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Assessment and Characterization of Soil of Pandariya Block in Kabeerdham District, Chhattisgarh, India

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A B S T R A C T

A survey of chemical properties of soil of Pandariya Block of Kabirdham District, Chhattisgarh India was carried out in year 2016-17. 27 Soil samples were collected at a depth of 0-15, 15-30 and 30-45 cm from 9 Village- Baghraytola (V_1), Amarpur (V_2), Chhirpani (V_3), Jhingradongri (V_4), Kodwagodan (V_5), Vicharpur (V_6), Ravan manjholi (V_7), Gudha (V_8), Malkachhra (V_9). Soil sample were analysed for pH, EC, OC and N, P, K, Zn and S. The value of pH, EC, OC is found in ranges from 6.3 to 7.8, 0.11- 0.68 dSm^{-1}, 0.13 to 0.60 per cent respectively. and N, P, K, Zn, S is found in ranges from 180.3 to 288 kg ha^{-1}, 10.4 to 20.2 kg ha^{-1}, 129.2 to 205.2 kg ha^{-1}, 0.87 to 1.24 ppm, 10.5 to 18.4 ppm respectively. The pH is neutral, Electrical Conductivity is normal. The status of organic carbon percent and nitrogen is low to medium, the status of phosphorus, potassium and sulphur is medium in soil, and Zn is medium to high.

Introduction

Soil is the basic resource for agriculture and its proper management is essential to sustain agricultural production and maintain soil productivity. Soil testing is one of the best available tools, to ascertain the physical characteristics & nutrient status of a field so as to assess the fertilizer requirements for a crop or a cropping system or for knowing the reclamation requirements if the soil is saline or sodic in nature. Fertilizer application based on soil tests is the best available approach for harvesting the economically viable potential yields of crops by increasing input use efficiency and maintaining soil health (Singh and Brar, 2005). Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998). The production of rice crop is more in the Central part of India. Chhattisgarh is situated in the central part of India. The state of Chhattisgarh, with Raipur as its capital, came into existence on 1st November, 2000 by separation of 16 districts of Chhattisgarh region from Madhya Pradesh. At present 27 districts are there in Chhattisgarh.

Chhattisgarh is situated between 17-23.70 N latitude and 80.40-83.380 E longitude in Central eastern part of India. The total geographical area of the state is 136.03 thousand sq. km.

Geographically, Chhattisgarh is divided into three distinct land areas viz.

Chhattisgarh Plains,

Bastar Plateau and

Northern Hill Zones.

The state receives annual rainfall ranging from less than 1200 mm to greater than 1600 mm in different areas. The border of Chhattisgarh is touched by the states Uttar Pradesh in the North, Bihar in the North East, Orissa in the East, Andhra Pradesh in the South and South East, Maharashtra in South West and Madhya Pradesh in the West. Paddy is the main crop of the state and due to abundance of production of paddy Chhattisgarh was known as 'Rice Bowl of Central India.'

A vast region of Chhattisgarh is covered by red & yellow soil. There are a number of types of soil found in Chhattisgarh area but there are four major types namely Kanhar, Matasi, Dorsa and Bhata, which cover major portion of the total land area. The red color of soil is generally related to unhydrated ferric oxide, and partially hydrated ions oxides. The yellow color in soil is also due to oxides of iron. The soils of the region are deficient in important mineral nutrients like nitrogen, phosphorous, lime and potash, which are concentrated in the lower parts of the soil layer. However, the tropical red and yellow soils or the red sandy soils of the region possess texture suitable for growing crops. For the state as a whole, the predominant soil type is red and yellow loamy Soil. The percolation/water retention capacity, as well as the productive capacity of different soils, varies.

The following types of soils are found in Chhattisgarh (Tripathi and Bhardwaj, 2016):

Kanhar (clayey)

A low-lying deep bluish black soil with high moisture retention capacity. It is well suited for rabi crops, particularly wheat.

Matasi (sandy loamy)

This is a yellow sandy soil, with an admixture of clay. It has limited moisture retention capacity. Though used for paddy.

Dorsa (clay-loam)

This type of soil is intermediate in terms of soil moisture retention between kanhar and matasi. This is best described as loamy, and is a color between brown and yellow.

Bhata (laterite)

This soil is a coarse-textured, red sandy-gravelly soil, found on upland tops. It is deficient in minerals and other productivity enhancing nutrients.

Materials and Methods

Site Detail

Pandariya is a Block located in Kabeerdham district in Chhattisgarh. Placed in rural region of Chhattisgarh, it is one among the 4 blocks of Kabeerdham District (Fig. 1). Pandariya is located at 22°14′N 81°25′E to 22.23°N 81.42°E.) normal rainfall is 1450.0 mm and average rainfall 1241.0 mm. The region generally experiences hot, sub humid climate, having average rainfall of 1157.1 mm. It has an average elevation of 348 m (1,142 ft).

Sampling and analysis

The 27 soil samples were collected with different depths (0-15cm, 15-30 cm, 15-30 cm) from 9 Village- Baghraitola (V_1), Amarpur (V_2), Chhirpani (V_3), Jhingradongri (V_4), Kodwagodan (V_5), Vicharpur (V_6), Ravan manjholi (V_7), Gudha (V_8), Malkachhra ($V_{9)}$. The pH was determined in 1:2 soil water suspensions using Digital pH Meter (Jackson 1958). The EC was determined in 1:2 soil water suspensions using Digital Conductivity Meter (Wilcox 1950). The organic carbon was determined by Rapid Titration Method (Walkley 1947). The available nitrogen (kg ha^{-1}) in soil is determined by alkaline potassium permanganate method (Subbiah and Asija 1956).

The available phosphorous was extracted from soil by 0.5 M $NaHCO_3$ (pH 8.5) solution. Phosphorous in the soil extract is determined colorimetrically using a Photoelectric Colorimeter after developing molybdenum blue colour (Olsen *et al.*, 1954).

The exchangeable potassium is extracted from 1N NH_4OAC (pH 7.0) and K was determined by Flame Photometer (Toth and Prince 1949). The available sulphur (ppm) by turbidimetric method (Bardsley and Lancaster, 1960). The available zinc (ppm) was determined by suggested method of Shaw and Dean (1952) and Holmes (1945).

Results and Discussion

Soil pH

The Lowest value of pH found in Kodwagoda at depth (30-45 cm) 6.3 and highest value in Gudha at depth (15-30cm and 30-45cm) 7.8 and Malkachhra at depth (15-30cm) and pH was found to be non-significant at different depths and villages.

Electrical conductivity (EC)

The lowest value of electrical conductivity found in Baghraytola at depth (15-30 cm) 0.11 dSm^{-1} and Rawan manjholi at depth (30-45 cm) 0.11 dSm^{-1} and highest value in Chhirpani at depth (30-45cm) 0.68 dSm^{-1}. The EC was found to be non-significant at different depths and villages.

Organic carbon (OC) percent

The lowest value of organic carbon percent is found in soil of Kodwagoda at depth (30-45 cm) 0.13 per cent and highest value in soil of Gudha at depth (0-15cm) 0.60 per cent. The OC (%) was found to be significant at different depths and villages.

Available nitrogen (kg ha^{-1})

The Lowest value of nitrogen is found in soil of Amarpur at depth (30-45 cm) 180.3 kg ha^{-1} and highest value in soil of Ravan manjholi at depth (0-15cm) 288 kg ha^{-1}. The available nitrogen (kg ha-1) was found to be significant at different depths and villages.

Available phosphorus (kg ha^{-1})

The value of available phosphorus (kg ha^{-1}) is found in varied from 10.4 to 20.2 kg ha^{-1}.The lowest value of phosphorus is found in soil of Chhirpani at depth (30-45 cm) 10.4 kg ha^{-1} and highest value in soil of Kodwagodan at depth (0-15cm) 20.2 kg ha^{-1}. The available phosphorus (kg ha-1) was found to be non-significant at different village but found to be significant at different depths.

Available potassium (kg ha^{-1})

The lowest value of potassium is found in soil of Baghraitola at depth (30-45 cm) 129.2 kg ha^{-1} and highest value in soil of Vicharpur at depth (0-15cm) 205.2 kg ha^{-1}. The available potassium (kg ha-1) was found to be non-significant at different depths and villages.

Table.1 Rating chart for soil test values and their nutrient indices based on the specific rating chart modified from Brajendra *et al.,* (2014)

Soil property	Unit	Range		
Soil pH	pH unit	< 6.0 (Acidic)	6.1-8.0(Neutral)	>8.0 (Alkaline)
Electrical conductivity	dSm^{-1}	<1.0 (Normal)	1.0-2.0 (Critical)	>2.0 (Injurious)
Organic carbon	Percent	<0.5 (Low)	0.5-0.75(Medium)	>0.75 (High)
Available nitrogen (N)	kg ha^{-1}	<280 (Low)	280-560 (Medium)	>560 (High)
Available phosphorus (P_2O_5)	kg ha^{-1}	<10 (Low)	10-25 (Medium)	>25 (High)
Available potassium (K_2O)	kg ha^{-1}	<110 (Low)	110-280 (Medium)	>280 (High)
Available sulphur (S)	ppm	<10 (Low)	10-30 (Medium)	>30 (High)
Available zinc (Zn)	ppm	<0.6 (Low)	0.6-1.0 (Medium)	>1.0 (High)

Fig.1 District and Block map of Kabeerdham District

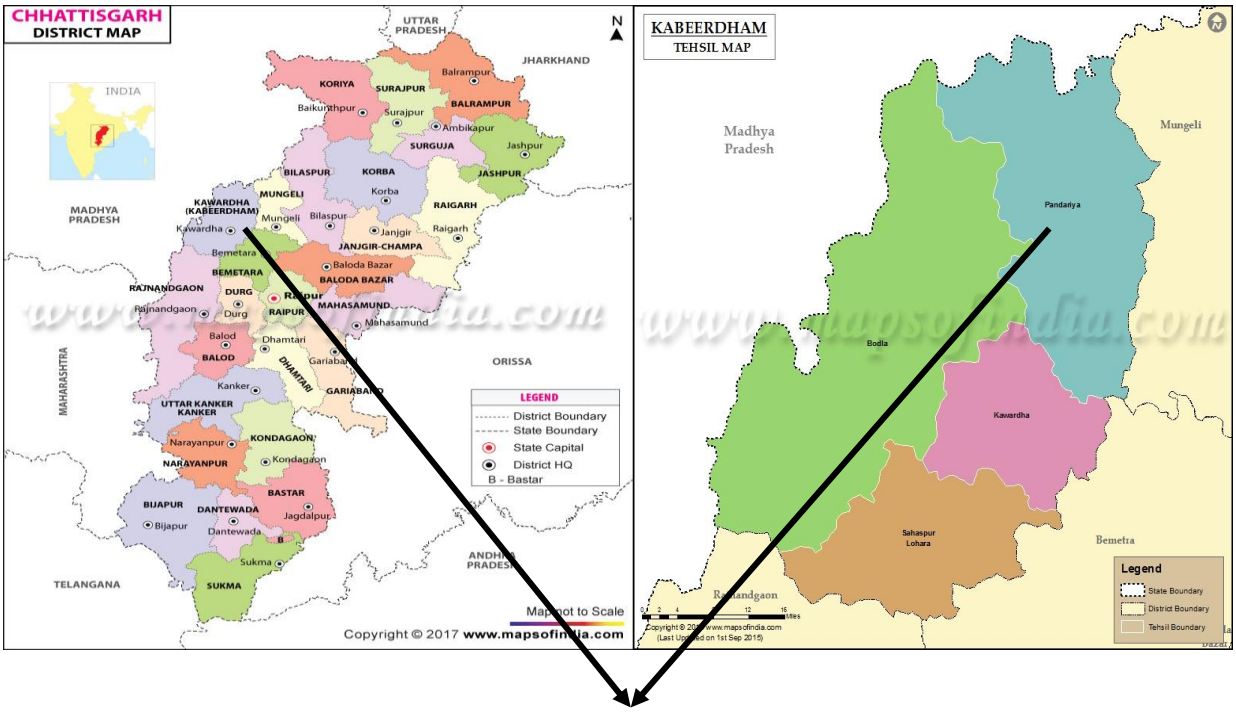

Table.2 Analysis results of chemical parameters of soil samples of Pandariya Block in Kabeerdham District, Chhattishgarh

Village	Depth in cm	pH	EC (dSm^{-1})	OC in %	Nutrient				
					N ($kg\ ha^{-1}$)	P ($kg\ ha^{-1}$)	K ($kg\ ha^{-1}$)	Zn (ppm)	S (ppm)
Baghraitola (V_1)	0-15	7.0	0.6	0.22	235	16.1	172.7	1.13	16.2
	15-30	7.0	0.11	0.21	208.9	11.8	142.2	1.01	14.8
	30-45	7.5	0.38	0.17	205.4	11.6	129.2	0.91	14
Amarpur (V_2)	0-15	7.3	0.59	0.60	198.1	18.2	175.7	1.07	14.4
	15-30	7.2	0.4	0.36	187.2	16.8	168.4	0.98	12.8
	30-45	6.4	0.62	0.31	180.3	11.4	164.4	0.95	12.1
Chhirpani (V_3)	0-15	7.4	0.38	0.42	210.8	18.5	185.7	1.19	12.1
	15-30	7.0	0.32	0.26	205.1	12.2	150.2	1.16	11.4
	30-45	6.8	0.68	0.25	198.26	10.4	148.7	1.08	11.1
Jhingradongri (V_4)	0-15	6.5	0.48	0.62	207.6	18.7	190.2	1.1	14.1
	15-30	6.4	0.31	0.43	185.2	15.8	161.2	1.03	13.2
	30-45	7.1	0.18	0.21	181.3	15.8	150.4	0.87	10.5
Kodwagodan (V_5)	0-15	7.2	0.28	0.35	214.4	20.2	188.4	1.2	18.4
	15-30	7.2	0.4	0.31	195.23	16.4	178.4	1.18	16.2
	30-45	6.3	0.41	0.13	189.23	11.2	174.5	1.8	15
Vicharpur (V_6)	0-15	7.4	0.41	0.22	198.53	18.2	205.2	1.11	15.2
	15-30	7.5	0.18	0.20	186.3	15.3	185.1	0.97	14.2
	30-45	7.3	0.58	0.19	182.3	14.8	172.7	0.94	12.2
Ravan manjholi (V_7)	0-15	6.8	0.54	0.39	288	17.4	190	1.14	14.6
	15-30	7.0	0.12	0.37	252.1	17.2	179.2	1.12	11.2
	30-45	7.5	0.11	0.25	223.2	11.2	168.4	0.98	11.3
Gudha (V_8)	0-15	7.0	0.14	0.60	284	16.2	168.5	1.24	14.2
	15-30	7.8	0.16	0.52	281	15.1	150.4	1.17	13.2
	30-45	7.8	0.16	0.51	276.6	15.1	146.4	1.03	13.1
Malkachhra (V_9)	0-15	7.0	0.32	0.31	210.8	17.2	190.2	1.02	16.5
	15-30	7.8	0.24	0.29	194.6	17	181.1	1	15.8
	30-45	7.1	0.38	0.24	181.3	16.3	171.7	0.93	14.1

Available zinc (ppm)

The lowest value of zinc (ppm) is found in soil of Jhingradongri at depth (30-45 cm) 0.87 ppm and highest value in soil of Gudha at depth (0-15cm) 1.24 ppm. The available zinc (ppm) was found to be non-significant at different depths and villages.

Available sulphur (ppm)

The lowest value of sulphur is found in soil of Jhingradongri at depth (30-45 cm) 10.5 ppm and highest value in soil of Kodwagodan at depth (0-15cm) 18.4 ppm. The available sulphur (ppm) was found to be non-significant at different depths and villages.

It can be concluded that the soil of Pandariya Block in Kabeerdham district of Chhattisgarh showed status according to (Table 1) the value of pH is found varied from 6.3 to 7.8. It is neutral in nature, similarly results reported by (Meena *et al.,* (2006). The EC value is varied from 0.11- 0.68 dSm^{-1} and it is normal, similarly results found (Upadhyay *et al.,* 2014). The value of OC percent is found in varied from 0.13 to 0.60 per cent and this is low to medium level. The value of available nitrogen (kg ha^{-1}) is found in varied from 180.3 to 288 kg ha^{-1} is low to medium level similarly results reported by Pandey *et al.,* (2013).

The value of available phosphorus (kg ha^{-1}) is found in varied from 10.4 to 20.2 kg ha^{-1} is medium level. The value of available potassium (kg ha^{-1}) is found in varied from 129.2 to 205.2 kg ha^{-1} is medium level similarly results reported by (Rao *et al.,* 2016). The value of available zinc (ppm) is found in varied from 0.87 to 1.24 ppm is medium to high level. The value of available sulphur (ppm) is found varied from 10.5 to 18.4 ppm is medium level (Table 2).

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