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Original Research Paper

Physico-Chemical Characteristics and Fertility of Soils from Three Different Ecological Regions of Aurangabad

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ABSTRACT

Soil is the source for most of the essential nutrients required by crops for their healthy growth. These nutrients are not always enough in the soil for a plant to grow healthy. The soil analysis provides the farmer with an estimate of the amount of fertilizer nutrients needed to supplement those in soils. Soil is studied for its pH, texture, percent exchangeable sodium, percent organic matter, and salinity expressed as electrical conductivity, water holding capacity and the nutrients available to plants. The present study deals with analysis of 23 soil samples belonging to three different ecological regions.

INTRODUCTION

High yields of top-quality crops require an abundant supply of 16 essential nutrient elements. Soil is the source for most of the essential nutrients required by crops. The 13 mineral nutrients, which come from soils, are dissolved in water and absorbed through roots. These nutrients are not always enough in the soil for a plant to grow healthy. This is why many farmers and gardeners use fertilizers to add the nutrients to the soil. As nutrients are removed by one crop and not replaced for subsequent crop production, yields will decrease accordingly. The soil analysis provides farmers with an estimate of the amount of fertilizer nutrients needed to supplement those in the soil. Applying the appropriate type and amount of needed fertilizer will give the farmer a chance to get the desired crop yield. Crop yields are determined by a variety of factors including crop variety selection, available moisture, soil fertility, crop adaptation to the area, and the presence of diseases, insects and weeds. The soil analysis and its interpretation deal only with the fertility level of the soil. The soil analysis report includes characterization and fertility status of the soil, and fertility recommendations. Soil characterization is study of pH, texture, percent exchangeable sodium, percent organic matter, and salinity expressed as electrical conductivity. The fertility status is reported as nutrients available to plants (Baker 1997).

The present study deals with analysis of 23 soil samples belonging to three different ecological regions viz., cultivated, uncultivated (barren) and garden soils from Aurangabad.

MATERIALS AND METHODS

Collection of soil samples: Soil samples were collected from various sites in and around Aurangabad (Table 1). Three different ecological types of soils were selected i.e., barren land soils (B), cultivated soils (C) and garden soils (G). Samples were collected from pits dug in the area to be sampled. Samples were collected with a surface sterilized trowel. Soil was scraped along the walls of the pits and collected in polythene bags. Soils from 8-10 pits, collected from 10-15 cm depth were pooled together and mixed well in the same polythene bag.

Chemical and physical analysis of soil: The soil samples were analysed for physical and chemical properties like electrical conductivity, soil fertility, water holding capacity, soil density, soil texture, pH, organic carbon, available P and K, % Ca, % Mg, % Na and % free lime using standard methods (Hooda & Kaur 1999).

RESULTS

The results of the analysis of various soil samples are given in Table 2. Organic carbon content of all the cultivated soil samples was found to be high (0.8-1.00%) to very high (above 1%) except the sample C1 in which it was low (0.31%). In barren land soil samples also the organic carbon was high to very high except in one soil B3 where it was low (0.273%). All garden soils under the study were very low in organic carbon content (up to 0.20%) except G4 and G7 where it was medium (0.799% and 0.546% respectively).

Phosphorus (P) is an essential part of the process of photosynthesis. It is involved in the formation of all oils, sugars, starches, transformation of solar energy into chemical energy, proper plant maturation, withstanding stress, rapid growth, blooming and root growth. Available phosphate in cultivated soils was medium (15-21 kg/ha) to low (8-14 kg /

ha). In barren land soils also, it ranged from medium to low. In garden soils, the available phosphorus was slightly better than the other two types of soils. It was between medium high (22-28 kg/ha) to medium (15-21 kg/ha).

Potassium is absorbed by plants in larger amounts than any other mineral element except nitrogen, and in some cases, calcium. It helps in the building of protein, photosynthesis, fruit quality and reduction of diseases. Available potassium of cultivated soils and barren land soils was between medium high (201-250 kg/ha) and medium (151-200 kg/ha), whereas in garden soils it was medium.

Calcium is an essential part of plant cell wall structure, provides for normal transport and retention of other elements as well as strength to the plant. It is also counteract the effect of alkali salts and organic acids within a plant. Calcium content in all the soils was medium to very low, ranging from 720-320 kg/ha. Comparatively, agricultural soils were better in calcium content (465-720 kg/ha).

Magnesium is part of the chlorophyll in all green plants and essential for photosynthesis. It also helps activate many plant enzymes needed for growth. All the soil samples showed magnesium within the normal range required (8-13%) except for two samples each in all the three types of soils that were below the required levels (below 7%).

Sodium percent of all the soils was within the normal range of 3-11% except for one sample of garden soil with slightly beyond the limit (12%).

Soil pH is measure of acidity or alkalinity of soils. It is one of the most important soil properties that affect the availability of nutrients. Macronutrients tend to be less available in soils with low pH, while micronutrients tend to be less available in soils with high pH. The pH of all the soil samples was between 7.5 and 8.5, hence all the soils were slightly alkaline in nature. Percentage of free lime was observed to be towards lower side of the normal limits (0.00 to 22.0%).

Electric conductivity of all the soil samples was between 0 and 1 dsm^{-1} indicating that all the soils were good for germination of seeds and growth of any type of plants.

Soils with 35 to 65% overall fertility are considered to be good for plant growth. All the soils under study were found to be fairly fertile. It was surprising to observe that uncultivated soils were quite fertile (42-52%), while cultivated soils, where crops like sugar cane, cotton, maize and gram were grown, were less in fertility (32-34%).

The water holding capacity (WHC) of all the soil samples ranged from 12.08% to 19.2%. This was well within the normal limits. Only soil with less water holding capacity was soil G1 where the soil was under cultivation.

Table 1: Location and plantation type of soil samples.

Sr.No.	Soil No.	Type of Soil	Place of collection
1	C1	Cultivated Soil	Sugarcane plantation
2	C2	Cultivated Soil	Bajra Plantation
3	C3	Cultivated Soil	Tur Plantation
4	C4	Cultivated Soil	Cotton plantation
5	C5	Cultivated Soil	Wheat plantation
6	C6	Cultivated Soil	Jowar Plantation
7	C7	Cultivated Soil	Gram plantation
8	C8	Cultivated Soil	Cotton Plantation
9	C9	Cultivated Soil	Maize Plantation
10	C10	Cultivated Soil	Cotton Plantation
11	B1	Barren Soil	Waste land
12	B2	Barren Soil	Waste land
13	B3	Barren Soil	Waste land
14	B4	Barren Soil	Waste land
15	B5	Barren Soil	Waste land
16	B6	Barren Soil	Waste land
17	G1	Garden Soil	Cultivated Garden (Fig Plantation)
18	G2	Garden Soil	B.A.M.University, Botanical Garden
19	G3	Garden Soil	Siddharth Garden
20	G4	Garden Soil	Bibi ka Makabara garden
21	G5	Garden Soil	Himayat Bag, Varied cultivation.
22	G6	Garden Soil	Shivchhatrapati Museum Uddyan
23	G7	Garden Soil	College, Botanical Garden

Except for four soil samples from cultivated fields and two barren lands, all the soil samples exhibited soil density below normal (2-3%). Silt and clay percentage in all the soils were found to be within the range of good soil (20-25% and 7-50% respectively). The values of soil testing have been compared with the critical values given by ICAR (2006).

CONCLUSION

The organic matter content in any soil decides the fertility of that soil. One cultivated (C1), one uncultivated (B3) and all garden soils were quite low in organic matter. These soils need organic supplement. Soils C4, C6, B1 and B6 need to be supplemented with phosphorus. All soils have acceptable amounts of potassium and needed calcium to be added. Two samples in each ecological type C2, C4, B4, B5, G2 and G4 require magnesium supplementation. All the soils under the study were slightly alkaline, which may affect absorption of micronutrients such as boron (B), copper (Cu), iron (Fe), chlorine (Cl), manganese (Mn), molybdenum (Mo) and zinc (Zn). Observed values of free lime appeared to be within the limits, but as it increases pH of the soil, content of free lime may be lowered. Overall condition of cultivated and natural uncultivated types of soils was better than any of the garden soils and needs proper supplementation of organic and inorganic nutrients.

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Table 2: Physico-chemical characteristics of soils.

Sr. No.	Soil Factor	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	B1	B2	B3	B4	B5	B6	G1	G2	G3	G4	G5	G6	G7
1	Org. carbon, %	0.31	1.04	1.38	0.87	0.94	0.81	0.74	2.11	2.11	1.31	1.88	1.34	0.27	1.31	1.51	0.88 low	very low	very	low	0.8 low	very	0.18	0.55
2	Available P kg/ha	28	20	19	13	18	11	21.2	14.8	14.8	17.2	14.4	18.5	14.4	26.2	18.1	13.5	21.8	17.8	14.9	29.2	28	23.4	24.3
3	Available K kg/ha	281	202	280	216	229	236	216	224	224	178	235	235	186	193	231	200	160	198	216	228	263	209	188
4	Calcium kg/ha	580	720	670	595	720	465	550	566	566	706	325	320	620	575	375	408	670	530	382	388	549	372	490
5	Magnesium, %	9	7	10	9.1	12.1	11.1	12.5	9.2	9.2	10.5	10.1	12	9.1	7	7	8.3	12.9	7.9	10.3	7.5	10	9.9	9.6
6	Sodium, %	5	5.4	6	8.08	13	9.08	9	6.68	6.68	4.8	2	5.02	7	12	8	5.4	12	4.9	6.6	5.7	7.7	6.96	4.5
7	Free lime, %	2.05	5.2	5.05	5.07	3.05	3.75	8.03	2.95	2.95	8.33	3.15	3.75	2.62	5	10	6.2	11.3	5.68	4.23	5.9	4.7	7.12	3.84
8	pH	7.81	7.91	8.03	8.31	8.27	8.03	7.92	8.12	8.12	8.18	7.78	7.91	7.57	8.02	7.75	8.03	8.24	7.98	7.48	8.02	8.2	8.18	8.24
9	Electrical conductivity	0.76	0.6	0.25	0.26	0.27	0.29	0.35	0.12	0.12	0.15	0.76	0.59	0.23	0.53	0.59	0.16	0.19	0.31	0.4	0.27	0.2	0.2	0.16
10	Soil fertility, %	34	48	60	58	56	42	32	32	32	38.6	42	48	42	52	42	44	36	45	42	55	58	58	49
11	Max.W.H.C. %/100cm	-	-	-	-	-	-	19.2	16.7	16.7	14	-	-	18.1	-	-	12.4	9.83	17.7	14.9	13	18	12.1	18.3
12	Soil density (g/cm^3)	2.01	2.6	2.8	1.99	2.6	1.28	1.45	1.08	1.08	0.83	3.01	2.2	1.02	1.05	1.05	1.61	1.41	1.12	1.23	0.89	1.3	0.97	1.04
13	C. S. %	14	12	11	16	19	19	12.8	16	16	17.8	13	16	13.3	14.1	9	17.1	17.4	14.8	11.8	14.3	11	10.6	13.4
14	F. S., %	9	6	8.07	6.09	11	6.08	7.7	6	6	9.88	8	7	9.8	6.03	14	11	7.9	8.2	9.2	9	12	9	7.5
15	Silt, %	18	19	22	14	23	22	25.5	22	22	18	18	26	20.2	24	18	23	26.2	25.6	20.3	22	22	26	27
16	Clay, %	32	22	45	40	48	44	13	28.6	28.6	44	35	38	25	32	21	31	32.2	42	55	48	52	49	38

C1-C10: Soil samples from agricultural fields; B1-B6: Soil samples from barren lands; G1-G7: Soil samples from gardens.

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