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Physico-Chemical Properties of Soil of Laokhowa Wildlife Sanctuary, Nagaon, Assam

Sanjeeb Kumar Nath and S. K. Sarma*
Department of Botany, Dhing College, Dhing, Nagaon-782 123, Assam, India
*Department of Botany, Gauhati University, Guwahati-781 014, Assam, India

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ABSTRACT

The study deals with analysis of soil of Laokhowa Wildlife Sanctuary of Assam to understand the physico-chemical properties. The soil is mainly alluvial in nature. The texture varies from sandy and loamy sandy to clay loam. The removal of finer soil particles from the soil surface during rainy season might have contributed to sandy or sandy loam nature, and accumulation of finer soil particles and deposition of clay during flood have resulted in clayey loam nature of soil in different parts of the sanctuary. The soil is acidic in nature with soil pH varying from 4.36-6.86. Logging and grazing have direct effect on physical and chemical conditions of soil, nutrient content and decomposition rate of litter. Organic carbon varies from 0.09-3.24% and the difference may be attributed to recurrent floods and addition of plant litter and animal remains. In general, different chemical properties of the soil show variations to a great extent. The variation in the chemical content in different parts of the sanctuary may be due to periodic flood, siltation and excessive biotic interferences.

INTRODUCTION

Soil and vegetation have a complex relationship, one influencing the other. The nutrient status of soil varies considerably in the forest ecosystems depending upon the rate of deposition and decomposition of organic materials like leaves, twigs, fruits, etc. Thus, the dominant species present in them regulate the physico-chemical properties of the soil and also soil microflora.

It is presumed that certain native trees positively influence soil fertility. Again, differences in vegetation type are likely to impart differences on soil properties. This is for the fact that soil supports particular type of flora and fauna and there is a characteristic climate for vegetation and wildlife of a particular area (Wild 1993). Soil environment in quantitative terms includes how much and what kind of organic matter is added by the type of vegetation growing on the soil including the rate of growth, rate of return of litter and the size and longevity of the root system under available climatic regime (Russel 1970).

Soil is the product of environment, characterized and developed under the influence of innumerable factors, the most important of which are climate, living organisms, time and parent material. The development of soil and production of vegetation are so intimately related that it is scarcely possible to study the one without the knowledge of the other. Functionally, the most important thing about soil is its productivity for plants. Those characteristics, which make soil productive, are biological forces, particularly native vegetation. The greatest influence of climate on soil is exerted indirectly through its partial determination of the kind of native vegetation under which the soil evolves.

A detailed account of the soils of Assam was carried out by Bora & Das (1972); besides, subdivisionwise analysis of soils of Assam is found in the works of Barooah & Barua (1964). The soil

characteristics under three different plant communities *viz.,* Jhum fallow, bamboo forest and natural forest of northeast India is found in the works of Singh et al. (1995). Effect of different plant covers or forest plantations based on the physico-chemical properties of soil are found in the works of Singh & Das (1992), Prasad et al. (1985) and Devi (1997).

The present investigation covers the physico-chemical properties of the soil of Laokhowa Wildlife Sanctuary to bring into focus the type and quality of the soil of the study site, which supports very rich vegetation along with its associated fauna.

MATERIAL AND METHODS

Laokhowa Wildlife Sanctuary is situated in the Nagaon district of Assam, India between the latitudes 26°30 N to 26°32 N and longitude 92°40 E to 92°47 E in the floodplains of the River Brahmaputra with a total area of 70.10 sq. km. The Sanctuary is located just in the central part of S
state of Assam. The soil of the area is mostly alluvial deposits of the River Brahmaputra. Soil is generally fertile, clay loam mixed with silt. The climate of the sanctuary has sub-tropical monsoon type climate. Annual temperature of the sanctuary varies between 9.6°C (min) and 33.8°C (max). Average annual rainfall remains around 2000 mm. The relative humidity varies from 65-95%.

The sanctuary is arbitrarily divided into 10 compartments for physico-chemical analysis of soil. Soil samples were collected randomly, 3 replicates from each compartment (10 × 3) i.e., a total of 30 samples. The samples were collected from a depth of 10 cm by using a corer. After determining the pH, the soil samples were mixed thoroughly, air dried and passed through a 2mm mesh sieve to remove the stone pieces and large root particles. The samples were used for subsequent physico-chemical analysis by following methods.

Soil colour: The colour of the soil samples was studied by Munsell colour chart in moist state.

Mechanical analysis of soil: International pipette method was used to determine the mechanical composition i.e., percentage of sand, silt and clay of soil samples as described by Piper (1966).

Soil pH: The pH of the soil was determined in 1:5 soil:water suspension with the help of a glass electrode (Jackson 1973).

Organic carbon (OC): Organic carbon content of the soil samples was determined by titrimetric method as reported by Walkley & Black (1934) and represented as % of OC.

Organic matter (OM): Organic matter content of the samples was calculated from organic carbon by multiplying it by Von Bemmlen factor (1.724).

Available nitrogen (N): Available N was determined by titrimetric method (Walkley & Black 1934).

Available phosphorus: The available phosphorus of the soil was determined colorimetrically as per Bray & Kurtz (1945) using 0.03 N NH_4F in 0.025 N HCl as extracting reagent.

Available potassium: The readily exchangeable and water-soluble potassium was determined in neutral ammonium acetate represented as available potassium in soil. The estimation was done with the help of the flame photometer (Jackson 1973).

Calcium (Ca) and magnesium (Mg): Ca and Mg were determined by complexometric titration method (Jackson 1973).

RESULTS AND DISCUSSION

The findings of the physico-chemical properties of soil samples are given in Table 1. The colours of

Table 1: Physico-chemical analysis of soil samples of Laokhowa Wildlife Sanctuary.

Characteristics	Compartments									
	1	2	3	4	5	6	7	8	9	10
Colour	L.Grey	L.Grey	D.Grey	D.Grey	D.Grey	D.Grey	D.Grey	D.Grey	D.Grey	D.Grey
Texture	S	Ls	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl
pH	6.15	6.62	4.82	4.62	5.32	5.75	6.18	6.86	5.76	5.34
OC %	0.09	0.30	2.70	3.24	1.80	1.20	3.24	2.85	2.25	2.85
OM %	0.16	0.52	4.65	5.58	3.10	2.06	5.58	4.91	3.87	4.91
Calcium (meq/100g)	1.8	3.0	5.0	6.0	5.0	8.0	6.0	8.4	7.0	7.6
Magnesium (meq/100g)	0.2	2.0	3.0	3.0	3.0	6.0	4.6	4.8	4.0	2.8
Phosphorus (kg/ha)	36.96	5.04	25.76	45.92	17.92	20.18	49.28	21.24	5.04	16.80
Sodium (kg/ha)	30.8	99.5	895.5	1014.5	597.0	396.7	1074.5	945.5	145.2	945.5
Potassium (kg/ha)	114.8	190.4	280.0	812.0	86.8	204.4	1140.0	630.0	146.4	138.0

S-Sandy, Ls-Loamy sandy, Cl-Clayey loam, L.Grey-Light Grey, D.Grey-Dark Grey, OC-Organic carbon, OM-Organic matter

the soil in all the 10 compartments were observed to be light grey to dark grey. The soil texture showed that clayey loam type of soil was the representative texture in the compartments III to IX because of the higher percentage of clay particles recorded there. The higher percentage of sand in compartments I and II showed the prevalence of sandy or sandy loam type of soil in these compartments. The soil was found to be acidic with highest pH value of 6.86 in compartment VIII, and lowest in compartment III i.e., 4.82 indicating maximum acidic nature of the soil of the compartment. The percentage of exchangeable calcium was highest (8.4 meq/100g) in compartment VIII, and lowest (1.8 meq/100g) in the compartment I. The percentage of organic carbon was not uniform i.e., highest (3.24%) in compartments IV and VII, and lowest (0.09%) in compartment I. The percentage of organic matter also varied with highest (4.65 %) in compartments IV and VII, and lowest (0.16%) in compartment I. The Phosphorus was found to be highest in compartment VII (49.28 kg/ha), and lowest in compartments II and IX (5.04 kg/ha). K_2O was found to be highest (812 kg/ha) in compartment IV, and lowest in compartment V (86.80 kg/ha). Nitrogen was highest in compartment VII (1074.56 kg/ha), and lowest in compartment I (30.81 kg/ha).

Clay loamy soils are found to be more favourable for forest growth than either coarse sands or fine clays, which can be supported by the rich forest areas in most of the compartments. The soil texture of the sanctuary was clay loam in eight compartments and sandy loam in two compartments. Accumulation of floodwater has resulted in clay nature of soil in major parts of the sanctuary. Extensive overgrazing and deforestation might have resulted in sandy nature in the two compartments due to the removal of top vegetation layer. The other chemical properties of the soil amongst different compartments are found to be significantly different. There are variations in chemical contents of soil in different compartments of the sanctuary. This may be due to variations of litter contribution by similar species of plants or may be because of uneven leaching due to rainfall amongst the compartments that may ultimately create different microhabitat in different compartments. However, some trends were detected in relation to the type of plant species and their contribution to the nutrient content of each compartment of the sanctuary.

The pH of the soil was found to be acidic (4.62 to 6.86), which may be due to the more soil organic matter content associated and high microbial activity resulting in high organic acid production. Least acidity in compartments III and IV may be due to poor addition of soil organic matter by plant species. Miles (1986) reported that acidification of soil depends on the type of species, the

environmental condition, developmental stages and on plantation management. Low pH is detrimental to plant growth in extreme conditions, but tolerance to acidity varies from species to species. The tree cutting has a direct effect on physical and decomposition rate of litter.

The high level of organic carbon, nitrogen and phosphorus in most of the compartments is attributed to recurrent floods, which resulted in the sedimentation and nutrient enrichment of soil by further addition of organic matter. Woodland ecosystems are characterized by large and rapid turnover of organisms (Pandit & Pandya 2005). The presence of tree species like *Bischofia javanica* and *Gamelina arborea* might have contributed more phosphorus to compartment VII as these are less in compartment II and XI resulting in low concentration of phosphorus in the latter. High percentage of organic carbon in compartment VII may be due to the high species richness and also presence of good number of tree species like *Lagerstroemia reginae, Albizia procera* and *Bombax ceiba,* etc., which might have contributed more litter to the soil. The low percentage of organic carbon in compartments I and II may be due to the deforestation and other methods of extensive human disturbances. The difference in soil contents among various compartments was recorded, which was attributed to species contents of these compartments.

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