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Soil and Leaf Nutritional Studies and Status of Healthy and Declined Mandarin Orchards

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Abstract

The present investigation was carried out to determine soil and leaf nutritional status of some typical healthy and declined mandarin orchards of Amravati District (M.S) during 2016-19.Total twenty five representative surface and depth wise soil and leaf samples from healthy and declined mandarin orchards were collected and analyzed various nutrients in plant as well as leaf samples. The data analysis showed that total nitrogen content in healthy and declined mandarin orchards from surface soils varied from 0.045 to 0.093 % and 0.015 to 0.37% respectively. The available nitrogen, phosphorus and potassium content of healthy orchards surface soils varied from 200.0 to 265.7 kg ha^{-1}, 22.0 to 35.3 kg ha^{-1}, 320.0 to 665.0 kg ha^{-1} and in declined orchards it varied from 130.4 to 203.5 kg ha^{-1}, 17.8 to 21.3 kg ha^{-1}, 360.0 to 744.4 kg ha^{-1} respectively. The exchangeable calcium and magnesium together constitute more than 80% of exchange complex. The exchangeable calcium, magnesium and sulphur content in healthy orchards surface soils varied from 26.34 to 30.22 cmol (p^{+}) kg ha^{-1}, 11.71 to 16.92 cmol (p^{+}) kg ha^{-1}, 0.27 to 0.90 kg ha^{-1} and in declined orchards it varied from 29.00 to 31.98 cmol (p^{+}) kg ha^{-1}, 12.07 to 13.71 cmol (p^{+}) kg ha^{-1}, 0.36 to 0.69 kg ha^{-1} respectively. Micronutrients status of orange orchards showed that available copper, zinc, iron and manganese in healthy orchards surface soils varied from 2.20 to 5.60 ppm, 0.50 to 0.79 ppm, 4.50 to 6.29 ppm, 12.61 to 18.11 ppm and in declined orchards it varied from 1.90 to 2.48 ppm, 0.35 to 0.46 ppm, 3.40 to 5.00 ppm, 8.10 to 12.24 ppm respectively. Findings revealed that total nitrogen, available nitrogen, phosphorus, sulphur, zinc and manganese content found more supporting in healthy orchards than declined ones. Depth wise distribution showed that total nitrogen, available nitrogen, phosphorus and copper showed decreasing trend with the soil depth.

The leaf nutrient content in the plant showed that nitrogen, phosphorus and potassium content in leaf of healthy orchards varied from 2.35 to 2.55%, 0.14 to 0.17%, 0.82 to 1.00% and in declined orchards it varied from 1.75 to 2.00%, 0.10 to 0.13%, and 0.84 to 1.70% respectively. Calcium, magnesium and sulphur content in healthy orchards varied from 3.00 to 3.90%, 0.60 to 0.74%, 0.21 to 0.19% and in declined orchards it ranged from 2.40 to 3.15%, 0.33 to 0.74%, and 0.19 to 0.23% respectively. Results pertaining to micronutrient showed that iron; manganese, copper and zinc in healthy orchards varied from 105.6 to 140.6 ppm, 21.72 to 34.62 ppm, 29.40 to 35.96 ppm, 30.45 to 39.18 ppm, and in declined orchards it varied from 70.66 to 100.00 ppm, 20.38 to 27.67 ppm, 21.72 to 26.05 ppm, and 17.24 to 25.00 ppm respectively. Results showed that a healthy orchard has significantly higher content of nutrient than declined orchards except potassium content.

Key Words
Leaf
Mandarin Orchids
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Soil

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1. Introduction

Citrus ranks third among fruit crops after Mango and Banana. Citrus have a prominent place among popular and extensively grown tropical and subtropical fruits. It is one of the most important commercial fruit crop grown in different parts of the world. India ranks fifth position in citrus productivity. Citrus is one of the ruminative commercial fruit crop after mango and banana. In India, it is occupying an area of 4.97 lakh ha with total production 54 lakh tons. Among the important citrus fruits, Nagpur mandarin is cultivated on a very large scale especially in central and south Indian states. Maharashtra is a leading state in its cultivation and at present area under Nagpur Mandarin is around 1,50,000 ha and most of the area concentrated in Nagpur and Amravati District of Vidarbha region. Morshi and Warud Tahsil are also popularly known as California of Vidarbha region due to its export quality of Nagpur mandarin.

In the last decade, area and production of Nagpur mandarin decreased because of several reasons like problematic soils, Faulty selection root stocks, unavailabity of quality planting material and many orchards of Nagpur mandarin of Warud and Morshi area have proven to be failure because of defective soil site selection and less availability of nutrients causing deterioration and decline in citrus. Thus affect yield, bearing and growth of the tree. Therefore the present study has been taken to characterize and classify some typical healthy and declined Nagpur mandarin gardens in Warud and Morshi Tahsil of Amravati District (M.S.) for their suitability assessment and quality production of Nagpur mandarin in Amravati region

2. Material and Methods

The present investigation was carried out by selecting healthy and declined orchards of Warud and Morshi tehsil Amravati district (M.S.). Ten orchards from healthy and declined condition were selected on the basis of their yield performance for last five years (2011-15) and pedigree and phenotypic observations respectively. Twenty five representative depth wise sample, ten one from healthy and ten one from declined mandarin orchards were collected. Soil samples were analyzed for total nitrogen & available nitrogen, phosphorus, potassium, sulphur by modified Kjeldhal's method [1] alkaline potassium permanganate method [2], Olsens method (Jackson, 1967), flame photometer method [3] and turbidimetric method [4], respectively.

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Exchangeable cations (calcium and magnesium) were determined by neutral normal ammonium acetate method [1]. Available micronutrients (copper, zinc, iron and manganese) were determined by Atomic absorption spectrophotometer [5]. The leaf samples were analyzed for nitrogen, phosphorus, potassium, calcium magnesium and sulphur by standard methods [3]. Total iron, manganese, copper and zinc were determined by Atomic Absorption Spectrophotometer method [5].

3. Results and Discussion

The data regarding nutritional status (Soil & Plant) of mandarin orchards are presented in Table 1.

3.1 Soil nutritional status of healthy and declined Mandarin orchards.

3.1.1 Total Nitrogen and available Nitrogen, Phosphorus and Potassium content

Nitrogen is a constituent of protein so without a sufficient supply of nitrogen, no new cells can be formed; therefore, total nitrogen is more important nutrient in soil for orange plantation. The total nitrogen content in surface layers soil ranged 0.045 to 0.093 per cent indicating its wide variation in soils of healthy orchards. In declined orchards soils it ranged between 0.015 to 0.037 per cent in surface layers. Depth wise distribution showed decreasing trend of total nitrogen content with the soil depth in all healthy and declined orchards soil. The results showed that total nitrogen content in healthy orchards was high as compared to decline ones. Similar results were also reported by [6] under Nagpur condition.

Available nitrogen content in healthy and declined orchards soils varied from 200.0 to 265.7 Kg ha^{-1} and 130.4 to 203.8 Kg ha^{-1} respectively. All soils of orange orchards were categorized as low to very low in available nitrogen. Available nitrogen content was found higher in soils supporting healthy orchards than declined orchards. The results showed that available nitrogen decreases with soil depth in all healthy and decline orchards. Similar results were observed [7].

The available phosphorus content of healthy and declined orange orchards surface soils ranged from 22.0 to 35.3 Kg $ha^{-1}$and 17.8 to 21.3 Kg ha^{-1} respectively. According to the standard rating it appears that healthy orchard soils were found to be low to medium and declined orange orchards in low in available P_2O_5 content. From observation it was observed that available P_2O_5 decreased continuously with soil depth. Similar results were reported [7].

Table 1. Nutrients Status of Healthy and Declined Orange Orchards

Sr. No	Depth (cm)	Total Nitrogen (%)	Available Nutrient (Kg Ha^{-1})			Echangeable Cations cmol (p^{+}) kg ha^{-1}			Available Micro-nutrient (ppm)			
			N	P_2O_5	K_2O	Ca^{++}	Mg^{++}	S	Fe	Mn	Cu	Zn
Healthy Orange Orchards												
	Location : LH1											
	0 – 20	0.056	222.9	37.6	392.0	31.58	15.32	11.00	6.39	14.32	2.33	0.56
1	20 – 50	0.043	189.1	26.8	296.8	32.77	15.62	9.40	5.42	8.33	2.01	0.63
	50 – 80	0.036	177.8	23.2	347.2	33.23	16.70	8.70	8.81	9.75	1.80	0.50
	80 - 100	0.032	172.1	21.5	358.4	33.72	16.03	9.90	7.20	3.92	1.22	0.41
	Location : LH2											
	0 – 20	0.056	234.2	38.4	672.0	31.71	13.71	11.30	5.82	17.11	3.15	0.84
2	20 – 50	0.049	214.5	30.6	638.4	31.92	14.32	12.10	6.40	13.71	2.27	0.42
	50 – 80	0.045	208.8	28.6	560.0	33.30	15.70	11.00	6.56	6.10	2.18	0.38
	80 - 100	0.036	169.3	19.7	532.0	34.00	14.30	9.50	8.28	4.92	1.97	0.32
	Location : LH3											
	0 – 20	0.052	206.0	25.0	324.0	29.34	14.41	11.00	4.69	12.72	2.85	0.69
3	20 – 50	0.046	189.1	23.2	284.8	31.70	13.32	10.10	5.84	11.0	2.76	0.52
	50 – 80	0.038	186.2	19.7	296.5	31.90	12.07	9.50	5.01	8.61	2.31	0.30
	80 - 100	0.029	177.8	14.1	294.4	33.42	13.83	7.30	7.21	6.33	2.40	0.32
	Location : LH4											
	0 – 20	0.061	241.6	31.4	492.8	30.61	16.8	11.20	5.70	14.35	2.30	0.80
4	20 – 50	0.046	210.3	21.5	324.8	31.20	15.74	12.10	5.83	12.65	2.55	0.62
	50 – 80	0.037	194.7	17.3	291.2	33.21	15.90	10.30	6.22	7.37	2.40	0.41
	80 - 100	0.030	176.2	13.4	257.6	33.92	15.92	9.70	6.15	6.39	2.30	0.41
	Location : LH5											
5	0 – 20	0.058	245.5	26.8	560.0	31.70	16.90	11.60	5.09	15.05	2.34	0.63
	20 – 50	0.026	186.2	15.9	390.2	32.33	14.21	8.30	6.33	8.27	1.50	0.52
Declined Orange Orchards												
	Location : LD1											
	0 – 20	0.031	206.8	22.0	420.0	30.77	15.19	9.00	5.03	8.79	2.05	0.42
6	20 – 50	0.024	186.0	17.0	312.8	31.03	16.87	9.70	5.40	5.48	1.42	0.45
	50 – 80	0.021	155.2	14.3	296.8	31.17	15.97	8.50	7.12	5.53	1.51	0.21
	80 - 100	0.018	149.3	11.2	310.0	33.29	14.89	6.30	5.20	4.98	1.14	0.21
	Location : LD2											
	0 – 20	0.031	208.8	19.8	368.4	32.07	15.71	9.70	4.13	12.07	2.02	0.51
7	20 – 50	0.029	180.6	16.0	390.8	32.81	15.4	11.00	4.51	7.71	1.44	0.31
	50 – 80	0.026	163.6	12.1	280.0	33.17	14.98	8.40	5.17	6.91	2.00	0.30
	80 - 100	0.023	149.5	9.9	357.6	33.47	14.73	7.40	5.21	4.44	1.05	0.20
	Location : LD3											
	0 – 20	0.029	177.8	20.2	750.4	31.22	15.69	10.80	4.83	10.15	2.25	0.42
8	20 – 50	0.022	152.4	19.1	587.2	31.37	15.90	8.90	4.72	11.27	2.07	0.39
	50 – 80	0.021	141.1	17.3	465.8	32.83	14.72	9.40	4.81	7.30	1.51	0.22
	80 - 100	0.015	135.4	12.5	517.9	34.12	13.89	7.60	4.49	5.40	1.17	0.20
	Location : LD4											
9	0 – 20	0.038	197.5	23.6	364.0	33.98	14.27	11.50	4.29	12.34	2.38	0.51
	20 – 50	0.029	180.6	20.8	313.6	35.72	13.90	10.60	4.43	8.29	1.95	0.54
	50 – 73	0.017	124.1	11.2	374.2	31.70	12.08	7.60	5.17	4.43	1.78	0.31
	Location : LD5											
	0 – 20	0.036	149.5	23.3	554.4	31.70	13.93	11.40	3.50	11.24	2.88	0.46
10	20 – 50	0.027	141.1	19.8	412.8	34.02	13.73	8.10	3.90	8.27	1.33	0.36
	50 – 80	0.019	124.1	14.3	291.2	34.19	13.70	8.60	3.98	6.62	1.21	0.31
	80 - 100	0.014	112.8	12.3	327.5	36.59	11.80	6.50	4.10	4.25	1.07	0.30

Available potassium content in healthy and declined orange orchards ranged from 320.0 to 665.0 Kg $ha^{-1}$and 360.0 to 744.4 Kg ha^{-1} in surface layer respectively. All soils of healthy and declined orchards were under high to very high available potassium content according to standard ratings. The high potassium content may be attributed to the presence of potassium supplying minerals in the parent rock of the

area. High amount of available potassium was also been reported [8] for the black soil. Data clearly indicate that there was no uniform increase or decrease trend of available potassium content with depth of the soil.

3.1.2 Exchangeable Calcium, Magnesium and Sulphur

Calcium and magnesium are predominant found on the Colloidal complex of these soils. Their content in surface soil ranged from 26.34 to 30.00 cmol (p+) ha-1 and 11.71 to 16.92 cmol (p+) ha-1 respectively. In respect of exchangeable calcium there was increasing trend with soil depth in all orchards soil except orchard site No. 10. it was observed that these soils contained very high content of Ca and Mg, which together form more than 80 per cent of the exchangeable cations on the exchange complex and there was similar findings [9].

Available sulphur in surface layers of healthy and declined orange orchards ranged from 12.61 to 18.11 ppm and 8.10 to 12.24 ppm respectively. The soils supporting healthy orchard content high available sulphur than declined areas [10]. The result showed that there was no any uniform increasing or decreasing trend with soil depth.

3.1.3 Micronutrient Status of Orange Orchards

The results indicate that surface soil layers in healthy orchards content higher amount of available copper as compared to declined orchard. It ranged from 2.20 to 5.60 ppm and 1.90 to 2.48 ppm in healthy and declined orange orchards respectively. Similar observations were also reported [11]. The availability of copper in healthy and declined orange orchards soils was quite high as compared with its critical limit (0.2 ppm) as suggested [5] and similar results were also reported [9]. Available zinc content in healthy and declined orchards varied from 0.50 to 0.79 ppm and 0.35 to 0.46 ppm in surface soil samples respectively. It was further observed that by and large, the soil samples from declined orange orchards soils content comparatively less available zinc than healthy orchards. Similar observation was also reported [11]. The critical limit for available zinc is 1.0 ppm, so zinc content in all declined orange orchards showed low content of available zinc.

Available iron content in healthy and declined orchards varied from 3.40 to 5.00 ppm and 3.50 to 5.13 ppm in surface soil samples respectively. It was observed that most of the orchards soils were well supported with available iron. Similar observations were also reported [12]. Available manganese content in healthy and declined orange orchards ranged from 12.61 to 18.11 ppm and 8.10 to 12.24 ppm in surface soil samples respectively. The available manganese content was invariably higher in the soils of healthy orchards than decline orange soils. Similar observations were also reported [12].

3. Leaf nutritional status of healthy and declined Nagpur mandarin orchards:

Data regarding leaf nutritional status of healthy and declined orange orchards are presented in Table 2.

3.2.1 Total Nitrogen Phosphorus and Potassium

The data regarding nitrogen content in leaves of healthy orchards varied from 2.35 to 2.55 per cent with mean value of 2.41 per cent and in declined orchards it varied from 1.70 to 2.08 per cent with mean value of 1.92per cent, similar observation were also reported [13] It was observed that nitrogen content in leaves of healthy orchards was higher as compared with declined ones. This may be due to higher soil nitrogen status of healthy orange orchards than declined orange orchards. Phosphorus content in the leaves of Nagpur mandarin varied from 0.14 to 0.17 per cent in healthy trees and 0.08 to 0.11per cent in declined trees with a mean value of 0.14per cent and 0.09 per cent in the leaves of healthy and declined orchards respectively. Similar observations were also [13]. It was observed that phosphorus content in the leaves of healthy trees was higher as compared to declining trees. Low concentration phosphorus might be due to low available phosphorus status in soils of declined orange orchards and inadequate use of phosphatic fertilizers.

Potassic content in the leaves of healthy trees varied from 0.82 to 1.00per cent with an average of 0.89 per cent. In declining trees it varied from 0.83 to 1.73per cent with mean value of 1.06per cent. It was observed that the declined trees accumulated more potassium in the leaves than the healthy ones which is in accordance with the findings [14].

3.2.2 Calcium Magnesium and Sulphur

Citrus plants contain more calcium than any other plant nutrient. The mean concentration of calcium in leaves of Nagpur mandarin was 3.42 per cent, with a ranged of 3.00 to 3.90per cent in healthy trees. In the declined trees, it ranged from 2.40 to 3.15per cent with a mean value of 2.90per cent. Most of the healthy and declined trees contained calcium in optimum range. It was observed that calcium status was higher in healthy trees than that of declined one. Similar observations were also reported earlier [12]. Average magnesium concentration was 0.64per cent, which ranged from 0.60 to 0.74per cent in healthy

Table II. Leaf Nutrient Content of Healthy and Declined Orange Orchards.

Sr No	Location	Age of trees	Total 'N' (%)	Total'P' (%)	Total'K' (%)	Ca (%)	Mg (%)	S (%)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)
Healthy Orange Orchards.												
1	LH1	14	2.38-2.42 (2.40)	0.14-0.16 (0.15)	0.85-0.88 (0.87)	3.64-3.70 (3.78)	0.59-0.65 (0.61)	0.19-0.21 (0.20)	132-147 (138.6)	26.0-30.1 (28.45)	27.0-29.0 (27.69)	27.9-29.1 (28.37)
2	LH2	12	2.36-2.40 (2.37)	0.12-0.14 (0.13)	0.86-0.88 (0.87)	3.18-3.22 (3.20)	0.52-0.62 (0.57)	0.17-0.22 (0.19)	108-130 (122.3)	25.0-31.5 (28.52)	24.2-30.0 (27.40)	26.0-31.6 (29.13)
3	LH3	12	2.50-2.53 (2.51)	0.16-0.17 (0.16)	0.82-1.10 (0.99)	3.96-4.02 (3.86)	0.68-0.74 (0.71)	0.18-0.23 (0.20)	98-107 (102.6)	30.0-35.5 (32.54)	28.1-31.0 (29.94)	27.2-28.8 (28.31)
4	LH4	8	2.38-2.47 (2.43)	0.12-0.14 (0.12)	0.79-0.84 (0.81)	2.92-3.12 (3.02)	0.56-0.68 (0.64)	0.17-0.14 (0.18)	129-132 (130.6)	31.0-41.0 (37.18)	32.0-33.1 (32.46)	23.5-29.5 (25.79)
5	LH5	9	2.17-2.29 (2.30)	0.15-0.17 (0.16)	0.78-0.81 (0.80)	3.14-3.38 (3.37)	0.58-0.62 (0.60)	0.16-0.24 (0.20)	92-109 (101.0)	32.0-39.0 (36.16)	31.0-36.1 (33.96)	19.7-24.4 (22.31)
	Mean Value		2.41	0.14	0.89	3.42	0.64	0.19	120.81	33.16	29.97	26.99
Declined Orange Orchards.												
6	LD1	7	1.78-1.87 (1.82)	0.09-0.12 (0.10)	1.58-1.98 (1.73)	3.04-3.14 (3.08)	0.68-0.74 (0.70)	0.16-0.23 (0.19)	87-102 (96.66)	28.7-31.3 (30.00)	20.0-24.7 (22.00)	19.5-23.4 (20.30)
7	LD2	15	2.05-2.11 (2.08)	0.08-0.09 (0.08)	0.97-1.06 (1.00)	2.70-2.74 (2.72)	0.48-0.51 (0.49)	0.14-0.19 (0.16)	79-98 (82.66)	21.2-23.8 (22.38)	18.0-23.1 (20.72)	18.9-24.0 (21.54)
8	LD3	9	1.64-1.75 (1.70)	0.09-0.13 (0.11)	0.91-0.99 (0.95)	3.06-3.18 (3.10)	0.44-0.52 (0.48)	0.19-0.22 (0.20)	97-109 (94.00)	22.O-27.0 (24.20)	22.7-28.0 (24.92)	19.7-22.0 (20.72)
9	LD4	13	1.93-2.05 (1.99)	0.08-0.10 (0.08)	0.85-0.97 (0.89)	3.16-3.27 (3.21)	0.34-0.54 (0.44)	0.14-0.21 (0.18)	70-77 (73.66)	28.7-31.7 (30.67)	21.0-26.8 (23.08)	17.2-23.7 (20.93)
10	LD5	16	2.00-2.10 (2.04)	0.08-0.12 (0.09)	0.79-0.88 (0.83)	2.30-2.72 (2.46)	0.30-0.36 (0.33)	0.14-0.19 (0.16)	95-110 (102.00)	22.8-28.7 (25.61)	20.0-23.7 (21.60)	19.8-22.0 (22.60)
Mean			1.92	0.09	1.06	2.90	0.45	0.17	91.55	25.53	22.89	20.94

orchards and in declined orchards it varied from 0.33 to 0.74per cent with mean value of 0.45per cent. Magnesium was optimum in both healthy and declined trees. Mean concentration of sulphur in leaves of healthy and declined trees was 0.19 and 0.17per cent respectively. It ranges from 0.18 to 0.23 per cent in healthy and 0.16 to 0.20per cent in declined trees of Nagpur mandarin orchards respectively. Similar observations were also reported [15].

3.2.3 Micro-Nutrient Status of Leaves

It was evident from the results that the concentration of iron in the leaves of healthy orchards varied from 105.6 to 140.6 ppm with mean concentration of 122.81ppm. In declined orchards it varied from 73.66 to 102.00 ppm with mean concentration of 91.55 ppm. Results indicated that the iron content in the leaves of healthy trees was higher as compared to declined orchards. Similar findings were reported [15]. The iron content in the leaves of healthy and declined trees was in the optimum range [15]. Manganese content ranged from 28.45 to 37.18 ppm with mean value of 33.16 ppm in leaves of healthy orchards and 22.38 to 30.67 ppm with mean value 25.53 ppm in declined orchards. From the results it was observed that manganese

content in the healthy orchards was found higher as compared to declined orchards. Similar findings reported [16].

Concentration of copper varied from 21.72 to 34.62 ppm with an average 29.97 ppm in healthy orchards and in declining orchards it varied from 20.72 to 25.05 ppm with an average value of 22.89 ppm. Copper content in healthy trees was higher than that of declined orchards. Similar observations were also reported [7, 15].

Zinc is required in very minute quantity by citrus trees. It ranks next to nitrogen in citrus nutrition. Zinc concentration ranged from 20.38 to 27.67 ppm with mean value of 26.99 ppm in leaves of healthy orchards and in declined orchards it varied from 17.64 to 25.00 ppm with mean value of 20.94 ppm. It was evident from the results that the concentration of zinc in leaves of healthy orchards was higher than that of declined orchards. Similar findings were reported [12]. A comparison of leaf zinc and copper status with the standards values showed that all declined trees were in low range whereas most of the healthy trees was in optimum range of zinc except trees of garden no 5.

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5. Conclusion

On the basis of data analyzed from five locations of each healthy and declined mandarin orchards it is concluded that total nitrogen content in healthy and declined mandarin orchards from surface soils varied from 0.045 to 0.093 % and 0.015 to 0.37% respectively. The available nitrogen, phosphorus and potassium content of healthy orchards surface soils varied from 200.0 to 265.7 kg ha-1, 22.0 to 35.3 kg ha-1, and 320.0 to 665.0 kg ha-1 and in declined orchards it varied from 130.4 to 203.5 kg ha-1, 17.8 to 21.3 kg ha-1, and 360.0 to 744.4 kg ha-1 respectively. The exchangeable calcium and magnesium together constitute more than 80% of exchange complex. The exchangeable calcium, magnesium and sulphur content in healthy orchards surface soils varied from 26.34 to 30.22 cmol (p+) kg ha-1, 11.71 to 16.92 cmol (p+) kg ha-1, 0.27 to 0.90 kg ha-1 and in declined orchards it varied from 29.00 to 31.98 cmol (p+) kg ha-1, 12.07 to 13.71 cmol (p+) kg ha-1, 0.36 to 0.69 kg ha-1 respectively.

Micronutrients status of orange orchards showed that available copper, zinc, iron and manganese in healthy orchards surface soils varied from 2.20 to 5.60 ppm, 0.50 to 0.79 ppm, 4.50 to 6.29 ppm, 12.61 to 18.11 ppm and in declined orchards it varied from 1.90 to 2.48 ppm, 0.35 to 0.46 ppm, 3.40 to 5.00 ppm, 8.10 to 12.24 ppm respectively. Findings revealed that total nitrogen, available nitrogen, phosphorus, sulphur, zinc and manganese content found more supporting in healthy orchards than declined ones. Depth wise distribution showed that total nitrogen, available nitrogen, phosphorus and copper showed decreasing trend with the soil depth.

The leaf nutrient content in the plant showed that nitrogen, phosphorus and potassium content in leaf of healthy orchards varied from 2.35 to 2.55%, 0.14 to 0.17%, 0.82 to 1.00% and in declined orchards it varied from 1.75 to 2.00%, 0.10 to 0.13%, and 0.84 to 1.70% respectively. Calcium, magnesium and sulphur content in healthy orchards varied from 3.00 to 3.90%, 0.60 to 0.74%, 0.21 to 0.19% and in declined orchards it ranged from 2.40 to 3.15%, 0.33 to 0.74%, and 0.19 to 0.23% respectively.

Results pertaining to micronutrient showed that iron; manganese, copper and zinc in healthy orchards varied from 105.6 to 140.6 ppm, 21.72 to 34.62 ppm, 29.40 to 35.96 ppm, 30.45 to 39.18 ppm, and in declined orchards it varied from 70.66 to 100.00 ppm, 20.38 to 27.67 ppm, 21.72 to 26.05 ppm, and 17.24 to 25.00 ppm respectively. Results showed that a healthy orchard has significantly higher content of nutrient than declined orchards except potassium content.

6. References

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