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Evaluate sweet orange orchard leaf samples of Jalna district for nutritional status

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Abstract
An investigation was carried out to study the evaluation of nutrient status of sweet orange orchards in Jalna district by leaf analysis. One hundred representative sweet orange orchards from of sweet orange growing belt of Jalna district having cultivation of more than one ha with different health status were selected for the study. From 100 sweet orange orchards. Similarly, leaf samples from the same orchards were also collected.
Regarding fertility status, sweet orange orchard soils are very low in available N (128.3-241.2 kg ha^{-1}), low to medium in available P (7.34-19.37 kg ha^{-1}) and medium to rich in available K (223.3-1042.6 kg ha^{-1}). Further, it was observed that these are soils were well supplied with available Ca and Mg nutrient (1265-4320 and 356-1232 mg kg^{-1}). Among micro nutrients, sweet orange orchard soils are 44 % deficient in DTPA Fe (2.73-9.8 mg kg^{-1}) and 51 % deficient in are DTPA Zn (0.42-1.76 mg kg^{-1}) and are 100 % sufficient in Cu (0.89-4.05 mg kg^{-1}) and Mn (4.75-26.75 mg kg^{-1}). Leaf analysis of sweet orange orchards in Jalna district confirmed the wide spread deficiencies of soil nutrients *viz.*, N, Zn and Fe.

Keywords: nutrient status, sweet orange orchards, *Citrus sinensis* L.

Introduction
Sweet orange (*Citrus sinensis* L) is most common among citrus fruits grown in India. It occupies nearly 50 per cent of the total citrus area in India. Though, it is grown in every state, certain belts or pockets have emerged as the leading producers. Citrus is one of the most economically important crops in India. Sweet orange is one of the most important orange cultivars used in Maharashtra. In sweet orange, 100 g fruit contains 60-80 % fruit juice, protein 0.8-1.4 g, fat 0.2-0.4 g, fiber 0.8 g, vitamin-A 198 I.U, 0.113 mg vitamin B_1, 0.046 mg riboflavin, 65.69 mg vitamin C, 0.2-0.8 mg iron, 0.16 mg calcium and 192-201 mg potassium.
Leaf analysis in recent years have been widely used to identify nutritional problems to detect deficiencies of nutrients and to measure the response to the applied plant nutrients. Leaf is the principle site of plant metabolism and the changes in nutrient supply are reflected in the composition of leaf, since both soil and plant analysis techniques was complementary to each other. Leaf analysis if properly done provides a valuable tool to define the citrus nutrition programme.
Leaf tissue analysis is a much better indicator of the effectiveness of soil applied fertilizer for these elements than soil analysis. In addition, if particular elements have not been applied as fertilizer, leaf tissue analysis indicates the availability of those nutrients in the soil. No adequate scientific study concerning sweet orange leaf diagnostic norms and soil fertility status in the Jalna district area has been made till date. Hence, the present investigation was undertaken to generate sufficient data base of balanced fertilization for optimum and good quality production of Sweet orange.

Material and Methods
Collection of leaf samples
For sampling of leaf, 200 to 250 leaves of 20 % representative trees from each orchard were collected. Fourth leaf of fruiting terminal was used as an index leaf for nutritional status. The leaf samples were collected from 4 to 6 months old non-fruiting terminal from Mrug flush (Srivastava and Singh 2006) [10]. The composite leaf sample was prepared and used for analysis.
Leaf sample collected at random, from working height of the tree, covering all the four sides of tree canopy. The leaf sample was then labeled properly and put in clean paper bag and brought to laboratory.

Preparation of leaf samples

The leaf samples after bringing to laboratory were washed with detergent powder followed by dipping in 0.1 N HCL solutions and finally rinsed with distilled water. The samples were air dried first in laboratory and then in oven at 60^0C for 48 hours. The oven dried samples were then ground with electrical grinder having stainless steel blade to avoid contamination and stored in clean polythene bags. These samples were then subsequently used for nutrient analysis.

Leaf analysis

Leaf samples were analyzed for nitrogen content by Kjeldhal method. For the analysis of P, K, Ca, and Mg the samples were digested with diacid mixture (HNO_3: $HClO_4$ in the ratio of 9:4). The digested material was then diluted with glass distilled water and volume was made up to 250 ml (Piper, 1966). For micronutrient analysis, leaf samples were digested for 15 min with 5 ml of HNO_3 and 4ml of 33 percent H_2O_2 (Pequerl *et al.*, 1993). The digested material was then diluted to 100 ml with double distilled water. The plant samples were then analyzed by using standard procedures.

Result and Discussion

Evaluation of leaf nutritional status of sweet orange orchards

The macronutrient contents of the sweet orange leaves from orchards of Jalna district are presented in table 01.

The data presented in table 01 revealed that, leaf N was varied from 2.16 to 2.94 percent and with average value of 2.45 percent, in Jalna district. The tehsilwise description of the leaf nitrogen content revealed that among eight tehsils of Jalna district, Bhokardan tehsil is having content leaf N 2.16 percent whereas, Ghansavangi tehsil is having leaf N average 2.94 percent. The similar type of observation was recorded by Mann *et al.*, (1979) [5] in sweet orange orchards of Panjab.

The data presented in table 01 revealed that, leaf P was varied from 0.16 percent to 0.18 percent with average value of 0.16 percent in Jalna district. The tehsilwise description of the leaf phosphorus revealed that Ghansavangi tehsil is having content leaf P average 0.16 percent whereas Mantha tehsil is having leaf P average 0.18 percent.

The data presented in table 01 revealed that, leaf K was varied from 1.42 percent to 2.18 percent with average value of 1.79 percent in Jalna district. The tehsilwise description of the leaf potassium revealed that Partur tehsil is having content leaf K average 1.42 percent, whereas Jafrabad tehsil is having leaf K average 2.18 percent. The similar type of observation was recorded by Dhale and Prasad (2009) [1] in sweet orange orchards of Marathwada region.

The data presented in table 01 revealed that, leaf Ca was varied from 4.91 to 6.05 percent with average value of 5.41 percent in Jalna district. The tehsilwise description of the leaf calcium revealed that Partur tehsil is having content leaf Ca average 4.90 percent, whereas, Mantha tehsil is having leaf Ca average 6.05 percent. In case of leaf Mg was varied from 0.42 to 0.52 percent with average value of 0.47 percent in Jalna district. The tehsilwise description of the leaf reaction parameter revealed that Mantha tehsil is having content leaf Mg average 0.42 percent whereas, Bhokardan tehsil is having leaf Mg average 0.52 percent. Similar observations recorded by Kausadikar (2005) [4] in sweet orange orchards of Marathwada region.

The data presented in table 01 revealed that, leaf Fe was varied from 127.4 to 180.1 µg g^{-1} with average value of 148.6 µg g^{-1} in Jalna district. The tehsilwise description of the leaf Fe revealed that Bhokardan tehsil is having content leaf Fe average 127.4 µg g^{-1} whereas Partur tehsil is having higher leaf Fe average 180.1 µg g^{-1}. All the sweet orange orchard leaf of Jalna district is sufficient in Fe. Similar observations recorded by Jadhav (2007) [3] in sweet orange orchards of Marathwada region.

The data presented in table 01 revealed that, leaf Mn was varied from 21.6 to 43.4 µg $g^{-1}$with average value of 33.0 µg g^{-1} in Jalna district. The tehsilwise description of the leaf Mn revealed that Jafrabad tehsil is having content leaf Mn average 21.6 µg g^{-1}, whereas, Mantha tehsil is having higher leaf Mn average 43.4 µg g^{-1}. Thus, 8 percent sweet orange orchard leaf Jalna district is deficient in Mn. The similar type of observation was recorded by Dhale and Prasad (2009) [1] in sweet orange orchards of Marathwada region.

The data presented in table 01 revealed that leaf Zn was varied from 23.61 to 51.94 µg g^{-1} with average value of 37.78 µg g^{-1} in Jalna district. The tehsilwise description of the leaf reaction parameter revealed that Bhokardan tehsil is having content leaf Zn average 23.61 µg g^{-1}, whereas, Partur tehsil is having higher leaf Zn average 51.94 µg g^{-1}. Thus, 2 percent sweet orange orchards leaf of Jalna district is deficient in Zn. The similar type of observation was recorded by Gorde (1994) [2] in sweet orange in Marathwada region.

The data presented in table 01 revealed that, leaf Cu was varied from 4.30 to 5.74 µg $g^{-1}$with average value of 4.90 µg g^{-1} in Jalna district. The tehsilwise description of the leaf reaction parameter revealed that Jalna tehsil is having content leaf Cu average 4.30 µg g^{-1}, whereas, Mantha tehsil is having higher leaf Cu average 5.74 µg g^{-1}. Thus, 58 percent sweet orange orchard leaf of Jalna district is deficient in Cu. The similar type of observation was recorded by Dhale and Prasad (2009) [1] in sweet orange in Marathwada region.

The data leaf macronutrient and micronutrient properties of sweet orange orchards tehsilwise description from Jalna district are presented in table 02.

The data presented in table 02 revealed that, Jalna district among macronutrients *viz.*, leaf N, P and K ranged between 2.16 to 2.94, 0.16 to 0.18 and 1.19 to 2.18 and 1.19 to 2.18 percent with a mean value of 2.45, 0.16 and 1.79 percent, respectively. Similarly, leaf Ca and Mg ranged from 4.9 to 6.05 and 0.42 to 0.52 percent with an average value of 5.41 and 0.47 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged between 23.61 to 51.94, 4.30 to 5.74, 127.4 to 180.1 and 21.6 to 43.4 µg g^{-1} with average value of 37.78, 4.90, 148.6 and 33.0 µg g^{-1} respectively in leaf. The similar type of observation was recorded by Dhale and Prasad (2009) [1] in sweet orange orchards of Marathwada region.

The data presented in table 02 revealed that, Mantha tehsil among macronutrients *viz.*, leaf N, P and K ranged between 1.59 to 2.98, 0.12 to 0.30 and 1.69 to 2.31 percent with a mean value of 2.32, 0.18 and 1.94 percent, respectively. Similarly, leaf Ca and Mg ranged from 4.44 to 7.91 and 0.37 to 0.46 percent with an average value of 6.05 and 0.42 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 31.67 to 59.73, 3.72 to 8.8, 130 to 178.7 and 30.4 to 60.4 µg g^{-1} with average value of 41.71, 5.74, 142.2 and 43.4 µg g^{-1} respectively in leaf.

The data presented in table 02 revealed that, Partur tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.41 to 2.41, 0.17 to 0.17 and 1.42 to 1.42 percent with a mean value of 2.14, 0.17 and 1.42 percent, respectively. Similarly, leaf Ca and Mg ranged from 4.90 to 4.90 and 0.50

to 0.50 percent with an average value of 4.90 and 0.50 per cent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 51.94 to 51.94, 5.35 to 5.35, 180.1 to 180.1 and 28.1 to 28.1 µg g^{-1} with average value of 51.94, 5.35, 180.1 and 28.1µg g^{-1} respectively in leaf. The similar type of observation was recorded by Dhale and Prasad (2009) [1] in sweet orange orchards of Marathwada region.

The data presented in table 02 revealed that, Jalna tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.17 to 2.66, 0.17 to 0.20 and 1.63 to 2.20 percent with a mean value of 2.40, 0.17 and 1.94 percent, respectively. Similarly, leaf Ca and Mg ranged from 3.41 to 6.23 and 0.46 to 0.54 percent with an average value 4.91 and 0.49 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 20.05 to 41.53, 3.05 to 5.45, 92.22 to 158.9 and 15.5 to 41.4 µg g^{-1} with average value of 32.25, 4.30, 130.8 and 31.0 µg g^{-1} respectively in leaf. The similar type of observation was recorded by Gorde (1994) [2] in sweet orange orchards of Marathwada region.

The data presented in table 02 revealed that, Ghansavangi tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.18 to 4.31, 0.14 to 0.19 and 1.71 to 2.34 percent with a mean value of 2.94, 0.16 and 2.02 percent, respectively. Similarly, leaf Ca and Mg ranged from 4.92 to 5.90 and 0.46 to 0.52 percent with an average value of 5.38 and 0.48 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 41.53 to 51.32, 3.66 to 5.44, 133.7 to 184.1 and 29.8 to 38.0 µg g^{-1} with average value of 47.30, 4.63, 166.0 and 32.6 µg g^{-1} respectively in leaf.

The data presented in table 02 revealed that, Jafrabad tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.49 to 2.49, 0.17 to 0.17 and 2.18 to 2.18 percent with a mean value of 2.49, 0.17 and 2.18 percent, respectively. Similarly, leaf Ca and Mg ranged from 5.97 to 5.97 and 0.50 to 0.50 percent with an average value of 5.97 and 0.50 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 25.90 to 25.90, 4.38 to 4.38, 162.1 to 162.1 and 21.6 to 21.6 µg g^{-1} with average value of 25.90, 4.38, 162.1 and 21.6 µg g^{-1} respectively in leaf. Similar observations recorded by Kausadikar (2005) [4] in sweet orange orchards of Marathwada region.

The data presented in table 02 revealed that, Bhokardan tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.16 to 2.16, 0.17 to 0.17 and 1.95 to 1.95 per cent with a mean value of 2.16, 0.17 and 1.95 per cent, respectively. Similarly, leaf Ca and Mg ranged from 5.33 to 5.33 and 0.52 to 0.52 percent with an average value of 5.33 and 0.52 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 23.61 to 23.61, 4.48 to 4.48, 127.4 to 127.4 and 30.6 to 30.6 µg g^{-1} with average value of 23.61, 4.48, 127.4 and 30.6 µg g^{-1} respectively in leaf. Similar observations recorded by Jadhav (2007) [3] in sweet orange orchards of Marathwada region.

The data presented in table 02 revealed that, Badnapur tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.39 to 2.85, 0.15 to 0.20 and 1.48 to 2.15 percent with a mean value of 2.52, 0.17 and 1.83 percent, respectively. Similarly, leaf Ca and Mg ranged from 4.31 to 5.90 and 0.44 to 0.52 per cent with an average value of 5.27 and 0.46 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 26.92 to 43.87, 4.49 to 5.89, 123.8 to 156.3 and 31.1 to 49.3 µg g^{-1} with average value of 37.42, 5.17, 139.4 and 37.5 µg g^{-1} respectively in leaf.

The data presented in table 02 revealed that, Ambad tehsil among macronutrients *viz.*, leaf N, P and K ranged between 2.37 to 2.37, 0.16 to 0.16 and 1.84 to 1.84 percent with a mean value of 2.37, 0.16 and 1.84 per cent, respectively. Similarly, leaf Ca and Mg ranged from 5.54 to 5.54 and 0.45 to 0.45 percent with an average value of 5.54 and 0.45 percent, respectively. It was also noticed that, micronutrients *viz.*, Zn, Cu, Fe and Mn were ranged from 42.15 to 42.15, 5.25 to 5.25, 140.8 to 140.8 and 39.7 to 39.7 µg g^{-1} with average value of 42.15, 5.25, 140.8 and 39.7 µg g^{-1} respectively in leaf. The similar type of observation was recorded by Dhale and Prasad (2009) [1] in sweet orange orchards Marathwada region.

Assessment leaf nutrient status of healthy and unhealthy sweet orange orchards

The analytical data regarding the nutritional status of healthy and unhealthy orchards based on leaf analysis are presented in table 03 the mean nitrogen concentration in the leaf of healthy sweet orange orchards was 2.47 percent with range of 1.68 to 3.92 percent. In the unhealthy orange trees, it was 2.38 percent, which ranged from 1.59 to 3.85 percent. In case of phosphorus, it ranged from 0.13 to 0.31 and 0.12 to 0.31 percent with average value of 0.18 and 0.16 percent in healthy and unhealthy sweet orange orchards, respectively. Regarding leaf K concentration, it varied from 1.1 to 3.05 and 1.23 to 2.99 with average of 1.90 and 1.88 percent in healthy and unhealthy. Similar, observation was recorded by Srivastava and Singh (1999) in Jaipur district of Rajasthan. In case of leaf, Ca and Mg content differed from 3.15 to 7.91 percent (5.49 percent), 0.37 to 0.68 percent (0.48 percent), in healthy sweet orange orchards, respectively. While unhealthy sweet orange orchards showed leaf Ca and Mg concentrations as 3.12 to 7.91 percent (5.35 percent), 0.25 to 0.63 percent (0.47 percent), respectively.

Micronutrients like Fe, Mn, Zn and Cu varied from 86.5 to 239.9, 15.5 to 60.4, 14.75 to 60.83 and 3.05 to 8.8 µg g^{-1} with mean value of 147.3, 45.55, 38.98 and 5.11 µg g^{-1} in the foliage of healthy sweet orange orchards. Whereas, the leaf Fe, Mn, Zn and Cu varied from 72.2 to 239.9,15.25 to 60.4, 13.32 to 61.7 and 2.66 to 8.8 µg g^{-1} with mean value of 141.1, 33.74, 37.41, 4.83 µg g^{-1}, respectively in the foliage of unhealthy sweet orange orchards. Healthy sweet orange orchards showed higher leaf N, K, Ca and Mg while unhealthy orchards showed higher P, Fe, Mn, Zn, Cu contents. Higher micronutrient status might not be the reason for unhealthy status. Also, direct relationship of leaf micronutrients was not found with unhealthy status of orange orchards. Similar findings were recorded by Sharma and Mahajan (1990) [9] in sweet orange orchards of Marathwada region.

Table 1: Villagewise leaf macronutrient and micronutrient status of sweet orange orchards of Jalna district. (Mean values)

Village / Taluka	N	P	K	Ca	Mg	Zn	Cu	Fe	Mn
Unit	Per cent					µg g^{-1}			
Gevrai	2.26	0.30	1.69	5.61	0.46	45.69	3.72	130.0	49.8
Aakai	1.59	0.16	2.31	7.91	0.44	59.73	4.67	178.7	42.8
Kandali	2.98	0.12	2.03	4.45	0.41	31.67	8.8	141.1	30.4
Aakani	1.83	0.18	1.88	7.88	0.37	36.9	5.45	125.6	60.4
Vaturphata	2.98	0.16	1.94	4.44	0.45	34.6	6.1	136.1	33.7
Mantha	2.32	0.18	1.94	6.05	0.42	41.71	5.74	142.2	43.4
Yeldapur	2.41	0.17	1.42	4.90	0.50	51.94	5.35	180.1	28.1
Partur	2.41	0.17	1.42	4.90	0.50	51.94	5.35	180.1	28.1
Ramnagar	2.17	0.17	1.87	4.90	0.46	41.53	5.45	92.22	31.9
Savrgao	2.35	0.16	2.06	6.23	0.51	27.84	4.66	158.9	35.5
Dhanurshivar	2.66	0.16	2.20	3.41	0.54	20.05	3.05	135.5	15.5
Viregao	2.45	0.20	1.63	5.12	0.48	39.59	4.07	136.8	41.4
Jalna	2.40	0.17	1.94	4.91	0.49	32.25	4.30	130.8	31.0
Rajni	4.31	0.14	2.34	4.92	0.46	41.43	5.44	180.3	29.8
Krushnapurwadi	2.18	0.17	2.03	5.33	0.52	49.17	3.66	133.7	38.0
Hivra	2.33	0.19	1.71	5.90	0.46	51.32	4.81	184.1	30.2
Ghansavangi	2.94	0.16	2.02	5.38	0.48	47.30	4.63	166.0	32.6
Asai	2.49	0.17	2.18	5.97	0.50	25.90	4.38	162.1	21.6
Jafrabad	2.49	0.17	2.18	5.97	0.50	25.90	4.38	162.1	21.6
Kedarkhada	2.16	0.17	1.95	5.33	o.52	23.61	4.48	127.4	30.6
Bhokardan	2.16	0.17	1.95	5.33	0.52	23.61	4.48	127.4	30.6
Varudi	2.39	0.15	2.01	4.31	0.49	34.87	4.96	134.7	27.6
G.Bajar	2.45	0.18	1.48	5.20	0.44	32.66	4.73	125.2	49.3
Kandari	2.85	0.17	1.67	5.26	0.44	43.52	5.89	156.3	39.8
Sumthana	2.47	0.20	2.15	5.90	0.43	43.87	5.48	141.2	42.9
Dudhanvadi	2.53	0.17	1.75	5.17	0.46	42.69	5.52	123.8	34.7
Badnapur	2.43	0.18	1.97	5.81	0.52	26.92	4.49	155.3	31.1
Badnapur	2.52	0.17	1.83	5.27	0.46	37.42	5.17	139.4	37.5
Badapur	2.37	0.16	1.84	5.54	0.45	42.15	5.25	140.8	39.7
Ambad	2.37	0.16	1.84	5.54	0.45	42.15	5.25	140.8	39.7
JALNA (Range/Mean)	(2.16-2.94) 2.45	(0.16-0.18) 0.16	(1.42-2.18) 1.79	(4.9-6.05) 5.41	(0.42-0.52) 0.47	(23.61-51.94) 37.78	(4.30-5.74) 4.90	(127.4-180.1) 148.6	(21.6-43.4) 33.0

Table 2: Tehsilwise leaf macronutrient and micronutrient status of sweet orange orchards of Jalna district

Tehsil	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Zn (µg g^{-1})	Cu (µg g^{-1})	Fe (µg g^{-1})	Mn (µg g^{-1})
Mantha	(1.59-2.98) 2.32	(0.12-0.30) 0.18	(1.69-2.31) 1.42	(4.44-7.91) 6.05	(0.37-0.46) 0.42	(31.6-59.7) 41.71	(3.72-8.8) 5.74	(130.0-178.7) 142.2	(30.4-60.4) 43.4
Partur	(2.41-2.41) 2.41	(0.17-017) 0.17	(1.42-1.42) 1.42	(4.90-4.90) 4.90	(0.50-0.50) 0.50	(51.9-51.9) 51.90	(5.35-5.35) 5.35	(180.1-180.1) 180.1	(28.1-28.1) 28.1
Jalna	(2.17-2.66) 2.40	(0.16-0.20) 0.17	(1.63-2.20) 1.94	(3.41-6.23) 4.91	(0.46-0.54) 0.49	(20.0-41.5) 32.25	(3.05-5.45) 4.30	(92.22-158.9) 130.8	(15.5-41.4) 31.0
Ghansavangi	(2.18-4.31) 2.94	(0.14-0.19) 0.16	(1.71-2.34) 2.02	(4.92-5.90) 5.38	(0.46-0.52) 0.48	(41.4-51.3) 47.30	(3.66-5.44) 4.63	(133.7-184.1) 166.0	(29.8-38.0) 32.6
Jafrabad	(2.49-2.49) 2.49	(0.17-0.17) 0.17	(2.18-2.18) 2.18	(5.97-5.97) 5.97	(0.50-0.50) 0.50	(25.9-25.9) 25.90	(4.38-4.38) 4.38	(162.1-162.1) 162.1	(21.6-21.6) 21.6
Bhokardan	(2.16-2.16) 2.16	(0.17-017) 0.17	(1.95-1.95) 1.95	(5.33-5.33) 5.33	(0.52-0.52) 0.52	(23.6-23.6) 23.61	(4.48-4.48) 4.48	(127.4-127.4) 127.4	(30.6-30.6) 30.6
Badnapur	(2.39-2.85) 2.52	(0.15-0.20) 0.17	(1.48-2.15) 1.83	(4.31-5.90) 5.27	(0.44-0.52) 0.46	(26.9-43.8) 37.42	(4.49-5.89) 5.17	(123.8-156.3) 139.4	(31.1-49.3) 37.5
Ambad	(2.37-2.37) 2.37	(0.16-0.16) 0.16	(1.84-1.84) 1.84	(5.54-5.54) 5.54	(0.45-0.45) 0.45	(42.1-42.1) 42.1	(5.25-5.25) 5.25	(140.8-140.8) 140.8	(39.7-397) 39.7
Jalna	(2.16-2.94) 2.45	(0.16-0.18) 0.16	(1.42-2.18) 1.79	(4.9-6.05) 5.41	(0.42-0.52) 0.47	(23.6-51.9) 37.78	(4.30-5.74) 4.90	(127.4-180.1) 148.6	(21.6-43.4) 33.0

Table 3: Leaf nutrient status of healthy and unhealthy sweet orange orchards from Jalna district

Nutrients	Healthy orchards		Unhealthy orchards	
	Range	Mean	Range	Mean
Nitrogen (%)	1.68-3.92	2.47	1.59-3.65	2.38
Phosphorus (%)	0.13-0.31	0.18	0.12-0.31	0.16
Potassium (%)	1.1-3.05	1.90	1.2-2.99	1.88
Calcium (%)	3.15-7.91	5.49	3.12-7.91	5.35
Magnesium (%)	0.37-0.68	0.48	0.25-0.63	0.47
Iron (µg g^{-1})	86.5-239.9	147.3	72.2-239.9	141.1
Zinc (µg g^{-1})	14.75-60.83	38.98	13.32-61.7	37.41
Manganese(µg g^{-1})	15.5-60.4	45.55	15.2-60.4	33.74
Copper (µg g^{-1})	3.05-8.8	5.11	2.66-8.8	4.83

Conclusions

Leaf analyses of sweet orange orchards in Jalna district confirmed the wide spread deficiencies of available nutrients as well as leaf N, Zn, Cu and Mn.

The leaf sweet orange orchards of jalna district are available N 36 percent deficient and all orchards leaf in 100 percent sufficient in available P and K. In case the all orchards leaf in 100 percent sufficient in available Ca and Mn in leaf. Among micronutrients, leaf was deficient in Mn 8 percent and Zn 2 percent, Cu 58 percent contents and was sufficient in Fe.

Leaf healthy sweet orange orchards of Jalna district are N 17 percent deficient and all orchards leaf in 53 percent sufficient in available P and K. In case the all orchards leaf in 53 percent sufficient in available Ca and Mn in leaf. Among micronutrients, leaf healthy sweet orange orchards were deficient in Mn 4 percent and Zn 1 percent, Cu 27 percent contents and was 53 percent sufficient leaf healthy sweet orange orchards in Fe.

Leaf unhealthy sweet orange orchards of Jalna district are available N 19 percent deficient and all orchards leaf in 47 percent sufficient in available P and K. In case the all orchards leaf in 47 percent sufficient in available Ca and Mn in leaf. Among micronutrients, a leaf unhealthy sweet orange orchard was deficient in Mn 4 per cent and Zn 1 percent, Cu 31 percent contents and was 47 per cent sufficient leaf healthy sweet orange orchards in Fe.

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