J. Soils and Crops 28 (2) 421-427, December 2018

ISSN 0971-2836
NAAS Rating - 4.46
Scientific Journal Impact Factor - 6.736

INFLUENCE OF VARIOUS NUTRIENT MANAGEMENT PRACTICES ON SOIL PROPERTIES AND YIELD OF NAGPUR MANDARIN GROWN ON VERTISOL

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ABSTRACT

The field investigation was carried out on farmer's field of Katol tehsil during the year 2016-17 with the objective to evaluate the soil properties and yield of Nagpur mandarin under various nutrient management practices. Results revealed that soil reaction comes under moderately alkaline and moderately calcareous in nature. Organic carbon was observed 9.2 g kg $^{-1}$ and 7.8 g kg $^{-1}$with orchards age of eight years treated with use of 15 kg FYM + 332:140:83 g NPK tree^{-1} and 20 kg FYM + 171:125:83 g NPK tree^{1}, respectively. Fertility status of soils was maintaining with the application of various organic liquid alone or in combination of FYM, inorganic fertilizer and integrated manner. Exchangeable cations follow order of Ca^{2++}>Mg^{2++}>Na^{+}>K^{+}. Fruit yield of Nagpur mandarin (20.3 t ha^{-1}) was obtained with the combined application of 20 kg FYM + 171:125:83 g NPK tree^{-1}. However, maximum fruit yield (25.0 t ha^{-1}) of Nagpur mandarin was noted with the combined application of 15 kg FYM+ N:P:K:Mg:S- 449.5:67.5:25:150:50 g tree^{-1}. Organic carbon (r =0.804) was positively and significantly correlated with available N(r=0.546*).Yield of Nagpur mandarin was significantly and positively correlated with available N (r =0.546*), available K (r = 532*) and $CaCO_3$ (r = 0.624**).Thus, use of inorganic fertilizers(171:125:83 g NPK tree^{-1}) continuously in combination of 20 kg FYM tree^{-1} to eight years orchard is useful for sustaining the fruit yield of Nagpur mandarin under Vertisol.**

(Key words: Management practices, organic resource, Nagpur mandarin, vertisols)

INTRODUCTION

Orange is successfully grown in semi-arid to sub humid areas of Maharashtra. Performance of orange orchards in Nagpur district has directly related to the physical and the chemical characteristics of the soils influencing the plant stand. In India, Maharashtra state ranks first in area and production of oranges followed by Punjab, Karnataka, Andhra Pradesh and Tamil Nadu. In India, the average productivity of Mandarin is 10.4 t ha^{-1} (Anonymous, 2015).

Of many constrains impairing the sustained citrus production, nutrient management is claimed to be of paramount importance and of the viable strategies to fulfill nutritional requirement of crop. Extensive use of fertilizers with low doses of organic manures has resulted in deterioration of soil fertility and soil health as well. Nutrient applied without organic matter become less effective in improving the citrus fruit production even at higher doses and more effective with organic matter. Hence, the concept of judicious and nutrient management practices comes in picture which lays emphasis on improvement in soil productivity through appropriate use of fertilizers, bio-fertilizers and green manures and their scientific management for optimum growth, yield and quality of crop in specific agro- ecological situation (Marathe and Bharambe,2007). Out of many factors, poor nutrient status of soil as well as improper water and fertilizer management is considered to be the major factors responsible for citrus decline and low yield. Hence, an integrated use of organic resources, bio fertilizers and appropriate use of chemical fertilizers could help in achieving the goal of obtaining sustainable yield and soil health. Therefore, we must adopt most appropriate nutrient management practices for Nagpur mandarin.

MATERIALS AND METHODS

Considering the various nutrient management practices adopted by farmers for Nagpur mandarin, the five

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locations were selected viz., Fetri, Katol, Katol (RFRS), Wandali wagh, Hatla. villages of Katol tehsil of Nagpur district for assessment of soil fertility and yield of Nagpur mandarin under various nutrient management practices. The various organic and inorganic sources under nutrient management practices were applied from 7- 12 years continuously. The doses of organic manure or liquid fertilizers were not applied similar at the studied locations. The organic inputs applied as foliar spray every month from June to January (Total 8 months).The details of quantity of organic and inorganic resources used by the farmers are given in table 1.Soil profile samples were taken from 0-30 cm, 30-60 cm, and 60-90 cm depth, from randomly selected spots over the field of orchard. Soil samples were analyzed by adopting standard methods for various soil properties in order to assess the fertility status of soil. Electrical conductivity was determined by conductivity meter (Jackson,1973). $CaC0_3$ was determined by rapid titration method (Piper, 1966).Organic carbon was assessed by wet oxidation method (Walkley and Black,1934). Available nitrogen was analysed by using Kjeldahl's method (Subbiah and Asija,1956), phosphorus was estimated by using vanado molybdate yellow colour method (Jackson,1973) and potassium was estimated from diacid extract by using flamephotometer (Jackson,1973).Exchangeable calcium and magnesium were determined by using 1N KCL triethanolamine buffer silution (pH 8.2) and titrating the leachate with standard EDTA solution using murroxide and EBT as an indicator (Jackson, 1973).Exchangeable sodium and potassium were determined by flame photometer method (Jackson 1973).

RESULTS AND DISCUSSION

Fertility status of soil of Nagpur mandarin

From the data presented in table 1, pH of saturated soil (1:2.5 soil:water suspension) ranged from 6.5 to 8.5 indicating their moderately alkaline in nature and electrical conductivity of Nagpur mandarin soils ranged from 0.30 to 0.51 dS m^{-1} found in different locations indicated non-saline but higher amount of salt in soils restrict the nutrient uptake and thus, affect the plant growth. Organic carbon was recorded 9.2 g kg^{-1} and 7.8 g kg^{-1} with the use of 15 kg FYM + 332:140:83 g NPK $tree^{-1}$ and 20 kg FYM + 171:125:83 g NPK $tree^{-1}$, in location of Wandali Wagh-I and II, respectively among the practices of integrated nutrient management. However, maximum values of organic carbon in soil was observed in location of Fetri-II (11.2 g kg^{-1}) with orchards treated with use of organic inputs comprising of Jivamrut-60 L diluted in 100 L water+ Dashparni ark – 10 L diluted in 100 L water + Nimboli ark - 10 L diluted in 100 L water and applied 500 L ha^{-1} every month through foliar spray orchards of Nagpur mandarin for monthly from June to January and lowest value of organic carbon 3.9 g kg^{-1} was noted under inorganic practices, adopting such practices since 7-12 years. Improvement in soil organic carbon status with continuous use of different organic inputs might have seen due to incorporation of organic inputs, residue management practices and also its rapid mineralization under temperate conditions. Jagdish Prasad *et al.* (2001) reported that organic carbon in orange growing soil ranged from 2.1 to 9.9 g kg^{-1}through depth being higher in surface layer of pedon than the subsurface horizons. Higher value of $CaCO_3$ was observed in location Hatla-I(6.7 to 8.4 per cent) where as lower value in Fetri- I (3.0 to 3.9 per cent), $CaCO_3$ mostly found to accumulate in the lower part of profile, this trend has been mainly due to leaching of bicarbonate during rainy season from upper layers. All these soils are slightly calcareous except location Hatla-I being calcareous in nature. Reddy *et al.* (2013) reported orange growing soils are moderate to high calcareous (3.13 to 15.48%) in nature and it adversely affects the availability of macronutrients on yield of Nagpur mandarin.

In the present study, available nitrogen of soil were observed between 200.1 to 333.0, 210.3 to 328.4 and 203.8 to 330.2 kg ha^{-1}under orchards treated with the management practices of organic, inorganic and integrated nutrient management which exhibited low to medium in range (Table 2). Medhi *et al.* (2007) showed that surface soils contained higher levels of available N, P, K and organic carbon reflecting their maximum accumulation than the subsurface layers. Fertility status of soil might have helped in the mineralization of soil N leading to its higher build up with use of balanced amount of organic and inorganic inputs. Highest available P (19.5 kg ha^{-1}) was noticed at Katol- III with the application of balanced inorganic fertilizer N:P:K-322:270:300 g $tree^{-1}$.Available K of soil was recorded between 290.2 to 390.5, 325.5 to 419.5 and 298.7 to 423.1 kg ha^{-1} under different orchards (Table 2).

Exchangeable cations of soil

The data regarding exchangeable cations at different depth of 0-30, 30-60 and 60-90 cm soil samples of Nagpur mandarin orchards are presented in table 3. The exchangeable calcium and magnesium content in soils of Nagpur mandarin orchards varied from 30.6 to 38.2, 22.2 to 38.6 and 32.4 to 40.3 and 8.0 to 17.3, 8.1 to 18.1 and 12.1 to 16.8 Cmol (p^+) kg^{-1}, respectively among different 15 locations categorized as organic, inorganic and integrated manner. Sum of exchangeable cations ranged from 46.0 to 62.2 Cmol (p^+) kg^{-1}. Ca/Mg ratio increased with depth indicating the increase of calcium with simultaneous increase of magnesium.

The exchangeable sodium and potassium content of soil varied from 1.0 to 8.3, 0.5 to 1.3, 0.5 to 7.9, 0.3 to 2.7 and 0.7 to 4.8, 1.2 to 1.9 Cmol (p^+) kg^{-1} under different locations associated with organic, inorganic and integrated nutrient management practices, respectively. Sodium content increased with depth. In the present study, sum of exchgangeable cations was observed from 46.0 to 58.5 Cmol (p^+) kg^{-1} . Surwase (2016) reported the sum of exchgangeable cations from 37.4 to 53.9 Cmol (p^+) kg^{-1} with exchangeable cations follow the order of $Ca^{2++}>Mg^{2++}>Na^+>K^+$.Srivastava

Table 1. Status of chemical properties of soil as influenced by different nutrient management practices in Nagpur mandarin

Depth (cm)	Nutrient management practices											
	Organic *				Inorganic **				Integrated ***			
	pH	EC dS m^{-1}	O.C g kg^{-1}	$CaCO_3$ (%)	pH	EC dS m^{-1}	O.C g kg^{-1}	$CaCO_3$ (%)	pH	EC dS m^{-1}	O.C g kg^{-1}	$CaCO_3$ (%)
	Fetri- I				Katol- RFRS- I				Wandali wagh- I			
0-30	6.5	0.33	10.2	3.0	7.4	0.27	7.5	3.5	7.5	0.35	9.2	4.0
30-60	6.5	0.34	6.9	3.5	7.4	0.33	6.0	3.9	7.6	0.32	8.3	4.5
60-90	6.6	0.39	4.3	3.9	7.2	0.23	4.7	5.5	7.3	0.31	5.5	5.1
	Fetri- II				Katol – RFRS- II				Wandali wagh- II			
0-30	7.0	0.30	11.2	2.8	7.4	0.33	7.0	3.2	7.5	0.31	7.8	3.8
30-60	7.1	0.39	6.2	3.6	7.5	0.31	6.5	4.0	7.3	0.37	6.2	4.1
60-90	7.3	0.40	4.3	4.5	7.2	0.33	4.2	4.5	7.1	0.32	3.1	4.8
	Fetri- III				Katol - RFRS –III				Wandali wagh- III			
0-30	7.4	0.32	9.2	3.1	7.5	0.31	7.9	3.9	7.4	0.32	8.5	4.0
30-60	7.4	0.30	7.2	3.8	7.8	0.32	6.3	4.0	7.3	0.42	6.5	4.5
60-90	7.6	0.39	4.6	4.2	7.6	0.33	5.1	5.5	7.3	0.31	4.8	5.5
	Katol-I				Katol- III				Wandali wagh- IV			
0-30	7.3	0.30	9.1	3.1	7.5	0.33	8.5	3.4	8.4	0.32	6.5	3.9
30-60	7.2	0.32	5.6	3.9	7.3	0.32	7.5	4.1	8.4	0.43	5.2	4.2
60-90	7.5	0.42	4.5	4.2	7.6	0.33	3.9	5.6	8.3	0.29	4.1	4.8
	Katol-II				Katol- IV				Hatla- I			
0-30	7.6	0.30	9.6	3.5	7.6	0.32	9.2	3.5	8.1	0.42	6.7	6.7
30-60	7.7	0.32	6.6	3.9	7.6	0.34	7.2	3.9	8.3	0.43	6.5	8.3
60-90	7.9	0.32	4.5	5.8	7.3	0.47	4.2	4.5	8.5	0.51	4.3	8.4

*** Fetri- I, *II and *III- Jivamrut- 60 L diluted in 100 L water+ Dashparni ark – 10 L diluted in 100 L water + Nimboli ark - 10 L diluted in 100 L water and applied 500 L ha^{-1} every month through spraying from June to January. (Total 8 months)**

*** Katol- I and II- FYM- 20 kg^{-1} + Jivamrut- 60 L diluted in 100 L water and applied 500 L ha^{-1} every month through spraying from June to January.**

**** Katol RFRS- I, II and III- N:P:K 502:460:160 g $tree^{-1}$ through DAP + MOP + urea**

**** Katol- III and IV- N:P:K- 322:270:300 g $tree^{-1}$ through Urea + SSP + MOP**

***** Wandali wagh- I- FYM- 15 kg + N:P:K- 332:140:83 g $tree^{-1}$ through SSP + Urea + MOP**

***** Wandali wagh- II- FYM- 20 kg + N:P:K:-171:125:83 g $tree^{-1}$ through 20:20:0 + urea + MOP**

***** Wandali wagh- III- FYM- 15 kg + N:P:K:- 502:460:83 g $tree^{-1}$ through DAP + Urea + MOP**

***** Wandali wagh- IV- FYM-15 kg+ N:P:K:-171:158:83 g $tree^{-1}$ through 20:20:0 + SSP + urea + MOP $tree^{-1}$**

***** Hatla- I FYM- 15 kg + N:P:K:Mg:S- 449.5:67.5:25:150:50 g $tree^{-1}$ through SSP + 18:18:10 + urea + magnesium sulphate + sulphur**

Table 2. Fertility status of soil as influenced by different nutrient management practices in Nagpur mandarin

Depth(cm)	Nutrient management practices								
	Organic			Inorganic			Integrated		
	Available N kg ha^{-1}	Available P kg ha^{-1}	Available K kg ha^{-1}	Available N kg ha^{-1}	Available P kg ha^{-1}	Available K kg ha^{-1}	Available N	Available P	Available K
		Fetri I			Katol – RFRS- I			Wandali wagh- I	
0-30	321.2	16.8	360.2	288.1	17.6	375.6	311.5	15.6	326.2
30-60	288.1	15.6	350.4	275.4	16.5	360.0	290.5	14.5	322.3
60-90	200.1	13.1	315.4	268.0	13.3	345.0	268.8	11.2	298.7
		Fetri- II			Katol - RFRS-II			Wandali wagh- II	
0-30	333.0	17.9	385.2	280.3	18.1	364.2	302.0	18.5	325.6
30-60	278.1	15.9	340.4	268.2	14.9	355.0	259.0	12.3	320.5
60-90	232.3	15.0	300.2	255.7	14.2	340.0	243.8	11.2	299.3
		Fetri- III			Katol - RFRS- III			Wandali wagh- III	
0-30	305.7	10.8	380.5	304.0	17.9	360.6	305.0	18.6	379.4
30-60	293.2	8.67	352.6	253.0	16.5	365.0	266.3	14.5	325.2
60-90	260.7	7.30	337.4	242.1	11.2	355.2	240.0	10.4	322.2
		Katol- I			Katol- III			Wandali wagh- IV	
0-30	330.4	17.8	390.5	328.4	19.5	419.5	325.5	17.9	401.5
30-60	288.4	16.5	340.4	278.0	17.5	368.7	225.3	13.5	345.2
60-90	235.2	13.3	320.2	210.3	12.2	355.3	203.8	9.3	312.2
		Katol- II			Katol- IV			Hatla- I	
0-30	305.7	18.0	380.4	320.0	18.4	413.0	330.2	18.3	423.1
30-60	288.2	13.4	325.4	295.2	17.1	375.6	272.3	11.2	368.2
60-90	208.3	12.3	290.2	241.3	11.8	325.5	215.1	8.6	345.3
Range	200.1-333.0	7.30-18.0	290.2-390.5	210.3-328.4	11.2- 19.5	325.5-419.5	203.8- 330.2	8.6-18.6	298.7- 423.1
Mean	277.3	14.16	370.3	273.8	15.78	365.2	270.6	13.72	305.1

Table 3. Status of exchangeable cations of soil as influenced by different nutrient management practices in Nagpur mandarin

Depth (cm)	Organic							Inorganic							Integrated						
	Ca* (cmol (p*) kg-1)	Mg* (cmol (p*) kg-1)	K* (cmol (p*) kg-1)	Na* (cmol (p*) kg-1)	Sum	CEC (cmol (p*) kg-1)	Ratio Ca/Mg	Ca* (cmol (p*) kg-1)	Mg* (cmol (p*) kg-1)	K* (cmol (p*) kg-1)	Na* (cmol (p*) kg-1)	Sum	CEC (cmol (p*) kg-1)	Ratio Ca/Mg	Ca* (cmol (p*) kg-1)	Mg* (cmol (p*) kg-1)	K* (cmol (p*) kg-1)	Na* (cmol (p*) kg-1)	Sum	CEC (cmol (p*) kg-1)	Ratio Ca/Mg
	Fetri- II							Katol-RFRS- I1							Wandali wagh- I						
0-30	33.8	12.6	1.2	8.0	55.6	58.1	2.7	37.1	9.1	1.8	7.9	55.9	60.3	4.0	34.2	12.1	1.7	4.8	52.8	58.2	2.8
30-60	30.6	10.1	1.0	8.0	49.7	52.2	3.0	38.6	9.1	2.7	7.5	57.9	62.2	4.2	35.2	13.2	1.8	4.0	54.2	60.1	2.3
60-90	33.6	10.1	1.0	8.3	51.8	54.2	4.5	38.4	9.0	1.8	7.4	56.6	61.1	4.2	36.3	13.9	1.9	4.1	56.2	62.2	2.3
	Fetri- II							Katol-RFRS- II							Wandali wagh- II						
0-30	36.9	8.0	0.9	5.2	51	53.1	4.1	36.4	14.5	0.8	1.6	53.3	55.2	2.5	38.1	14.1	1.6	0.1	53.9	58.9	2.3
30-60	38.1	9.2	0.5	4.1	51.9	55.2	4.1	35.9	14.9	1.1	1.2	52.1	55.4	2.4	39.2	14.3	1.8	0.8	56.1	60.3	2.3
60-90	38.2	9.1	0.8	4.1	52.2	55.2	1.2	33.6	16.4	0.8	1.1	51.9	56.2	2.0	40.3	15.4	1.9	0.8	58.4	62.1	2.3
	Fetri- III							Katol-RFRS- III							Wandali wagh- III						
0-30	32.3	17.3	1.3	7.6	58.5	53.5	3.1	28.8	16.4	1.8	0.6	47.6	50.2	1.2	32.4	13.2	1.4	4.3	51.3	56.2	2.4
30-60	33.0	10.5	1.2	7.5	52.2	55.2	3.3	26.8	17.2	1.6	0.6	46.0	50.1	2.4	33.5	14.1	1.6	4.4	53.6	58.2	2.5
60-90	34.5	10.4	0.9	7.4	53.5	56.2	3.4	22.2	18.1	1.9	0.7	42.9	51.6	1.2	34.8	14.1	1.4	4.8	55.1	59.9	2.4
	Katol- I							Katol- III							Wandali wagh- IV						
0-30	34.2	9.3	1.1	1.8	46.4	49.4	4.1	36.1	9.4	0.5	0.9	46.9	53.1	3.4	34.3	16.1	1.5	0.8	52.7	57.8	2.1
30-60	35.6	8.6	0.9	1.0	46.1	50.1	4.3	38.2	13.8	0.3	0.5	52.8	58.2	2.3	35.3	16.2	1.2	0.9	53.6	58.9	2.1
60-90	36.2	8.3	0.9	1.0	46.4	53.1	3.4	35.3	17.3	0.6	0.7	53.9	60.2	2.0	36.4	16.8	1.6	0.9	55.7	57.8	2.1
	Katol- II							Katol- IV							Hatla- I						
0-30	34.4	8.8	0.7	8.1	52	54.2	3.4	35.1	8.1	1.7	8.1	53.0	58.3	4.3	36.8	12.4	1.7	0.7	51.6	56.8	2.3
30-60	35.5	8.9	0.6	8.0	53	58.2	3.4	36.2	8.2	1.2	8.2	53.8	58.2	4.4	37.9	12.5	1.8	0.9	53.1	58.9	3.0
60-90	35.6	8.4	0.6	7.8	52.4	56.3	4.2	37.8	8.5	1.5	8.1	55.9	61.2	4.4	37.0	12.8	2.1	0.8	52.7	59.1	2.3

Table 4. Yield performance of Nagpur mandarin as influenced by various nutrient management practices

Locations and nutrient management practices	Age of orchards (years)	Fruit yield	
		Fruits tree^{-1}	t ha^{-1}
Organic nutrient management			
Fetri- I	7	510-550	17.0
Fetri- II	7	550-600	19.0
Fetri- III	7	600-650	18.0
Katol- I	7	650-700	20.0
Katol- II	7	620-650	18.5
Inorganic nutrient management			
Katol- RFRS- I	10	580-650	19.0
Katol-RFRS- II	10	550-600	18.0
Katol-RFRS- III	10	650-700	20.5
Katol – III	12	800-850	24.0
Katol- IV	12	700-750	22.7
Integrated nutrient management			
Wandaliwagh- I	8	700	22.0
Wandali wagh- II	8	650-700	20.3
Wandaliwagh- III	7	700-750	22.5
Wandaliwagh- IV	7	750	23.0
Hatla- I	12	800-850	25.0

Table 5. Correlation of different chemical properties of soil with yield of Nagpur mandarin

	Yield t ha^{-1}	pH	EC dSm^{-1}	O.C g kg^{-1}	CaCO3 (%)	N kg ha^{-1}	P kg ha^{-1}	K kg ha^{-1}
Yield t ha^{-1}	1							
pH	0.451	1						
EC dSm^{-1}	-0.026	-0.111	1					
O.C g kg^{-1}	0.163	-0.405	0.119	1				
CaCO3 (%)	0.624**	0.320	0.057	0.170	1			
N kg ha^{-1}	0.546*	-0.100	0.172	0.804**	0.285	1		
P kg ha^{-1}	0.273	0.144	0.012	0.090	0.208	0.293	1	
K kg ha^{-1}	0.532*	0.144	-0.116	0.361	0.509	0.536*	0.352	1

** significant at 1% level * significant at 5% level

and Singh (1999) observed that higher exchangeable Ca^{2++} (34.8-35.7 Cmol (p^+) kg^{-1}) registered at 0-15 cm (27.1 Cmol (p^+) kg^{-1}) or beyond it and upto 60-90 cm (28.5-29.8 Cmol (p^+) kg^{-1}). The CEC of soil of Vertisol varied from 49.4 to 58.2, 50.1 to 62.2 and 56.2 to 62.2 Cmol (p^+) kg^{-1} among the practices of organic, inorganic and integrated nutrient management, respectively.

Yield of Nagpur mandarin

The yield data of Nagpur mandarin orchards as influenced by different nutrient management system are presented in table 4. The yield of Nagpur mandarin orchards were recorded from 17.0 to 25.0 t ha^{-1}. Application of Jivamrut- 60 L diluted in 100 L water+ Dashparni Ark – 10 L diluted in 100 L water + Nimboli Ark - 10 L diluted in 100 L water and applied 500 L ha^{-1} every month through foliar spray from June to January recorded the fruit yield of 17, 19 and 18 t ha^{-1} in the location of Fetri-I, Fetri-II, Fetri-III, respectively when same doses were applied in these locations while the tree receiving FYM 20 kg + Jivamrut- 10 L diluted in 100 L water improved fruit yield of Nagpur mandarin (20.0 t ha^{-1}) under organic inputs alone. The application of N may increased the yield somewhat with increasing nitrogen rates as spraying of Jivamrut- 60 L diluted in 100 L water+ Dashparni Ark– 10 L diluted in 100 L water + Nimboli Ark - 10 L diluted in 100 L water and applied 500 L ha^{-1} every month through foliar spray from June to January. Combined application of FYM + inorganic fertilizer performed better result compared to those organic inputs alone. Under integrated nutrient management practices, fruit yield of Nagpur mandarin (20.3 t ha^{-1}) was obtained with the application of 20 kg FYM + 171:125:83 g NPK $tree^{-1}$.However, fruit yield (25.0 t ha^{-1}) of Nagpur mandarin performed better at Hatla- I location with the use of FYM-15 kg + N:P:K:Mg:S- 449.5:67.5:25:150:50 g $tree^{-1}$ through SSP + 18:18:10 + Urea + magnesium sulphate + sulphur, followed by Katol- III (24.0 t ha^{-1}) with the application of N:P:K- 322:270:300 g $tree^{-1}$ through urea, SSP and MOP. Srivastava and Singh (2009) resulted that sustained fruit yield (30.7 t ha^{-1}) when tree application combination with RDF as 50 kg FYM-600 N, 200 P_2O_5 , 100 K_2O g $tree^{-1}$.Yield, fruit quality and soil-plant-nutrient buildup under best SSNM treatment with 600:400:300g NPK $tree^{-1}$ was observed on deep soil (Srivastava and Singh 2016).

Correlation between soil properties and yield of Nagpur mandarin orchard

Fifteen soil profiles samples were collected from five villages of Katol growing Nagpur mandarin adopted the practices of organic, inorganic and integrated nutrient management with 7 to 12 years age group of orchards were collected. The soil was medium deep to deep classified as Vertisol. Fruit yield of Nagpur mandarin was significantly and positively correlated with available N (r =0.546*), available K (r = 532*) and $CaCO_3$ (r= 0.624**) under different management practices. Earlier studied demonstrated the similar positive correlation of soil available N and P with fruit yield of Nagpur mandarin reported by Srivastava and Shyam singh (2001).Organic carbon (r =0.804**) was positively and significantly correlated with available N (r=0.546*), where the N was positively correlated with K (r = 0.536*). Srivastava (2013) resulted a positively significant correlation with available N, Fe, Zn, Mn andB with fruit yield of Nagpur mandarin. Under the practices of integrated nutrient management, use of 171:125:83 g NPK $tree^{-1}$ continuously in combination of 20 kg FYM $tree^{-1}$ to age of eight years orchard is useful for sustaining the fruit yield of Nagpur mandarin. However, maximum fruit yield (25.0 t ha^{-1}) of Nagpur mandarin was obtained with the combined application of 15 kg FYM+ N:P:K:Mg:S-449.5:67.5:25:150:50 g $tree^{-1}$.

REFERENCES

Anonymous, 2015. www:nhb.gov.in Data base, National Horticulture Board,ICAR,New Delhi.

Jackson, M. L.1973. Soil Chemical Analysis, Prentice Hall of India, pvt. Limited, New Delhi.

Jagdish Prasad, Nagaraju, Rajeev Srivastava, S. K. Ray and P. Chandran, 2001. Characteristics and classification of some orange growing soil in Nagpur district of Maharashtra J. Indian Soc. Soil Sci. **49**(4): 735-739.

Marathe, R.A. and P.R. Bharambe, 2007. Correlation of integrated nutrient management induced changes in soil properties with yield and quality of sweet orange on udic haplustert. J. Indian Soc. Soil Sci.**55**(3): 270 – 275.

Medhi, B.K., A.J. Saikia, S.C. Bora, T.K. Hazarika and A.C. Barbora, 2007. Integrated use of concentrated organic manures, biofertilizers and inorganic NPK on yield, quality and nutrient content of khasi mandarin. Indian J. Agric. Res., **41** (4): 235 – 241.

Piper, C. S. 1966. Soil and Plant analysis. Hans Publishers, Bombay.

Reddy, B., V.D. Guldekar and N. Balakrishnan, 2013. Influence of soil calcium carbonate on yield and quality of Nagpur mandarin, African J. Agri. Res. **8**(42) : 5193-5196

Srivasthava, A.K., S. Singh, 1999. Devlopment of optimum soil property limits in relation to fruit yield and quality of citrus recticulata Bhanco, CV. Nagpur mandarin. www:research get net.

Srivastava, A. K. and Shyam Singh, 2009. Citrus Decline: Soil Fertility and Plant Nutrition. J. Plant Nutri. **32**: 197–245.

Srivastava, A. K. and Shyam Singh, 2001. Soil properties influencing yield and quality of Nagpur Mandarin. J.Indian Soc. Soil Sci. **49**(1): 226-229.

Srivastava, A.K.2013. Nutrient Management in Nagpur mandarin: frontier developments scientific J. Agriculture. **2** (1): 1-14.

Srivastava.A. K. and S. Singh, 2016. Site-Specific Nutrient Management in Nagpur mandarin raised on contrasting soil type.Communications in Soil Sci. and Plant analysis.**47**:4

Subbiah, B. V. and G. L. Asija, 1956. A rapid procedure for the estimation of available nitrogen in the soil. Curr. Sci. **25**: 259-260.

Surwase, S. A., P. R. Kadu and D. S. Patil, 2016. Soil micronutrient status and fruit quality of orange orchards in Kalmeshwar tahsil, district Nagpur (MS). J. Global Biosci. **5**(1):3523-3533.

Walkey, N. M. and A. I. Black, 1934. Estimation of organic carbon by chromic acid titration method. Soil Sci. **25:** 259-263.

Rec. on 05.08.2018 & Acc. on 20.05.2018