried out to know the general information of orchards. The results reported that guava growers were well worked with the soil test recommendation. Similarly the soil and foliar nutrients were well within the recommended range. Farmers may be advised to continue similar fertilizers and cultural practices.

Keywords: Guava orchards, nutrient status, bench mark survey and foliar application

Introduction
Guava (*Psidium guajava* L.) belongs to family Myrtaceae is grown in tropical and sub-tropical regions of the world. It is one of the most important fruit crops in India which is also known as "Apple of tropics." The guava classified under genus *Psidium* that contains 150 species but only *Psidium guajava* L. is exploited commercially. The common guava is diploid (2n=22), but natural and artificial triploid (2n=33) and aneuploid exists. It was introduced in India in the 17th century by Portuguese and the area under this crop is extending from Mexico to Peru and is now being cultivated in more than 60 countries of the world including India, Algeria, Australia, Brazil, California, China, Columbia, Costa Rica, Cuba, Egypt, Florida, Hawaii, Indonesia, Israel, Kenya, Malaysia, New Zealand, Panama, Pakistan, Philippines, Spain, South Africa and U.S.A. It is now widely grown all over the tropics and subtropics and gradually becoming crop of commercial significance.

Guava is one of the fourth most important fruit crop in India after Mango, Banana and Citrus. It is grown commercially on an area of about 290 thousand hectares with an annual production 4539 thousand tonnes in India (Horticultural Statistics at a Glance, 2019-20) [6]. In Haryana, it occupies an area of 8.69 thousand ha and production of 195.60 thousand tonnes (National Horticultural Board, 2018). Guava is second important fruit crop of Haryana-after/Kinnow it obtained second rank among all fruit crops. Guava can be grown in wide range of soils but does best in deep fertile and well-drained loams. It can tolerate a wide range of pH from 4.5-8.2 water logging adversely affects the growth, although guava can tolerate drought conditions much better than other tropical fruits (Arshad, 2015) [1]. The tropical climate is considered excellent for cultivation.

The soil physio-chemical characteristics, soil nutrient status and environmental conditions influence the requirements of different nutrients by the crop. The proper study and knowledge of plant and soil nutrient status is very helpful to understand the tree health and production. Some workers consider soil nutrient status as the only means of specifying fertilizers needs of the orchards. Plant analysis is a technique to correlate the nutrient content of the whole plant or one of its parts with its physical appearance, growth rate, yield or quality of harvested products. Interpretation is based on the promise that there is a significant biological relationship between the contents of nutrient element in a plant and its growth. The results from sol tests and plant analysis play a major role in formulating soil management and fertilizer programs by growers.

However, information regarding nutrient status of guava orchards in Hisar district of Haryana is lacking. Keeping in view the above discussed facts of sufficient information and sparce related research, the present survey was undertaken to find out the nutrient status of guava orchards in Hisar district of Haryana conditions.

Material and Methods

The survey were carried out with a view of delineate the nutrient deficiency/sufficiency areas in the Hisar district of Haryana during June 2021 to February 2022. The area extent of Hisar district of Haryana is confined within northern latitudes of 29°15' 5'5" N and eastern longitudes of 75°72' 45'55" E and 215 meters (705 feet) above sea level is located in Northern India. Twenty four orchards were selected in the district for detailed investigations. In this regard bench mark survey was done at different locations of Hisar district. The bench mark survey of guava fruit crops was carried out to know the general information of orchards. Soil samples were collected from fruit orchards, on the basis of variability of orchard. Thereafter, from each selected orchard, three soil profiles, based on soil fertility, variation and plant performance were taken up. The sampling was done in each profile up to depth of 30 cm *i.e* 0-15 and 15-30. Samples were air dried, ground and passed through 2 mm sieve and were stored in properly labeled plastic bags for further analysis work. The data relating to each character were analyzed as per the procedure.

Results and Discussions

Soil pH

The soil pH of selected orchards varied from 7.60 to 8.51 with mean of 8.02 (Table 1). The maximum soil pH 8.51 was observed in orchard no. 4 and orchard no. 17 and the minimum soil pH 7.60 was observed in orchard no. 10. Similar results in kinnow orchards have been reported by Khokhar *et al*. (2012) [7] they found the orchard soils alkaline to saline in nature, with pH values ranging from 8.4 to 9.5. Bhatnagar *et al*. (2018) [2] also reported that the soil pH of Jhalawar district of Rajasthan was ranged from 6.27 to 8.37 in guava orchards. However PAU (2016) has recommended that the highest pH for healthy growth of each orchards including ground sampled should not be more than 8.7. Thus almost all the selected guava orchards were within healthy range of soil pH.

Table 1: Soil pH and Soil electrical conductivity (Mmhos cm^{-1}) at 0-30 cm soil depth of Guava Orchards in Hisar district

Orchard number	Soil pH	Electrical Conductivity (Mmhos cm^{-1})
Orchard 1	8.07	0.54
Orchard 2	8.05	0.47
Orchard 3	8.05	0.49
Orchard 4	8.51	0.53
Orchard 5	7.90	0.47
Orchard 6	7.90	0.57
Orchard 7	7.90	0.43
Orchard 8	7.90	0.51
Orchard 9	7.64	0.50
Orchard 10	7.60	0.48
Orchard 11	8.43	0.70
Orchard 12	7.63	0.48
Orchard 13	7.71	0.48
Orchard 14	7.86	0.81
Orchard 15	7.65	0.43
Orchard 16	7.99	0.51
Orchard 17	8.51	0.46
Orchard 18	8.05	0.37
Orchard 19	8.05	0.43
Orchard 20	7.85	0.39
Orchard 21	8.07	0.39
Orchard 22	8.35	0.42
Orchard 23	8.35	0.71
Orchard 24	8.41	0.53
Mean	8.02	0.50

Electrical conductivity

The data presented in Table 1 revealed that the electrical conductivity in Guava orchards varied from 0.37 to 0.81 mmhos cm^{-1} with mean of 0.50 mmhos cm^{-1}. The highest soil electrical conductivity of 0.81 mmhos cm^{-1} was observed in orchard no. 14 and minimum soil electrical conductivity of 0.37 was observed in orchard no. 18. The soil EC is a measure of soluble salt concentration in soil. Higher amount of salts in soils (higher EC) restrict the nutrient uptake and thus affect plant growth. According to Muhr *et al*. (1965) [9] the low, medium and high ranges of EC in soil test values are <1.0, 1 to 2 and >2.0 mmhos cm^{-1} respectively.

Organic Carbon (%)

Organic carbon in selected Guava orchard soils varied from 0.36 to 0.60 with mean of 0.51 (Table 2). The maximum organic carbon content of 0.60 was observed in orchard no.19&21 and minimum organic carbon content of 0.36 per cent was observed in orchard no. 18. Muhr *et al*. (1965) [9] suggested <0.5 low, 0.5-0.75 (medium), >0.75 high percent of organic carbon as a critical limit for soil organic carbon. Considering the limit given by Muhr *et al*. (1965) [9] eighteen orchards (no. 1, 2, 4, 5, 7, 8, 9, 10, 13, 14, 15, 16, 17, 19, 20, 21, 23 and 24) were found medium and remaining six orchards (no. 3, 6, 11, 12, 18 and 22) is low in organic carbon content. The organic carbon was in deficient range because FYM added by the farmer was utilized between February and August before taking the sample. The interaction between FYM and nitrogen significantly increased soil nitrogen content percentage over initial level.

Table 2: Soil organic carbon (%), available phosphorous and exchangeable potassium (kg acre^{-1}) at 0-30 cm soil depth of Guava Orchards in Hisar district

Orchard number	Soil Organic Carbon (%)	Phosphorous (kg acre^{-1})	Potassium (kg acre^{-1})
Orchard 1	0.54	4.00	64
Orchard 2	0.55	3.24	224
Orchard 3	0.42	2.72	176
Orchard 4	0.58	3.36	136
Orchard 5	0.58	3.04	112
Orchard 6	0.40	4.36	136
Orchard 7	0.52	3.00	120
Orchard 8	0.55	2.92	120
Orchard 9	0.55	3.64	80
Orchard 10	0.52	3.16	176
Orchard 11	0.37	3.72	160
Orchard 12	0.42	5.12	320
Orchard 13	0.57	3.88	96
Orchard 14	0.57	4.24	320
Orchard 15	0.52	3.64	112
Orchard 16	0.55	3.36	112
Orchard 17	0.52	3.08	128
Orchard 18	0.36	3.88	192
Orchard 19	0.60	4.24	216
Orchard 20	0.58	3.60	192
Orchard 21	0.60	2.88	184
Orchard 22	0.37	4.08	176
Orchard 23	0.55	2.48	216
Orchard 24	0.54	3.24	272
Mean	0.51	3.54	168

Available Phosphorous (kg acre^{-1})

The available phosphorous ranged from 2.48 to 5.12 kg acre^{-1} with mean of 3.54 kg acre^{-1} was observed in Guava orchards of Hisar district (Table 2). The maximum phosphorous content of 5.12 kg acre^{-1} was observed in orchard no. 12 and minimum phosphorous content of 2.48 kg acre^{-1} was observed in orchard no. 23. The differences in the availability of phosphorous content among the orchards can be ascribed to the differences in the rate of phosphorous application and or uptake. High phosphorous content in some orchards might be due to high phosphorous application and low mobility of phosphorous. Muhr *et al*. (1965) [9] suggested 1<2.5 (low), 12.5-25 (medium) and >25 (high) kg ha^{-1} of phosphorous as a critical limit for phosphorous. Thus among the orchards under study one orchards (no. 23) were in low, rest were in medium range orchards under Table 3. However as per PAU (2016) recommendations all orchards under study were in medium to high range.

Table 3: Foliar nitrogen (%), phosphorous (%) and potassium (%) content of Guava orchards in Hisar district

Orchard number	Foliar Nitrogen	Foliar Phosphorous	Foliar Potassium
Orchard 1	3.82	0.21	0.22
Orchard 2	4.13	0.21	0.26
Orchard 3	4.16	0.22	0.63
Orchard 4	3.99	0.21	0.38
Orchard 5	3.96	0.13	1.27
Orchard 6	4.28	0.12	1.07
Orchard 7	4.06	0.09	0.86
Orchard 8	3.35	0.11	0.90
Orchard 9	3.33	0.12	0.89
Orchard 10	4.31	0.11	0.87
Orchard 11	4.34	0.12	1.12
Orchard 12	4.13	0.22	1.17
Orchard 13	3.72	0.13	1.17
Orchard 14	3.43	0.11	0.88
Orchard 15	4.19	0.15	0.82
Orchard 16	3.58	0.10	0.92
Orchard 17	4.49	0.11	1.36
Orchard 18	3.49	0.13	1.54
Orchard 19	3.70	0.09	1.26
Orchard 20	4.21	0.12	1.59
Orchard 21	3.47	0.09	1.15
Orchard 22	4.00	0.09	1.03
Orchard 23	4.06	0.13	1.47
Orchard 24	4.17	0.12	1.39
Mean	4.10	0.14	1.05

Available Potassium (kg acre^{-1})

The data presented in the Table 42revealed that the soil potassium content varied from 64 to 320 kg acre^{-1}. The maximum potassium content 320 kg acre^{-1} was observed in orchard no. 12&14 and minimum potassium content of 64 kg acre^{-1} was observed in orchard no.1. The mean potassium content 168 kg acre^{-1} was observed in Hisar district of haryana. Muhr *et al*. (1965) [9] suggested, 135 (low), 135-335 (medium) and >335(high) kg ha^{-1} of potassium as a critical limit for potassium.

Foliar nutrient status of Guava orchards

Foliar Nitrogen

The data revealed that the foliar nitrogen content varied from 3.33 to 4.49 per cent (Table 3). The maximum foliar nitrogen content 4.49 per cent was observed in orchard no. 17 and the minimum foliar nitrogen content of 3.33 per cent was observed in orchard no. 9. The mean foliar nitrogen content of 4.10 percent was observed in Guava orchards of Hisar district. Dahiya *et al*. (1987) [5] observed that the nitrogen concentration of some guava orchards in Haryana was in the range of 1.07 to 3.24 per cent and they also reported that 40 percent leaf samples of guava were deficient in leaf nitrogen content when survey of 21 guava orchards was conducted in Haryana The optimum leaf nitrogen concentration of guava was within the range of 1.25 to 1.40 per cent (Koen and Hobbs, 1990) [8].

Foliar Phosphorous

The foliar phosphorous content varied from 0.09 to 0.22 percent presented in Table 3. The maximum value of foliar phosphorous content 0.22 percent was observed in orchard no. 3&12 and the minimum foliar phosphorous content 0.09 percent was observed in orchard no. 7, 19, 21 and 22. The mean foliar phosphorous content of 0.14 percent was observed in Guava orchards of Hisar district. The results are in conformity with the findings of (Ravi *et al.*, 1990) [11] he reported that the leaf phosphorous concentration of guava cv. Allahabad safeda in Haryana region was from 0.17 per cent. The optimum leaf phosphorous concentration of guava were within the range of 0.11 to 0.17 per cent (Koen and Hobbs, 1990) [8]. Which means all the orchard studies were within or little higher than optimum range. Which might be due to application of phosphatic fertilizers by the farmers.

Foliar Potassium

The foliar potassium content varied from 0.22 to 1.59 per cent presented in Table 3. The maximum value of foliar Potassium content 1.59 per cent was observed in orchard no. 20 and the minimum foliar potassium content 0.22 per cent was observed in orchard no. 1. The mean foliar potassium content of 1.05 per cent was observed in Guava orchards of Hisar district. Cahoon (1970) [3] reported that the critical range of Potassium in guava leaves was varied from 0.70-1.10 per cent. Chhibba *et al.* (1987) [4] reported that the leaves from declining guava trees had significantly lower concentrations of N, P and K compared to leaves of healthy guava trees. Poor supply of these nutrients seems to be the main cause of the tree decline, low yields and poor fruit quality. However among the orchards under study (Table 6) only five orchards (17, 18, 20, 23 and 24) were in medium range and rest were in low range. Which mean that farmers have applied fertilizers in recommended dose thus nutrient uptake was marginally lower to optimum range.

Conclusions

From the above information it may be concluded that the growers were well worked with the soil test recommendation. Similarly the soil and foliar nutrients were well within the recommended range. Farmers may be advised to continue similar fertilizers and cultural practices.

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