Physicochemical Characterization of Red and Black Soils of Wardha Region

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Abstract:

The search for agro-socioeconomic sustainability and new production System paradigms are greatest challenges of modern agriculture which involves among other technological practice an adequate soil management .For appropriate management of soils it is essential to understand physical and chemical properties of red and black soil viz. soil texture, bulk density ,cation exchange capacity, organic carbon ,available nitrogen .phosphorus and potassium. In present study of five samples of black and red soil in wardha region observe that black soil is alkaline in nature .Red soil is acidic to slightly alkaline in nature .Black soil have high cation exchange capacity than red soil. Red soils type are poor in organic matter, available nitrogen and phosphorus.

Keyword - physicochemical, bulk density, cation exchange capacity.

Introduction:

Soil is a dynamic natural body developed as a result of pedogenic processes through weathering of rocks, consisting of mineral and organic constituents, possessing definite chemical, physical, mineralogical and biological properties, having a variable depth over the surface of the earth, and providing a medium for plant growth [1] .

The success in soil management to maintain soil quality depends on an understanding of how soils respond to agricultural practices over time. For this reason, recent interest in evaluating the quality of our soil resources has been stimulated by increasing awareness that soil is a critically important component of the earth's biosphere, functioning not only in the production of food and fiber but also in the maintenance of local, regional and world wide environmental quality [2] .

Land and water are essential resources for the sustained quality of human life and the foundation of agricultural developments. These resources should be managed in a sustainable manner so that the changes proposed to meet the needs of development are brought out without diminishing the potential for their future use (Kanwar, 1994). Sustainable management of natural resources is possible only after characterization and identification of constraints limiting crop production[3].

Soil is the medium for plant growth. Its physical, chemical and biological properties determine the degree of workability, suitability to specific crop varieties, physical and chemical capacities as well as productivity. The physical capacities of a soil are influenced by the size, proportion, arrangement and composition of the soil particles. The physical and biological properties of soils need careful study because they give mechanical support to plants. The ideal soil for agricultural use is loam, which combines good aeration and drainage properties of large particles, with the nutrient-retention ability of clay particles. The soil texture depends upon the percentage of clay, silt and sand particles in the soil[4].
Giikawad et. al 1974 repotted that Red soil are generally situated at higher level at while black soils are at lower level and transitional from soil in middle level of topography in the soil developed on basaltic parent materials[5] .

Red soil

Red soil is rich in iron. It is formed by break down of igneous rock and metamorphic rock .Red soil in India is largely found in states of Tamilnadu .In India red soil is also found in several other regions including Madhya Pradesh, Andhra Pradesh, Southern Karnataka, Bihar, Maharashtra, West Bengal and other states of North –East .Due to presence of iron oxide deposits, red soils get unique red tint and are comparatively infertile because of lime deficiency and soluble salt content.

Black soil

This is a well-known group of soils, characterized by dark grey to black colour. These are locally known as regurs and black cotton soil as cotton was the main crop growing on these soils. Black soils are mainly formed from Deccan basalt trap rocks either in situ or on transported material. At some places the black soil are also developed on granite and gneiss containing lime and feldspar and are basic in character.

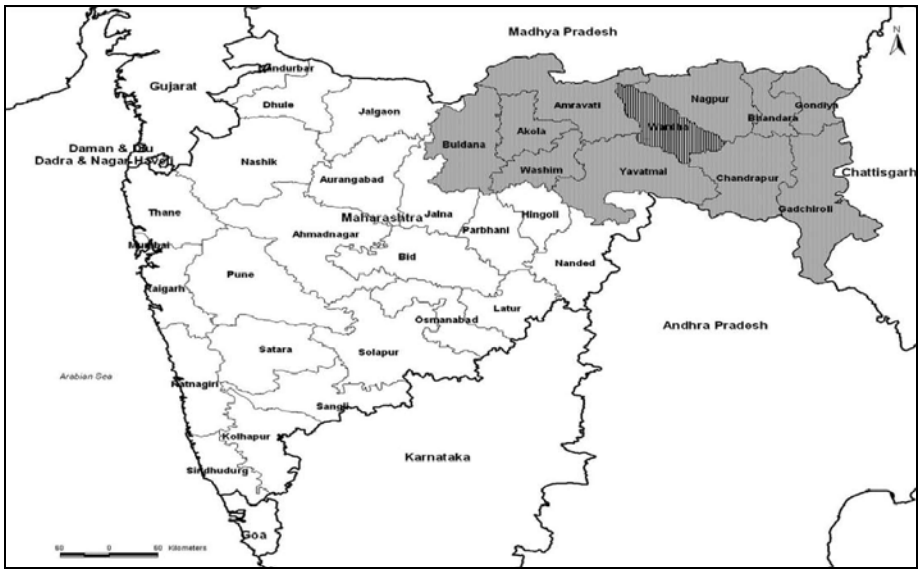
The physicochemical characterization of soils in an particular area is also useful to plan the basic minimum needs of farmers, thereby improving their socio-economic conditions and helps in evolving a broad national policy which can be applied by decision makers for sustainable development of any given study area.

Material and method:

About study area:

Wardha is classified under the category of tropical dry sub humid climate .The mean annual rainfall of district ranges between 982.2mm to 1132.70mm,of which about 80% is received from south west monsoon during June to September .The average number of rainy days is spread around 4 months over 60 rainy decreasing progressively to west 989.20mm,indicating relative moist eastern and dry western

sectors and it is of regular nature .The annual temperature ranges from 25^0c to 27^0c .The region experiences hot and mild winter with mean summer temperature of 33^0c and mean winter temperature of 21.6^0c. Wardha district lies in between north latitude of $20^0$18'to$20^0$21'east longitude of $78^0$4'to$79^0$15'. The district fall in survey of India degree sheet number 55K/Land P on north eastern side of state of Maharashtra. Geographically the district covers 6,316 Sq.km. area of state.



Map 1 Map of Maharashtra Showing Wardha District within Vidarbha

Temperature and rainfall:

Hot summer and general dryness throughout the year except during the southwest monsoon characterize the climate of district .The year may be divided in to four seasons the winter is from December to February .The hot season is from March to middle of June. This is followed by southwest monsoon ,which extends up to the week October .The rest of October and November constitute the post monsoon period .The average rainfall in the district is 1241.6 mm out of which ,rainfall during the period from June to September amounts to about 87 percent :July being the rainiest month .The rainfall generally increases from the west to the east in the district .The rainfall during the year ,outside monsoon months though low is well distributed among different months .

Soil sampling:

The soil samples are collected from 10 different locations. Collected samples were air dried .Then they are ground using mortar and pestle and passed through 2 mm sieved .The percentage of coarse fragments were expressed on the whole soil basis .Sieved samples were mixed and stored for subsequent physical ,chemical analysis.

Physicochemical Analysis

The soil samples were air dried crushed and passed through a 2-mm sieve and then mixed thoroughly to obtain a homogeneous mixture .Particles size analysis was performed using the Bouyoucous hydrometer method[6].Bulk Density **w**as determined by clod method (Black.1965)[7]. Maximum water holding capacity was measured by Piper (1996) [8] The soil pH was determined in1:2.5 soil-water suspension by potentiometer method (Jackson1973)[9]. Electrical conductivity was determined extract using Conductivity Bridge and expressed as dSm^{-1} (Jackson 1973) Organic carbon was determined by Walkley and Black (1934) Wet Oxidation method[10]. The cation exchange capacity of the soil was determined by equilibrating the soil with neutral normal sodium acetate solution and the excess salts were removed by 95 % isopropyl alcohol (Anon.1987). **Available Macrnutrients: i.e.**vailable Nitrogen (N), Phosphorus (P) and potassium (K) were estimated by the methods suggest by Subbiah and Asija (1965)[11]and Bray and Kurtz (1945)[12]and Hanway and Heidal (1945) respectively[13.] **Available Micronutrients:** Micronutrients Fe, Mn, Zn and Cu were determined by using DTPA extraction (Lindsay and Narvell, 1987) and by atomic absorption spectrophotometer (AAS)[14.]

Result and Discussion:

The soil samples were collected from different parts of Wardha region .There physico-chemical properties are given below

Table 1 Selected physical and chemical properties of the red soil studied

Sample No.	Depth (cm.)	Soil texture	Bulk density Mgm^{-1}	pH	CEC Cmol(p+) Kg^{-1}	EC dsm^{-1}	OC %	N Kg/ha	P Kg/ha	K Kg/ha
1	10-30	clay	1.75	7.6	47.3	0.18	1.00	270	31.2	403
2	10-30	clay	1.72	7.9	54.4	0.75	0.90	281	28.0	411
3	10-30	clay	1.69	7.5	42.1	0.34	0.61	276	30.5	398
4	10-30	clay	1.68	7.8	38.7	0.67	0.71	263	29.0	400
5	10-30	Silty-clay	1.70	7.7	37.5	0.26	0.51	285	35.0	400
6	10-30	clay	1.71	7.2	36.4	0.68	0.63	387	21.0	389
7	10-30	Silty-clay	1.72	7.1	55.2	0.78	0.55	303	22.6	380
8	10-30	Silyt-clay	1.75	7.6	50.0	0.56	0.54	404	24.1	401
9	10-30	clay	1.68	7.1	33.4	0.53	0.49	414	23.2	369
10	10-30	clay	1.69	7.4	40.1	0.74	0.78	389	26.1	409

Table 2 Selected physical and chemical properties of the black soil studied

Sample No.	Depth (cm.)	Soil texture	Bulk density Mgm^{-1}	pH	CEC $Cmol(p+)Kg^{-1}$	EC dsm^{-1}	OC %	N Kg/ha	P Kg/ha	K Kg/ha
1	10-30	Sand loam	1.38	6.8	15.4	0.23	0.15	140	18.19	367
2	10-30	Loamy sand	1.86	5.7	15.8	0.38	0.36	217	18.80	289
3	10-30	Loamy sand	2.02	5.9	14.9	0.40	0.45	161	13.40	293
4	10-30	Sand loam	1.76	5.8	16.2	0.38	0.54	163	14.60	287
5	10-30	Loamy sand	2.20	6.5	13.21	0.82	0.50	171	12..10	303
6	10-30	Loamy sand	1.45	5.2	11.2	0.56	0.40	200	17.41	293
7	10-30	Sand loam	1.80	5.4	12.2	0.20	0.35	184	15.60	300
8	10-30	Sand loam	1.65	5.5	11.1	0.25	0.45	222	18.40	389
9	10-30	Loamy sand	2.0	6.0	12.0	0.34	0.26	198	15.80	360
10	10-30	Sand loam	1.76	5.8	13.2	0.25	0.41	150	13.20	300

Physicochemical characteristics of soil samples are presented in Table 1 and 2.The particle size reveals the texture of soils are varying from sandy clay loam ,loam sandy loam and loamy sand with sand slit and clay The characteristics of soil largely determine its utilization [15].From this result the texture of soil under investigation can be classified .The red soil of Wardha region have relatively low clay content i.e15-22.5%, followed by black soils, where clay content ranging from 45.8 to 68.35%.The sand content of the red soils is higher and is in the range of 50-75%.In the black soils sand content ranges from 23.2 to 30.0% is very low slit is in the range of 5.9 to 30% and does not show any specific variations amongst red and black soils. .Bulk densities of red soils have low bulk density, while black soils have high bulk density. High bulk density may be due to high clay and that too of well –shrink type over burden leading to compaction

Maximum water holding capacity of red and black soils of Wardha region shows less variation due to macro pores and structure of both soils[16].Black soils show water holding capacity due to high percentage of clay and the smecititic clay minerals that have large surface area to retain higher amount of water at high sunction. Red soil has relatively low maximum water holding capacity as compared to black soils which could be attributed to the amount of clay content and minerals.

Red soil is moderately alkaline to acidic in nature .pH of red soil ranges from 5.2 to6.8. Black soils have high pH of when may be due to presence of high exchangeable cations on the exchange complex and may be due to presence of high exchange complex and may be due to calcareousness. From this we can conclude that pH is mainly dependent on exchangeable cations and calcium carbonate (Kaushal et.al.1986) which in turn are controlled by topography and physiographic position [17].

Black soils contain high organic carbon as compared to red soil .High organic carbon in the surface soils is due to addition of organic manures twice a year .Organic carbon content decreases with depth of profile .It may be due to its mineralization under existing climatic conditions on the surface or may be due to low leaching from surface layers or may be due to low leaching from surface layers or absorption by clay particles.

Red soils have relatively less cation exchange capacity that is in the range of 13.21to16.1Cmol(p+)$Kg^{-1.}$as compared to black soil where it ranges from37.4to54.4Cmol(p+)$Kg^{-1.}$ Red soil have very low cation exchange capacity may be due to very low clay content in these soils.

Electrical conductivity of red soil is low as compared to black soil .The variation in E.C. of red and black soils may be due to the removal of salts by overflow and its accumulation in black soil or may be due to evaporation of salts from surface layers.

Conclusion

From the result it is concluded that red soil is less fertile due to low clay content in soil, low water holding capacity, low organic matter, poor nutrient status as compared to black soil, the results have shown that the various soils samples differ in many important physical and chemical properties. Therefore, their potential to support various types of land use are expected to differ. This means that if their productivity must be enhanced and these maximized differences should be appreciated and taken into consideration in the planning and management of the various potential use types. Thus the present study clearly showed that variations in soil properties .Soil quality is directly related with sustainable agriculture .Therefore it is important to understand soil properties.

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