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Physicochemical characteristics of soil in Sal (*Shorea robusta*) forests in Jharkhand

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Abstract

The physicochemical properties of soil of three different types of Sal forests of Jharkhand; Moist Deciduous Sal forest, Dry Peninsular Sal forest and Northern Dry Mixed Deciduous forest were analyzed. Soil samples were collected from each of the forest types and analyzed for texture, pH, organic carbon, nitrogen, phosphorous and potassium. Organic carbon and pH exerted strong influence on the distribution of macronutrients. In all three forest types, soil was sandy loam with high percentage of sand. The pH values were lower in moist deciduous Sal forest (4.9) than the northern dry mixed deciduous forest (5.1) followed by Dry peninsular Sal forest (5.3). The higher levels values of organic carbon, nitrogen and potassium were found in Moist Deciduous Sal forest were due to increased supply of nutrients in the form of leaf litter and biomass from the larger number of Sal trees. The macro nutrient status was high in Moist Deciduous Sal forest followed by Northern Dry Mixed Deciduous forest and comparatively lesser in Dry Peninsular Sal forest.

Key words: Forest types, Macronutrient, Nitrogen, Physicochemical , *Shorea robusta*, Soil texture.

Introduction

Forest ecosystems comprise flora, fauna and forest soils which have very complex but important interactive relationship. Soil becomes one of the important medium of regulating forest ecosystem processes of nutrient uptake, decomposition, water availability etc., which is very important for plant community. At the same time flora is one of the important factors responsible for creation of new soil as leaves and other vegetation decompose after expiry of their living cycle. Forests and forest soils interact in a manner which creates and helps in maintaining the environmental conditions including microclimate needed for agricultural productivity. Physiochemical characteristics of forest soils vary in space and time due to variations in topography, climate, physical weathering processes, vegetation cover, microbial activities and several other biotic and abiotic variables. Vegetation plays an important role in soil formation (Chapman and Reiss 1992). For continuum of these positive effects on sustainability, forest and forest soils have to be properly managed.

Materials and methods

Description of the study area

Latehar district is one of the twenty-four districts of Jharkhand state in eastern India. This district is part of Palamu division. It is surrounded by Ranchi, Lohardaga, Gumla, Palamau and Chatra district apart from Chhattisgarh state. It has an average elevation of 327 m (1,073 ft). The higher areas in south receive annual rainfall upto1400 mm. but northern part of the district remains in rain shadow and receive less than 1200 mm rainfall. Three soil orders namely entisols, inceptisols and alfisols were observed in Latehar district. Alfisols were the dominant soils.

Hazaribagh district comprising majority area of Hazaribagh plateau and bounded by district Koderma in the north, Giridih and Bokaro in the east, Ranchi in south and Chatra in the west. The district has two subdivisions and fourteen development blocks. The general slope of the district is from north-west to south east. Major river is Damodar but there are few tributaries namely Jamunia, Baranki etc. The district receives annual rainfall of 1350 mm and more than 80 percent rainfall. Three soil orders namely Entisols, Inceptisols and Alfisols were observed in Hazaribag district. Alfisols were the dominant soils covering 71.9 percent of TGA followed by Entisols (18.1 %) and Inceptisols (7.8%).

West Singhbhum district is located in the southern portion of the state. It is bounded by Ranchi in the north, Saraikela in the east, Orissa in south and Simdega in the west. The district comprises two subdivisions (Chakradharpur and Chaibasa) and fifteen development blocks. The plain areas have the elevation about 300 metres but the hilly areas have about 300 to 500 metres. Important rivers in the area are South Koel, Sanjay Baitarni, Roso, Brahamini, Deo, Koyana, Kharkai etc. The district receives an annual rainfall of 1420 mm. All the hilly ranges are under forest cover and only in patches cultivation observed. Three soil orders namely Entisols, Inceptisols and Alfisols were o bserved in West Singhbhum district. Entisols cover 34.8% area fallowed by Inceptisols (33.2 %) and Alfisols (31.1 %).

Sl no.	Forest types(Champion&Seth1968)	Name of forest types	Selected districts	Range	Village
1	3C/C2e (ii)	Moist Deciduous Sal forest (MDS)	West Singhbhum	Goeilkera	Kentora, Ramkut
2	5B/C1	Dry Peninsular Sal forest (DPS)	Hazaribagh	Badkagaon	Kandtari, Mirjapur
3	5B/C2	Northern Dry Mixed Deciduous forest (NDMD)	Latehar	Kutku	Mandal, Badhaniya

Table 1- Sites have been selected from different forest types in Jharkhand.

Soil sampling

Randomly soil samples were collected at a depth of 15-45 cm from each of the forests types from two villages of the selected districts. The collected samples were packed in polythene bags and taken to the laboratory for analysis. The exact sample locations (latitude and longitude) were recorded with the help of a hand held GPS device. Soil analyses were performed at Institute for Environmental management (IEM) laboratory, Pundag, Ranchi. Soil texture was determined by the hydrometer method (PCARR 1980) and the texture group was determined by means of a texture triangle (USDA system). Organic carbon was determined using volumetric method. Total nitrogen content was determined by means of the Kjeldahl method, Phosphorus by using the Bray's method and Potassium content by Flame photometric method. Soil pH by electrode method.

Results

Vegetation of the study area was dominated by S. robusta. The moist deciduous Sal forest was forest composed predominantly of *Shorea Robusta*, in association with *Albizzia procera, Adina spp, Bombax spp, Terminalia tomentosa, Terminalia belerica, Dilenia pentagyna.* In the Northern dry mixed deciduous forest *Acacia, Syzgium cumini, Anageisus, Boswelia, Bombax, Garuga, Madhuca, Albizia* and other species were found and in Dry Peninsular forest *Shorea robusta* in association with *Terminalia, Acacia* and *Madhuca* were found.

All the forests had sandy loam type of soil texture. The soil of MDS forest was composed of 75.78% sand, 11% clay and 6.5% silt; DPS forest had 81.67% sand, 12% clay and 3.2% silt NDMD forest had 70.5% sand, 14% clay and 2.5% silt (Figure 1). Soils of all the forests were acidic. It was more acidic in MDS forest 4.9, DPS forest 5.3 and NDMD forest 5.1. The average organic carbon percentage in the soil of MDS type was

1.16%, DPS type 0.78% and 0.88% (Figure 2). The mean soil nitrogen in MDS forest was higher 341.64 kg/ha than NDMD forest 320 kg/ha and DPS forest 291.45 kg/ha. The mean value of available phosphorus in the soil of MDS forest was 15.02 kg/ha, in NDMD forest 13.46 kg/ha and DPS forest 12.45 kg/ha. The available potassium was 175.5 kg/ha in MDS forest, in 166.78 kg/ha NDMD forest and 143.78 kg/ha in DPS forest (Figure 3). The result of ANOVA tests (Table 2) of different forest types was statistically significant at $p<0.05$.

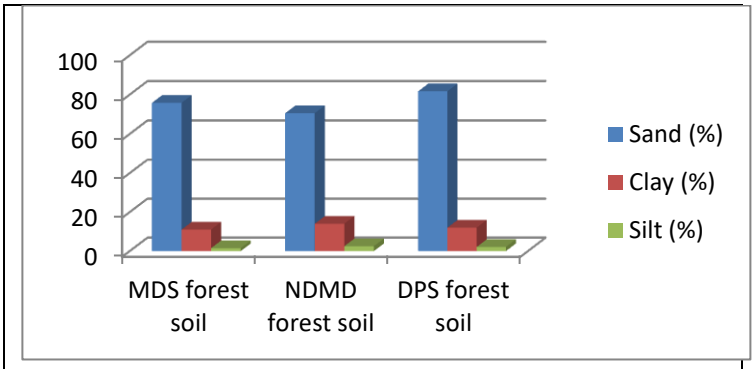

Figure 1. Soil texture in the forest

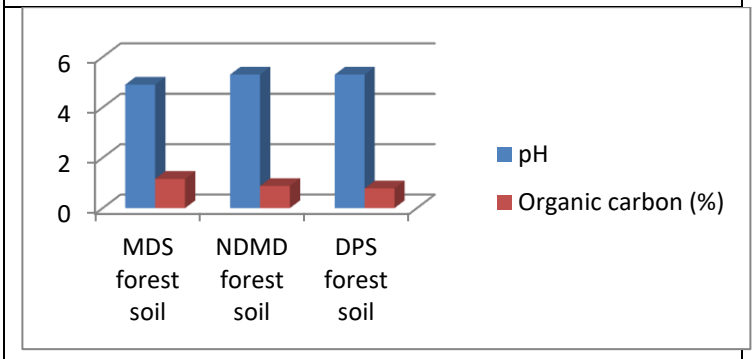

Figure 2. Different soil parameters

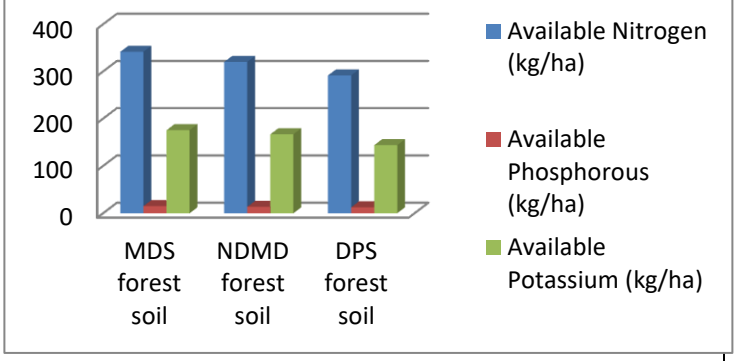

Figure 3. Different soil parameters

Variables	Source of Variation	F	P-value	F critical
Nitrogen(kg/ha)	NDMD	6.39	0.034	5.050
	DPS	7.31	0.029	5.050
	MDS	6.18	0.044	5.050
Phosphorus(kg/ha)	NDMD	7.40	0.048	5.050
	DPS	5.55	0.031	5.050
	MDS	7.21	0.042	5.050
Potassium(kg/ha)	NDMD	7.75	0.020	5.050
	DPS	6.24	0.050	5.050
	MDS	6.27	0.037	5.050
pH	NDMD	5.25	0.051	5.050
	DPS	12.34	0.008	5.050
	MDS	5.37	0.044	5.050
Organic carbon(%)	NDMD	7.24	0.024	5.050
	DPS	5.61	0.031	5.050
	MDS	5.45	0.046	5.050

Table 2- ANOVA table, significant at $p<0.05$

Discussion

Soil texture in all the three forest types were the sandy loam type which is good for Sal regeneration and high quality trees (Gupta, 1951). Soil texture also affects the nutrient supply of the soil (Shrestha, 1997). In the present study the pH of MDS forest soil which is dominated by Sal is acidic in nature more or less similar to those reported by Singh and Singh (1989). They reported a pH range of 4.5-5.5 in the Sal forest and concluded that this range is propitious for Sal sapling growth. Good Sal regeneration areas have low pH in soils (Bhatnagar, 1965). The low pH in the study area may be due to the continuous decomposition of surface litter. The OC% was higher in MDS forest followed by NDMD forest and DPS forest. The high organic matter in MDS forest because of more litter accumulation and decomposition. Tamhane et al (1964) mentioned that decomposing litter adds more organic matter to the soil. In the present study available nitrogen content was higher in MDS forest than NDMD forest followed by DPS forest. Nitrogen content decrease with the increase of disturbances (Das and Sharma, 2009). The phosphorus content was higher in MDS forest which is dominated by Sal trees similarly as reported by Paudel and Sah 2003 in pure Sal forest. Potassium content was higher in the pure S. robusta forest than in the mixed S. robusta forest. The sites of the present study had a higher rate of regeneration of Sal, probably due to the presence of higher proportion of potassium (Bhatnagar, 1965).

Conclusion

Soils in the forests were sandy loam. There was high nitrogen, high phosphorus and medium potassium content. Soil characteristics seem to have strong influence on the vegetation of the present study area. The Moist Deciduous Sal forest had relatively good soil characteristics as compared to the Northern Dry Mixed

Deciduous forest followed by Dry Peninsular Sal forest. The soil nutrient was found high in Northern Dry Mixed Deciduous forest than Dry Peninsular Sal forest may be due to good climatic condition and large species composition. The proper management of the forests will increase the quality of soils and the forest.

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