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A Study of Physio-Chemical Properties of Healthy and Declined Nagpur Mandarin Orchards

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Abstract

The present investigation was carried out to characterize and classify some typical healthy and declined Nagpur mandarin gardens in Warud and Morshi Tahsil's of Amravati District (M.S.). Total forty two representative surface and depth soil samples from healthy and declined Nagpur mandarin gardens were collected and analyzed for various physico-chemical properties. The findings revealed that the texture of soil is clayey (40 - 59 % clay in healthy gardens and 47.4 - 61.4 % clay in declined gardens). The bulk density and porosity in healthy gardens ranged 1.51 - 1.67 mg.m^{-3}, 35.85 - 43.02 % in declined gardens; it varied from 1.51 to 1.66 mg.m^{-3} and 25.85 to 43.02 % respectively. The pH, organic carbon and $CaCO_3$ content in healthy gardens soils varies 7.5 - 8.0, 4.8 - 9.0 g kg^{-1}, 5.35 - 8.31 % and in declined gardens it's 7.7 - 8.2, 1.95 - 3.75 gm kg^{-1}, 6.71 - 10.53 % respectively. The electrical conductivity and cation exchange capacity of healthy gardens soil was noticed 0.21 - 0.28 d.Sm^{-1}, 45.92 - 55.53 c.mol (p^+) kg ha^{-1} and in declined gardens it varied 0.22 - 0.32 d.Sm^{-1}, 46.20 - 51.92 c.mol (p^+) kg ha^{-1} respectively. Further, no significant difference was found in clay, bulk density, porosity, electrical conductivity and cation exchange capacity in healthy and declined gardens; however soil reaction was found high in declined gardens than healthy gardens. Organic carbon content was high and free lime content was reported lower in healthy gardens than declined gardens. Study on depth wise distribution showed that bulk density, pH and electrical conductivity increase with soil depth. Organic carbon and cation exchange capacity decreases with soil depth. The available nitrogen, phosphorus and potassium content of healthy gardens surface soils are ranged 206.0 - 273.7 kg ha^{-1}, 25.0 - 38.3 kg ha^{-1}, 324 - 672 kg ha^{-1} and in declined gardens it's varied as 135.4 - 206.8 kg ha^{-1}, 19.8 - 23.3 kg ha^{-1}, 364 - 750.4 kg ha^{-1} respectively. Available nitrogen and phosphorus content in healthy gardens found more supporting than declined ones. Depth wise distribution showed that available nitrogen and phosphorus showed decreasing trend with the soil depth.

Key Words
Documents
Dyes
Forgery
Spectral comparison
VSC

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1. Introduction

Citrus fruits rank 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, citrus fruits cultivation area

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occupying of 4.97 lakh hectare 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. Morshitahsil and Warud are also popularly known as California of Vidarbha region due to its export quality of Nagpur mandarin.

In 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 tahsil 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 Morshitahsil of Amravati District (M.S.) for their suitability assessment and quality production of Nagpur mandarin in Amravati region.

2. Materials and Methods

Under present investigation ten villages in Warud and Morshitahsil of Amravati District (M.S.), were surveyed and ten gardens from healthy and declined condition were selected on the basis of their yield performance for last three years and visual observations.

Out of total orchards, depth wise samples were collected from each healthy and declined Nagpur mandarin gardens. Soil samples were analyzed for particle size distribution, bulk density, particle density by the standards method respectively [1,2].

The chemical properties like soil pH, electrical conductivity, cation exchange capacity, free calcium carbonate and organic carbon were determined by appropriate methods of analysis [3]. Available nitrogen, phosphorus and potassium were determined by alkaline potassium permanganate method [4], Olsen's method and flame photometer method [5] respectively.

3. Results and Discussion

Data on physio-chemical properties of healthy and declined Nagpur mandarin gardens soils are presented in Table 1.

3.1. pH and Electrical Conductivity

The data on pH in healthy and declined gardens varied from 7.3 to 8.1 and 7.5 to 8.3 respectively. In all soils pH slightly increased with soil depth. Similar observation was reported earlier [6]. High pH found in declined gardens compared to healthy ones. This is due to higher content of free lime. Similar observations were also reported [7]. The safe limit of pH for citrus cultivation was reported as 6 - 8 [8]. So the pH in studied area was found in safe limit. Electrical conductivity is representative of soluble salts content in the soil. The data revealed that it varied as 0.19 - 0.34 dSm^{-1}. Electrical conductivity tends to be increase with the soil depth but no definite trend was observed at site 1 and 2. Electrical conductivity values less than 1 indicate that these soils are free from hazardous soluble salts as prescribed [9]. Thus, electrical conductivity in studied area is safe in limit.

3.2. Organic Carbon and Calcium Carbonate

Organic carbon content in healthy and declined garden soils are varied as 3.82 - 8.6 gm kg^{-1} and 1.90 - 3.66 gm kg^{-1} in surface layers respectively, indicating that the organic carbon content was more in soils supporting the healthy gardens as compared to declined gardens. In case of healthy gardens soils, the data showed that surface layer of all gardens soil under study are medium to rich in soil organic carbon; however their subsoil layers content less organic carbon. Soil organic carbon decreased with increasing soil depth in all healthy and declined garden soils. Similar results were observed in literature [10].

Free lime content in healthy and declined garden soils varied about 5.30 - 8.10 % and 6.65 - 12.53 % in surface layers respectively. All soils were found to be containing more than 5 % free lime, which qualify them to class as calcareous ones. The free lime content showed irregular trend in gardens soils of site 2, 4 and 9 in which there was found succession of decrease and increase in regular sequence was found throughout the depth. In remaining gardens soils free lime content was continuous increase with soil depth. Free lime content in soils of healthy gardens was found as lower as compared to declined once. Similar results were reported earlier [11].

3.3. Cation Exchange Capacity

The data revealed that the soils under study have high extent of cation exchange capacity (CEC) and it tends to be related with smectite clay content in soils.

Table 1. Physico-chemical characteristics of Nagpur mandarin gardens soil

S No	Depth (cm)	Particle Size Distribution (%)			Textural Class	Bulk Density (mg m^{-3})	Porosity (%)	pH	EC (dSm^{-1})	Organic Carbon (g kg^{-1})	$CaCo_3$ (%)	CEC c.mol (p^+) kg ha^{-1}	Available Nutrients (kg Ha^{-1})		
		Sand	Silt	Clay									N	P_2O_5	K_2O
	Location : JH (Age of trees – 07 years)														
	0 - 20	16.80	23.40	59.50	Clay	1.55	36.62	7.8	0.25	5.55	5.35	49.86	222.90	37.60	392.00
1	20 -50	18.10	21.90	60.00	Clay	1.58	35.49	7.7	0.22	4.35	6.40	51.87	189.10	26.80	296.80
	50 - 80	23.40	17.60	59.00	Clay	1.60	37.49	7.7	0.23	3.60	7.12	55.53	177.80	23.20	347.20
	80 - 100	25.70	13.80	60.50	Clay	1.67	36.36	8.0	0.25	2.40	9.44	53.22	172.10	21.50	358.40
	Location : JH1 (Age of trees – 12 years)														
	0 - 20	17.40	23.70	58.30	Clay	1.50	40.02	7.9	0.22	5.85	6.53	47.36	234.20	38.40	672.00
2	20 -50	22.40	19.40	58.60	Clay	1.53	42.89	7.8	0.21	4.95	8.12	48.33	214.50	30.60	638.40
	50 - 80	23.40	17.40	59.30	Clay	1.61	37.62	7.8	0.24	3.60	9.76	50.70	208.80	28.60	560.00
	80 - 100	23.80	17.00	59.20	Clay	1.60	39.87	8.0	0.27	2.55	6.72	50.11	169.30	19.70	532.00
	Location : JH2 (Age of trees – 12 years)														
	0 - 20	20.00	24.20	55.80	Clay	1.56	38.62	7.5	0.23	5.40	8.21	45.92	206.00	25.00	324.00
3	20 -50	19.10	22.10	58.80	Clay	1.54	37.49	7.7	0.23	4.65	8.30	47.03	189.10	23.20	284.80
	50 - 80	21.30	18.50	60.20	Clay	1.60	36.36	7.8	0.25	3.60	8.12	46.12	186.20	19.70	296.50
	80 - 100	21.20	16.80	62.00	Clay	1.62	36.00	7.9	0.26	2.40	10.44	49.23	177.80	14.10	294.40
	Location : JH 3 (Age of trees – 08 years)														
	0 - 20	19.40	23.60	57.00	Clay	1.49	41.02	7.7	0.24	4.80	6.76	49.32	241.60	31.40	492.80
4	20 -50	19.50	23.80	56.70	Clay	1.62	38.62	7.8	0.25	4.05	9.67	48.83	210.30	21.50	324.80
	50 - 80	22.20	20.30	57.50	Clay	1.54	37.87	7.9	0.25	3.15	8.39	50.70	194.70	17.30	291.20
	80 - 100	23.10	18.40	58.50	Clay	1.60	37.49	7.9	0.28	2.25	5.81	51.23	176.20	13.40	257.60
	Location : JH 4i (Age of trees – 09 years)														
5	0 - 20	19.30	23.50	57.20	Clay	1.51	42.89	7.9	0.21	5.90	5.85	50.02	245.50	26.80	560.00
	20 -50	29.80	19.20	50.90	Clay	1.56	42.13	8.0	0.23	2.95	7.23	48.82	186.20	15.90	390.20
	Location : JH 5 (Age of trees – 15 years)														
6	0 - 20	12.30	33.60	54.10	Clay	1.52	42.13	7.7	0.29	9.00	8.21	52.30	273.70	38.30	655.20
	20 -50	17.80	29.70	52.50	Clay	1.60	39.49	7.7	0.27	5.70	10.03	49.20	169.30	27.00	527.20
	50 - 70	29.00	21.40	43.30	Clay	1.57	36.85	7.8	0.27	4.05	10.12	47.20	160.90	16.80	582.40
	Location : JD (Age of trees – 07 years)														
	0 - 20	16.60	24.50	58.90	Clay	1.50	40.13	7.9	0.24	3.30	8.21	48.02	206.80	22.00	420.00
7	20 -50	17.20	23.60	59.20	Clay	1.56	38.62	7.9	0.24	2.55	12.21	49.70	186.00	17.00	312.80
	50 - 80	19.40	21.60	59.00	Clay	1.60	38.49	8.0	0.25	2.40	10.03	49.52	155.20	14.30	296.80
	80 - 100	19.90	18.60	61.30	Clay	1.67	27.85	8.2	0.29	1.95	12.62	50.33	149.30	11.20	310.00
	Location : JD 1 (Age of trees – 15 years)														
	0 - 20	28.30	24.30	47.40	Clay	1.50	40.02	7.9	0.22	3.50	8.21	49.22	208.80	19.80	368.40
8	20 -50	24.10	23.10	52.80	Clay	1.52	39.13	7.9	0.23	3.20	10.03	50.07	180.60	16.00	390.80
	50 - 80	20.40	22.40	57.20	Clay	1.59	36.62	8.1	0.28	2.90	13.44	50.79	163.60	12.10	280.00
	80 - 100	21.70	20.80	57.50	Clay	1.64	38.36	8.0	0.29	2.25	13.75	50.92	149.50	9.90	357.60
	Location JD 2 (Age of trees – 09 years)														
	0 - 20	17.20	31.60	51.20	Clay	1.57	39.62	7.7	0.24	3.00	9.02	48.67	177.80	20.20	750.40
9	20 -50	16.80	28.10	55.10	Clay	1.60	38.87	7.8	0.29	2.40	10.21	49.21	152.40	19.10	587.20
	50 - 80	19.20	25.00	55.80	Clay	1.62	38.49	7.8	0.29	2.10	14.30	49.67	141.10	17.30	465.80
	80 - 100	21.30	22.40	56.30	Clay	1.65	37.36	7.9	0.31	1.50	12.71	50.38	135.40	12.50	517.90
	Location JD 3 (Age of trees – 13 years)														
10	0 - 20	16.80	23.40	59.50	Clay	1.62	39.62	7.8	0.24	3.75	9.21	50.17	197.50	23.60	364.00
	20 -50	18.10	21.90	60.00	Clay	1.67	37.36	7.9	0.23	3.00	10.67	51.92	180.60	20.80	313.60
	50 - 70	27.20	22.30	50.50	Clay	1.65	37.36	8.0	0.29	1.80	13.25	46.02	124.10	11.20	374.20
	Location : JD4 (Age of trees – 16 years)														
	0 - 20	17.60	24.80	57.60	Clay	1.50	43.02	8.1	0.27	3.60	6.71	47.16	149.50	23.30	554.40
11	20 -50	19.20	22.60	58.20	Clay	1.55	41.89	8.0	0.29	2.70	9.89	49.23	141.10	19.80	412.80
	50 - 80	20.30	20.40	59.30	Clay	1.51	41.13	8.1	0.30	2.10	10.62	49.92	124.10	14.30	291.20
	80 - 100	21.70	16.90	61.40	Clay	1.60	38.49	8.2	0.32	1.65	12.70	51.73	112.80	12.30	327.50
	Location : JD5 (Age of trees – 09 years)														
	0 - 20	28.60	20.80	50.60	Clay	1.61	38.87	7.9	0.29	1.95	10.53	46.2	135.40	19.40	571.20
	20 -50	33.00	18.80	48.20	Clay	1.67	37.36	8.2	0.31	1.50	13.34	42.77	121.30	15.90	476.60

Note. *Sl. No.1 to 6 Refers Physicochemical characteristics of Nagpur mandarin gardens soil of Healthy Nagpur Mandarin gardens and Sl.No.7 to 12 refers physicochemical characteristics of Nagpur mandarin gardens soil of Declined Nagpur Mandarin gardens*

The CEC of surface layer of soil samples ranged 40.92-55.1 c.mol (p^+) kg^{-1}. In case of shallow depth soil, CEC decreased with depth, this is because of lower content of clay in subsurface layers. There is no significant difference was observed in CEC of healthy and declined soils, similar observation was reported [12]. Vertisols suffer from pedoturbation and this helps in transportation of finer material such as clay to lower depth. This might be due to reason that subsurface soils contain high amount of clay and also for high CEC (Table 1).

3.4. Available Nitrogen, Phosphorus and Potassium

The data regarding available nitrogen of healthy and declined gardens soils varies as 204 - 275 Kg ha^{-1} and 140 - 203.6 Kg ha^{-1} respectively. All soils of Nagpur mandarin gardens were categorized as low to very low in available nitrogen. Its content was found higher in soils supporting healthy gardens than declined gardens. Similar results were also reported [13]. Available nitrogen content in present investigation was found to decrease with soil depth in all healthy and decline gardens. The studied results were good agreement with the reported literature [14].

The available phosphorus content of healthy and declined gardens surface soils ranged about 22 - 36.3 kg ha^{-1} and 17.5 - 24.5 kg ha^{-1}. According to the standard rating it appears that healthy gardens soils were found to be low to medium and declined gardens in low in available P_2O_5 content. However relatively high level of available phosphorus in gardens soils may be attributed to regular application of organic manures, which further build up the phosphorus level in healthy gardens soils . Similar observations were also reported earlier [13]. The results showed that available P_2O_5 was decreased continuously with soil depth (shown in Table 1).

Available potassium content in healthy and declined gardens ranged from 326.0 to 674.0 Kg ha-1and 366.0 to 752.6 Kg ha-1 in surface layer respectively. All soils of healthy and declined gardens were under high to very high in available potassium content according to standard ratings. High amount of available potassium was also reported [15] for the black soil. The studied data indicates that there was no uniform increase or decrease trend of available potassium with soil depth.

4. Conclusion

From the above studies, it is concluded that the available nitrogen, phosphorus and potassium content of healthy gardens surface soils varied 206 - 273.7 kg ha^{-1}, 25 - 38.3 kg ha^{-1}, and 324 - 672 kg ha^{-1} and in declined gardens it varied as 135.4 - 206.8 kg ha^{-1}, 19.8 - 23.3 kg ha^{-1}, 364 - 750.4 kg ha^{-1} respectively. Available nitrogen and phosphorus content in healthy gardens found more supporting than declined ones. In depth wise distribution showed that available nitrogen and phosphorus showed decreasing trend with the soil depth. It is therefore very important to adapt integrated nutriment management in mandarin orchards for export oriented production in mandarin.

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