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Research Article

Vertical Distribution of Soils Fertility of Sagarpali and Chitbadagaon Village of Ballia District, Uttar Pradesh

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Abstract

An investigation was carried out for Characterization of soils of Sagarpali and Chitbadagaon village of Ballia District (U.P.). Depth wise soil samples were collected from two selected village *viz.* Sagarpali and Chitbadagaon. From both Sagarpali and Chitbadagaon pedons soil sample were collected from 0 - 20, 20 - 41, 41 - 61, 61 - 81, 81 - 101, 101 - 127, 127 - 152 and 152 - 177 cm depths and in this respect a soil profile was opened in each village. Standard method was followed for analysis of physico-chemical parameter of soil. Results revealed that pH of soil found to be slightly acid to slightly alkaline where EC was in normal range. Bulk density of soil found be 1.40 - 1.54 Mg m^{-3} and water holding capacity 36.89 - 47.79%. Organic carbon content varied from 0.13 - 0.71%. The soil was slightly moderately calcareous (0.36 - 2.34 $CaCO_3$%). Available N, P, K, and S content in soil varied from 106.62 - 304 kg ha^{-1}, 6.81 - 11.10 mgkg^{-1}, 240.8 - 403.2. kg ha^{-1} and 4.32 - 8.35 mgkg^{-1} respectively. The texture of soil was found to be clayey to clay loamy.

Keywords: Pedon; Soil Organic Carbon; Available N.P.K.S. Content and Soil Texture

Introduction

Soil is a natural gift for survivable of living organisms and base of nonliving things. Indian soils are generally poor in fertility, as these have consistently been depleted of their finite nutrients resource due to continuous cultivation for many centuries. Out of 20 nutrients, focus have been on nitrogen, followed by phosphorus, secondary and micronutrient have not been given due to attention. As a consequence deficiencies of nitrogen, phosphorus, potassium, sulphur, zinc have been reported to the extent of 89, 80, 50, 41 and 48% respectively (Singh, 2008). The deficiency of sulphur and zinc are becoming more widespread and critical. The use efficiency of applied N, P, K and Zn in Indian soils are 30 - 50, 15 - 20, 70 - 80, 2 - 5% respectively. Thus, problems of nutrient deficiencies are aggregated further because of low use efficiency of applied nutrient, particularly of P and micronutrients. Soil study and their analysis has played historical role in soil fertility maintenance and sustainability in agriculture. Soil profile study shall play crucial role in precision agriculture in area of all type of farming and rainfed areas, conservation agriculture and in contaminated soil diagnosis and remediation. Soil characteristics in relation to evaluation of soil fertility of area are important aspect in context to sustainable agriculture production. Because of imbalance and inadequate fertilizer application coupled with low efficiency of other inputs. The efficiency of chemical fertilizers nutrients has decline tremendously in intensive agriculture in day by day since last decades. The capacity of specific kind of soil to formation with in natural or managed ecosystem boundaries to substation Plant and animal productivity, maintain or enhance water and air quality as well as support human health and habitation (More, 2010). Soil texture is also an indicator of some other related soil feature such as type of parent material homogeneity and heterogeneity within the profile, migration of clay and intensity of weathering of soil material or age of

soil (Miller and Donahue, 1995; Lilienfein., *et al.* 2000). Soil characterization provides the information for our understanding of the physical, chemical, mineralogical and microbiological properties of soil. Based on its characteristics has a predictable response to management or any kind of manipulation, (Ogunkule, 2004). Therefore, the present study was undertaken to investigate the depth wise distribution of available nutrients and other related properties of soil in two village pedons for land use planning and crop suitability.

Materials and Methods

Ballia district is eastern part of the state of Uttar Pradesh and situated in central portion of the Ganges basin. The geographical extent of the district lies between 25°23" E to 26°11" N latitude and at from 83°38" to 84°39" E longitude with average elevation of 68 meters of sea level. The mean annual rainfall ranges from 950 to 1150 mm of the year. Soil samples were air dried in shade and well processed, powdered gently with a wooden mallet and passed through 2.0 mm sieve. Soil samples were analyses for soil pH by1:2.5 soil-water suspension method using glass electrode. Electrical conductivity (EC) was determined in 1:2.5 soil-water extract using Conductivity Bridge and expressed as dSm^{-1} [1]. Calcium carbonate (% $CaCO_3$) was determined by rapid titration method (Puri, 1930). Bulk density method described by Kanwar and Chopra [2]. Organic carbon was determined by rapid titration method [3]. Available nitrogen was determined by alkaline potassium per manganate method [4], available phosphorus by Olsen's., *et al*. [5] and available potash by ammonium acetate extractable method described by Muhr., *et al*. [6]. Available sulphur was analyses by extract of using 0.15 per cent calcium chloride solution [7]. Soil texture (sand, silt and clay %) determined by international pipette method, exchangeable calcium and magnesium by versinate method, water holding capacity by gravimetric method described by Kanwar and Chopra [2].

Result and Discussion

Soil pH

Data on soil pH in table 1 soil from two Pedon of Sagarpali and Chitbadagaon on 0 - 20, 20 - 41,41 - 61,61 - 81, 81 - 101, 101 - 127, 127 - 152 and 152 - 177 cm depth of soils were ranged from slightly acid to slightly alkaline showed. Pedon 1 was showed high value 7.20 pH at 0 - 20, 152 - 177 cm thereafter low value 6.6 at 76 - 91 cm was no pattern found in pedon-1 soil, pedon 2 was showed 6.70 pH at 41 - 61, cm there after increasing 7.40 at 20 - 41 cm soil the similar finding has been given by (Brammer, 1967). The black cotton soils are neutral to slightly acidic in reaction in the upper horizon whereas the lower higher biological activities might be responsible for decreased soil pH range on surface soil, the pH value showed in increase with increasing in the depth of soil which is attributed to determine of neutral soluble salt (Abrol, 1998).

Depth (cm)	Sagarpali						Chitbadagaon					
	pH (1:2.5)	EC (dSm^{-1})	Bd (Mgm^{-3})	W.H.C (%)	O.C. (%)	$CaCO_3$ (%)	pH (1:2.5)	EC (dSm^{-1})	Bd (Mgm^{-3})	W.H.C (%)	O. C. (%)	$CaCO_3$ (%)
0-20	6.7	1.011	1.46	47.76	0.71	2.34	7.12	1.010	1.54	44.1	0.58	1.89
20-41	7.9	1.010	1.48	45.88	0.68	1.8	7.40	1.010	1.44	40.22	0.49	1.78
41-61	6.9	1.012	1.45	43.97	0.58	1.23	6.70	1.011	1.46	37.32	0.48	1.34
61-76	7.1	1.08	1.49	43.80	0.44	0.98	7.4	1.001	1.42	39.11	0.44	1.49
76-91	6.6	1.011	1.45	44.89	0.26	0.92	6.99	1.017	1.46	42.1	0.28	1.12
91-119	6.8	1.012	1.40	43.9	0.20	0.76	6.81	1.010	1.49	39.89	0.19	0.98
119-152	7.4	1.009	1.44	45.49	0.17	0.63	7.2	1.009	1.44	36.89	0.17	0.56
152-177	7.2	1.010	1.43	41.21	0.14	0.46	6.95	1.011	1.45	38.89	0.13	0.36

Table 1: Status of soil pH, EC, W.H.C., O.C. and $CaCO_3$ of soil at different depth of pedons of two village of Ballia District, Uttar Pradesh.

Electrical conductivity of soil (EC) dSm-1

The perusal of data on soil EC presented in table 1 revealed that the EC of soil samples from two pedon of Hanumanganj (Sagarpali) and Sohaon (Chitbadagaon) Block soil of depth of wise were showed their values ranged from 1.007 $dSm^{-1}$to 1.012dSmindicated no wide variation between the both pedon were recorded. Pedon 1 relative lower EC 1.08 dSm-1 values in surface layer as compared to subsurface (61 - 76 cm) soil and high value 1.012

dSm^{-1} and (91 - 121 cm) soil depth. Pedon 2 has showed on some depth of their EC 1.001 dSm^{-1} and some depth of EC 1.011 dSm^{-1} were recorded. The similar finding was given by Gupta., *et al* [8].

Bulk density (Mg m^{-3})

Bulk density of soil was (Table 1) varied from 1.40 to 1.54 Mg m^{-3} of both pedon 1 and pedon 2. The maximum value 1.54 Mg m^{-3} was observed in surface soil of Chitbadagaon pedon and lowest value 1.40 Mg m^{3} in Sagarpali pedon on 101-119 cm depth. All horizons of both pedons has a small variation and decreasing to the increasing depth which has caused low compactness in lower layer of pedons might be due to increasing content of sand than the clay and other minerals develop the compaction [8].

Water holding capacity (%)

Water holding capacity of soil (Table 1) was ranged from 39.76% on 127 - 152 cm depth to 47.76% on 0 - 20 cm depth. The pedon-1 was showed 47.76% on 0 - 20 cm depth to 41.21% on 152 - 177 cm lower horizon and pedon 2 was showed 44.1% on 0 - 20 cm to 36.89% 127 - 152 cm horizon it might be due to soil compaction and minerals content seems to decline W.H.C. of soil on the different depth. The valve of water holding capacity was decreased with increasing soil depth in both pedon might be due to organic matter content and some other physical factors in the both pedon, the similar finding was given by Gupta., *et al* [8].

Organic carbon (%)

Data on soil organic carbon (Table 1) revealed that the per cent value at different depth of soil profile was decreasing content with increasing soil depth in both pedons. Greater organic carbon content (0.71%) were appeared on 0-20 cm in pedon 1 to 0.13% on 152-177 cm depth of horizons depth in pedon 2 although the lowest organic carbon content was fairly greaten in all profile up to 0 - 20 cm horizons depth it might be due to greater organic substances accumulation was observed [9], on the surface of pedon-1 and it was gradual decreased with depth and elevation of pedon, the similar findings was given by Sahu and Bala [10] and Singh., *et al.* [11]. Surface soil of pedon1 was showed that ogranic carbon content ranged between 0.71 to 0.14% and profile 2 was ranged between 0.58 to 0.13% with higher value in Chitabadragaon followed by cultivated land of soil profile in Sagarpali village.

Calcium carbonate (%)

Irrespective of the land use system the extent in horizons of calcium carbonate was measured with small variation in amount of $CaCO_3$ (Table 1) in both pedons. In both soil profile as per depth were showed decreasing ranged from order with their respective values of 2.34 to 0.30% throughout the depth. However, $CaCO_3$ content was found maximum (2.34%) on 0 - 20 cm and decreased regularly with soil depth in pedon-1. The pedon 1 was showed 2.34% at 0 - 20 cm depth to 0.46% in lower horizons, similarly pedon-2 was showed 1.89% on 0 - 20 cm depth to 0.30% on lower horizons (152 - 177 cm). There was great difference of calcium carbonate inclement was found in Sagarpali and Chitbadagaon village pedon, the similar finding was given by Gupta., *et al* [8].

Available nitrogen (kg/ha)

The perusal of data in table 2 revealed that the available nitrogen content in soil of two pedons on different depth were showed decreasing ranged from 304.19 to 106.62 kg/ha throughout the depth. However, available N content was found in greater amount (304.19 kg/ha) in 0 - 20 cm depth and decreased regularly with soil depth at pedon 1. Surface soil has showed greater available value might be possible due to the accumulation of natural vegetation residues and organic materials. It might be there where more microbial transformation due to moisture content and soil condition similar finding was given by Prasuna Rani., *et al*. [12], Singh., *et al* [11].

Available phosphorus (mg/kg)

The available phosphorus was measured at pedon-1 and 2 (Table 2). The greater amount of available phosphorous was found in Pedon-1 of 9.45 mg/kg and 11.1 mg/kg in 0 - 20 cm depth in pedon-2. The greater extent of available phosphorus in the surface horizons might be due to supplementation of the depleted phosphorus through external sources i.e. chemical fertilizers [13]. The variation trend was similar at Pedon-1 and 2, but Pedon-2 horizon showed higher value of available phosphorus than pedon1 as per their land use system. Because of Pedon-2 is located where last time Berseem crop grown and there was water submergence 4 - 5 week having decomposition of huge amount of organic materials to decomposition by microbes as per physical land information. The available phosphorus content in both pedons of 11.1 to 6.81 mg/kg. So that in surface soil horizons have increased the phosphorus fixation capacity of soil under [14] Sagarpali and Chitbadagaon village soil in current land use system.

Depth (cm)	Sagarpali				Chitbadagaon			
	Nitrogen (kg/ha)	Phosphorus (mg/kg)	Potassium (kg/ha)	Sulphur (mg/kg)	Nitrogen (kg/ha)	Phoshporus (mg/kg)	Potassium (kg/ha)	Sulphur (mg/kg)
0-20	304.19	9.45	403.2	8.35	288.96	11.1	392.2	7.63
20-41	241.47	9.12	347.2	7.45	275.51	10.88	235.8	6.73
41-61	250.88	9.18	322.4	6.96	228.92	10.51	268.8	6.44
61-76	197.00	8.11	313.6	6.87	194.43	9.89	358.4	5.54
76-91	181.88	8.81	336.8	6.67	141.25	8.68	280.1	6.87
91-119	134.84	7.96	313.6	4.32	125.44	8.12	302.4	5.89 5.5 5.54
119-152	122.30	6.96	289.8	4.08	112.89	7.81	263.6	4.86
152-177	116.03	6.81	278.6	3.03	106.62	6.87	240.8	3.65

Table 2: Status of available nutrients in soil at different depth of pedon of two village of Ballia District, Uttar Pradesh.

Available potassium (kg/ha)

The amount of available potassium in pedon-1 and pedon-2 (Table 2) was dealt that pedon 1 was measured 403.3 kg/ha value on 0 - 20 cm depth to 278.6 kg/ha on bottom horizon, pedon-2 showed 240.8 kg/ha on 152-177 cm depth to 392.2 on lower horizons (0 - 20 cm). There was great difference of content in both pedons of Sagarpali and Chitbadagaon village soil. Content in all pedons were varied from 403.2 to 240.8 kg/ha value. The maximum content was observerd in the surface horizons and showed decreasing trend with increasing horizons depths. It could be attributed to more intensive weathering and release of exchangeable K from organic residues. Application of potassic fertilizer in pedon-1 and pedon-2 land use system upward translocation of K from lower depth along capillary rise of ground water [15]. The content was increased from lower horizon to upper horizon in pedon-1 and pedon-2 land use system were 116.03 to 304.19 kg/ha-^{1} in pedon 1 and 240.8 to 403.2 kg/ha than pedon -2 similar finding was given by Singh., *et al* [16].

Available sulphur (mg/kg)

Data in table 2 revealed that for available sulphur was ranged from 8.35 to 3.03 mg/kg in pedon1 and 7.63 to 3.65 mg/kg in pedon2, respectively. Greater amount of content was found in surface soil than in sub surface soil resulted from its recycling over the years by plant and subsequent organic matter accumulation [17]. It has translocate in slows down the depth in all orders being lowest at lower depth. So, that available sulphur content declined with increase in depth at sub-surface, the contents of sulphur was more or less similar, it might be attributed that soil organic matter was regulates markedly variation on the content of suphate-S in alluvial soil. The similar finding was given by Trivedi., *et al* [18].

Exchangeable Ca^{++} [cmol (p+) kg^{-1}]

Exchangeable calcium (Table 3) content in different horizons was decreased with increase in horizons depth at both Pedoen of Sagarpali and Chitbadagon. The upper horizons of both pedon were observed greater exchangeable Ca^{++} than lower horizon. Exchangable calcium in surface soil of 0-20 to 152-177 cm horizons depth of at pedon 2 was 2.8 to 10.2 [cmol (p+) kg^{-1}]. Pedon 1 was showed soil of 0-20 cm, 14.3 to 152-177 cm, 3.7 [cmol(p+)kg^{-1}] respectively. The both Pedon was appeared greater Concentration of exchangeable Ca^{++} in Surface soil might be due to drying condition throughout the year except rainy season dry might In fact, in dry areas might be accumulate calcium and other materials removed from the upper soil, Brady and Weil (2008).

Exchangeable Mg^{++} [cmol (p+) kg^{-1}]

The content of exchangeable magnesium in table 3 revealed that content was decreasing with increasing soil horizons depth. Sagarpali village pedon was showed maximum content of 7.7 [cmol (p^{+}) kg^{-1}] at 0-20 cm and after that decreased continuing. The pedon-1 was measured 7.7 [cmol (p^{+}) kg^{-1}] on 0-20 cm depth to 3.10 [cmol (p+) kg-1] of lower surface horizon, and pedon 2, 5.2 [cmol (p^{+}) kg^{-1}] at 0-20 cm depth to 3.8 (mg/kg) on 152-177 cm lower depth horizons. Exchangeable Mg content in the low lying soil of nutrient elements was lower than that of double cropping area of pedon 1 due to recycling of nutrient in rhizosphere. The similar finding given by Vishrteresky and Steinberger [19].

Depth (cm)	Sagarpali					Chitbadagaon				
	Ca [cmol (p^+) kg^{-1}]	Mg [cmol (p^+) kg^{-1}]	Sand (%)	Silt (%)	Clay (%)	Ca [cmol (p^+) kg^{-1}]	Mg [cmol (p^+) kg^{-1}]	Sand (%)	Silt (%)	Clay (%)
0-20	14.3	7.7	35.5	41	21	10.2	5.2	46	34	16
20-41	11.9	8.6	44	35	19.5	9.6	4.8	45	35	17
41-61	10.5	7.4	52	30	16	8.7	3.0	44	40	12
61-76	11.5	6.0	55	35	8.6	9.3	2.8	46	30	20
76-91	9.8	6.8	55	29	12.5	8.8	4.8	58	26	16
91-119	7.6	5.6	52	32	13	6.2	3.6	46	30	20
119-152	5.3	4.5	52	31	13.8	3.5	3.0	55	25	16
152-177	3.7	3.10	45	37	17	2.8	3.8	52	24	18

Table 3: Status of exchangeable Ca^{++}, Mg^{++} content and Mechanical composition of soil at different depth of pedons of two village of Ballia district, Uttar Pradesh.

Soil texture

The value of sand, silt and clay percentage were measured in pedon-1and 2 data presented in table 3 indicated that sand, silt and clay per cent value decreased with increasing in horizons depth at both pedon. The percentage of sand, silt and clay in both soil profiles were varied from 25.5 to 55%, 29 to 41% and 8.6 to 21% in pedon 1 and 40 to 58%, 24 to 40% and 102 to 20% in pedon 2 respectively, according the textural class of these soils varied from sandy loam to clay loam [20]. Irrespective of the land use systems soil texture was finer in the sub-surface horizons than in the surface horizons and this might be due to the pedogenic process viz., clay illuviation [21-23].

Conclusion

Depth wise soil samples from two selected village *viz.* Sagarpali and Chitbadagaon of Hanumanganj and Sohaon block of Ballia district has revealed that pH of soil found to be slightly acid to slightly alkaline where EC was in considerable range for crop and soil, Bulk density of soil found be 1.40 - 1.54 Mg m^{-3} and water holding capacity 36.89 - 47.79%. The Organic carbon content varied from 0.13 - 0.71%, soil was slightly moderate calcareous (0.36 - 2.34 $CaCO_3$%). Available N, P, K, and S content in soil varied from 106.62 - 304 kg ha^{-1}, 6.81 - 11.10 $mgkg^{-1}$, 240.8 - 403.2. kg ha^{-1} and 4.32 - 8.35 $mgkg^{-1}$ respectively. The texture of soil was found to be sandy loam to clay loamy. The depth wise study showed that no more clearly hoziones develop in the pedons of the village to distinguish their characters.

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