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Assessment of physical properties and nutrient status of cotton growing soils in Amravati district

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Abstract
The present investigation in relation to "Assessment of physical properties and nutrient status of cotton growing soil in Amravati district." was undertaken during 2020-21. Total 60 i.e. 30 Surface and 30 subsurface soil samples were collected and analysed for their physical properties and macronutrient status in soil. The results revealed that, the soils under study were clayey in texture, bulk density of surface soil ranged from 1.12-1.45 Mg m^{-3} and sub-surface soil ranged from 1.28-1.48 Mg m^{-3}. The hydraulic conductivity of surface and sub-surface soil ranges from 0.71-0.98 cm hr^{-1} and 0.66-0.97 cm hr^{-1} respectively. The soil of Dhamangaon and Chandur block were very low to low in category (113.00-235.00 kg ha^{-1}) and (106.52-223.25 kg ha^{-1}) respectively, for available nitrogen, low to moderately high for phosphorus (13.47-25.10) for Dhamangaon block and medium to moderately high for Chandur block (17.55-22.22). Whereas, soil of Dhamangaon block were high to very high (205.00-400.00) for available potassium and Chandur block were moderately high to very high (280.00-406.00), respectively. The soils of Dhamangaon block were medium to high in available sulphur (11.77-20.10 mg kg^{-1}) and Chandur block were low to moderately high (9.89-18.32 mg kg^{-1}).

Keywords: Physical properties and macro nutrient

Introduction
Soil is source of infinite life, it is the most precious and natural resources and not renewable in short time. Soil fertility is the dynamic natural property which can change under the influence of natural and human induced factors. (Denis *et al*., 2017) [3]. The soil texture is a single most important property of soil, on which all physical, chemical and biological properties of soil depends. In general, physical nature of soil relates directly or indirectly to plant growth and provides an understanding in respect of soil water retention, nutrient availability and crop suitability.
Macronutrients (N, P and K) are important soil elements that control its fertility. Soil characterization in relation to evaluation of fertility status of the soils of an area or a region is an important aspect in context of sustainable agriculture production.

Materials and Methods
The research work entitled "Assessment of soil physical properties and nutrient status of cotton growing soils in Amravati district" conducted during the year 2020-21. Survey of selected villages of Dhamangaon and Chandur block i.e. Naygaon, Mangrul and Dighi villages from Dhamangaon block and Dhanodi, Supalwada and Nimgavan villages from Chandur block of Amravati district was conducted. Total 60 soil samples (0-15 and 0-30 cm) were collected after harvesting of cotton (10 soil samples from each village i.e. 5 Surface and 5 Subsurface).
Soil texture was determined by Bouyoucos hydrometer method described. The bulk density of soil was determined by clod coating method (Blake and Hartz, 1986) [1]. The hydraulic conductivity of soil was determined by constant head method as described. Available nitrogen was determined by alkaline permanganate method as described by Subbiah and Asija (1956) [13]. The available phosphorus was determined by using Olsen's reagent 0.5 M $NaHCO_3$ (pH 8.5) as extractant by using spectrophotometer (Jackson, 1973) [7]. Available potassium extracted from the soil by using neutral normal ammonium acetate solution and estimated with using flame photometrically as per Jackson (1973) [7]. The available sulphur estimated turbidmetrically using spectrophotometer described by Piper (1966) [11].

Results and Discussion

Soil Physical Properties

The particle size distribution showed that, the soils had fairly high amount of clay (Table 1), it varies from village to village. The soils of selected areas are developed on basaltic parent material and the soil developed on basalt produces the high amount of clay on weathering (Eswaran *et al*., 1988) [4].

Table 1: Soil texture and textural class of selected villages of Amravati district.

Name of villages	Sample No.	Sand (%)		Silt (%)		Clay (%)		Textural Class
		S	SS	S	SS	S	SS	
Dhamangaon								
Naygaon	1	15.8	14.8	30.1	24.6	54.4	66.8	Clay
Mangrul	2	12.5	11.8	25.8	24.9	61.7	63.9	Clay
Dighi	3	16.2	15.9	26.2	27.2	57.6	56.9	Clay
Chandur								
Dhanodi	4	18.7	18.2	26.8	25.4	54.5	56.4	Clay
Supalwada	5	17.2	16.2	24.3	26.2	59.5	57.6	Clay
Nimgavan	6	20.5	18.7	24.8	26.8	54.7	54.5	Clay

Where, S= Surface and SS= Subsurface

Bulk density

The bulk density is the mass of soil per unit volume, including pore spaces (Hillel, 2000). The bulk density of surface soil ranges from 1.12-1.45 mg m^{-3} and 1.26-1.42 mg m^{-3} with a mean of 1.33 and 1.32 mg m^{-3} in Dhamangaon block and Chandur block respectively. However, in sub-surface soil, bulk density slightly increased over surface soils, which varies from 1.28-1.48 mg $m^{-3}$and 1.31-1.46 mg m^{-3}, with a mean of 1.38 and 1.37 mg m^{-3}, respectively (Table 2). Increase in bulk density with depth in these swell-shrink soils is attributed to the high content of expanding type of clay minerals present and the over-burden pressure causing compaction in the sub-surface horizons (Nimkar, 1992) [10].

Hydraulic conductivity

Hydraulic conductivity depends upon clay content and pore size of soil (Wankhade *et al*., 2015) [16]. The hydraulic conductivity of surface soil varies from 0.78-0.96 cm hr^{-1} and 0.78-0.98 cm hr^{-1} with the mean of 0.87 and 0.84 cm hr^{-1} and in sub-surface soil it varies from 0.72-0.97 cm hr^{-1} and 0.66-0.92 cm hr^{-1} with the mean of 0.81 and 0.78 cm hr^{-1} (Table 2) in Dhamangaon and Chandur block, respectively. The saturated hydraulic conductivity of clayey soils is low and it sharply decreases with depth and reaches almost a negligible value (Nimkar *et al*., 1992) [10].

Table 2: Bulk density and hydraulic conductivity of Dhamangaon and Chandur block soil

Sample No.	BD (Mg m^{-3})		HC (cm hr^{-1})	
	Surface	Subsurface	Surface	Subsurface
Dhamangaon				
1.	1.45	1.48	0.81	0.68
2.	1.3	1.38	0.96	0.89
3.	1.4	1.48	0.84	0.74
4.	1.37	1.43	0.78	0.72
5.	1.12	1.28	0.90	0.87
6.	1.28	1.30	0.95	0.87
7.	1.39	1.43	0.79	0.75
8.	1.36	1.39	0.87	0.80
9.	1.41	1.45	0.84	0.81
10.	1.38	1.42	0.91	0.83
11.	1.26	1.35	0.85	0.79
12.	1.27	1.31	0.90	0.84
13.	1.34	1.39	0.86	0.82
14.	1.39	1.44	0.85	0.78
15.	1.25	1.29	0.93	0.87
Range	1.12-1.45	1.28-1.48	0.78-0.96	0.72-0.97
Mean	1.33	1.41	0.87	0.80
SD	0.08	0.06	0.058	0.08
CV	6.36	4.45	6.70	10.31
Chandur				
16.	1.27	1.33	0.98	0.92
17.	1.34	1.39	0.84	0.79
18.	1.38	1.42	0.78	0.73
19.	1.42	1.46	0.71	0.66
20.	1.24	1.31	0.92	0.87
21.	1.31	1.38	0.82	0.78
22.	1.26	1.31	0.91	0.84
23.	1.32	1.37	0.80	0.75
24.	1.35	1.39	0.83	0.77

25.	1.28	1.34	0.98	0.78
26.	1.39	1.42	0.75	0.71
27.	1.37	1.40	0.76	0.72
28.	1.26	1.33	0.98	0.85
29.	1.27	1.32	0.92	0.88
30.	1.39	1.42	0.75	0.67
Range	1.26-1.42	1.31-1.46	0.71-0.98	0.66-0.92
Mean	1.32	1.35	0.84	0.80
SD	0.05	0.05	0.09	0.07
CV	4.39	4.27	10.93	9.01

Macronutrient status

Available Nitrogen

The available nitrogen in the surface and subsurface soil of Dhamangaon block ranges from 113.00 to 235.00 and 106.52 to 223.25 kg ha^{-1} with the mean value 165.00 and 152.48 kg ha^{-1}, respectively. The available nitrogen in surface and subsurface soil of Chandur block varies from 113.00 to 223.00 and 106.52 to 182.22 kg ha^{-1} with the mean of 164.00 and 142.51 kg ha^{-1}, respectively (Table 3). The available N was found to be relatively higher in surface horizons over sub surface horizons, which might possibly be due to decreasing trend of organic carbon with depth (Rajeshwar and Mani 2013) [12].

Available Phosphorus

Study of available P in selected study area revealed that, in the surface and subsurface soil of Dhamangaon block the available P ranges from 13.47 to 25.10 and 11.18 to 22.22 kg ha^{-1} with the mean of 19.74 and 16.92 kg ha^{-1}, respectively. While in Chandur block it ranges from 17.55 to 22.22 and 14.47-19.94 kg ha^{-1} with mean of 19.91 and 17.35 kg ha^{-1} respectively (Table 3). Which is under low to medium category. Similarly, the soils of Nagpur district are also low to medium in available phosphorus. (Thombe *et al*., 2020) [14].

Available Potassium

The available K in surface soil of Dhamangaon and Chandur block were ranges from 205.00 to 400.00 and 280.00 to 406.00 kg ha^{-1} with mean of 357.19 and 350.26 kg ha^{-1} respectively, while in subsurface soil it varies from 220.57 to 376.60 and 331.01 to 406.67 with a mean of 330.61 and 331 kg ha^{-1}, respectively (Table 3). The value of available potassium ranged in moderately high to very high in study area of Amravati district. Waikar *et al*., (2014) [15] recorded Central farm, MKV, Parbhani were found sufficiently supplied with available K. This may be due to occurrence of potash rich minerals like mica and feldspar the available K was high Malewar, (1995) [8] and More *et al*., (2013) [9].

Available Sulphur

Sulphur is required for synthesis of S-containing amino acids cystine, methionine and cysteine, and these are essential components of protein that comprise about 90 per cent of the total S in plants (Havlin *et al*., 2010) [5]. The sulphur in surface soil ranges from 11.77 to 20.10 and 9.89 to 18.32 mg kg^{-1} with the mean of 15.94 and 15.05 mg kg^{-1}, respectively in Dhamangaon and Chandur block, while in subsurface soil it varies from 10 to 18.22 and 8.67 to 17.06 mg kg^{-1} with the mean of 14.40 and 13.80 mg kg^{-1}, respectively (Table 3).

Table 3: Distribution of surface and sub-surface soil N, P, K and S of Dhamangaon and Chandur block in Amravati District.

Sample No.	N		P		K		S	
	S	SS	S	SS	S	SS	S	SS
Dhamangaon								
Naygaon								
1.	113.00	106.52	15.21	12.42	332.09	328.95	11.99	12.00
2.	166.12	159.94	19.50	17.94	379.00	358.00	18.16	17.61
3.	130.09	122.30	17.00	15.78	352.87	338.76	16.06	15.51
4.	170.00	153.49	19.00	13.20	331.98	304.67	13.97	12.11
5.	231.34	223.25	25.10	22.22	400.00	376.60	20.01	18.22
Mangrul								
6.	225.81	209.44	23.70	20.35	380.21	340.81	19.00	17.49
7.	145.32	133.49	16.03	13.47	335.90	220.57	13.60	11.54
8.	115.22	108.52	21.64	19.94	365.76	342.28	16.54	15.50
9.	117.45	113.52	13.47	11.18	305.22	284.97	12.11	10.23
10.	177.00	155.44	20.70	17.80	355.45	350.00	17.50	16.06
Dighi								
11.	235.05	207.76	25.02	18.67	388.00	369.60	18.89	15.45
12.	170.00	156.69	17.67	15.80	335.34	319.95	11.77	10.00
13.	132.32	122.89	21.52	18.48	358.86	334.76	14.52	13.64
14.	186.00	163.43	19.22	16.77	382.00	347.70	18.11	16.71
15.	159.94	150.53	21.40	19.82	355.21	341.57	16.95	15.39
Range	113-235	106.53-223	13.47-25.10	11.18-22.22	205-400	220.57-376.60	11.77-20.10	10-18.22
Mean	164.97	152.48	19.74	16.92	357.19	330.61	15.94	14.49
Chandur								
Dhanodi								
16.	210.00	180.11	21.52	18.82	340.00	312.38	17.72	14.61
17.	138.00	131.71	20.24	17.30	348.80	331.67	14.88	16.06
18.	155.22	137.89	19.00	17.32	328.32	309.55	17.00	14.41

19.	162.22	146.03	19.77	17.33	360.99	338.59	15.62	13.91
20.	177.00	125.44	19.88	17.54	360.34	345.76	15.95	13.73
Supalwada								
21.	178.75	159.94	21.64	19.94	378.08	358.81	17.8	15.72
22.	159.94	146.8	21.40	19.82	365.12	331.58	18.16	16.50
23.	134.85	128.58	19.88	17.53	355.67	406.67	16.06	15.62
24.	189.00	155.32	21.40	18.11	348.65	291.99	18.32	17.06
25.	223.00	182.22	22.22	18.12	387.44	366.8	18.00	16.94
Nimgavan								
26.	120.00	108.52	17.55	14.82	296.02	278.33	9.89	8.72
27.	155.90	133.62	19.07	16.04	358.86	334.95	13.31	.12.42
28.	178.22	151.52	18.55	14.47	406.67	382.76	10.00	8.89
29.	160.00	143.49	19.07	17.32	338.05	313.44	13.20	12.53
30.	113.01	106.52	17.55	15.80	280.98	262.00	9.89	8.67
Range	113-223	106.52-182.22	17.55-22.22	14.47-19.94	280-406	331-406.67	9.89-18.32	8.67-17.06
Mean	163.67	142.51	19.91	17.35	350.26	331	15.05	13.81

Where, S= Surface and SS= Sub-Surface

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