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Physico Chemical Studies of Soil on the Growth of Sal Forest in Hazaribag

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Abstract

The study entitled “Physicochemical studies of soil on the growth of Sal forest in Hazaribag” was carried out in Hazaribag district, Jharkhand, India. This is the natural forest, dominated by Sal trees which had large economic value, and thus, a scientific forest management system was necessary for this forest. The paper describes the different basic factors which support the proliferous growth of Sal dominated forest found in these areas. The soil sampling was done using a quadrat method based on the principle of systematic sampling. Ten samples were collected from the Ichak and Bishnugarh Sal forest of Hazaribag for the study of soil properties. The soil samples from eight quadrates were taken for the determination of Soil texture, MC, WHC, OC, OM, pH, N, P, Na, K, and Ca. The soil pH is slightly acidic which was found to be in the range of 6.05-6.40. Moisture content, water-holding capacity, organic carbon, organic matter, total nitrogen of soil samples were found to be in the range of 7.20%-13.20%, 55.90%-77.70%, 1.32%-2.40%, 2.65%-4.05%, 0.17%-0.34%, respectively. P, Na, K in mg/L was found to be in the range of 0.54 mg/L-0.92 mg/L, 2.5 mg/L-5.3 mg/L, 8.7 mg/L-15.14 mg/L and Ca in meq/100 g was found to be 6.3 meq/100 g-7.4 meq/100 g respectively.

Keywords: Natural forest, Sal forest, Soil properties, Scientific forest, Proliferous growth

INTRODUCTION

Sal is the most important tree species with high sources of hardwood timber and spread across 10 million hectares (m ha) in India [1]. Sal, also known as *Shorea robusta* or sakura or shala tree, is a species of tree belonging to the *Dipterocarpaceae* family and is moderate to the slow-growing tree that can achieve heights of 30 m-50 m having a diameter of 3 m-3.5 m [2]. The tree has a clean, straight, and cylindrical bole often bearing epicormic branches, a crown is spreading and spherical. The bark is dark brown and thick, which gives it effective protection against fire. At an early stage of growth, a long taproot is developed in the Sal plant. Leaves are simple, glossy, and glabrous, approximately 10 cm-25 cm long and broadly oval at the base, with the apex tapering into a long point. The tree sheds leave approximately between February and April, and leaf burst begins in April and May. Flowers are whitish, arranged in large terminal or raceme-like panicles in leaf axils, fruits at full size attain a length of 1.3 cm-1.5 cm and diameter of 1 cm. It is surrounded by whorls of the sepals enlarged into five rather unequal wings about 5 cm-7.5 cm long. This tree requires an average temperature of 22°C-47°C throughout the year for its proper growth. The tree needs a mean annual rainfall of around 3000 mm and a maximum of 6600 mm. Well-drained, deep, moist, slightly acidic, and sandy to clayey soil is appropriate for the growth of Sal [3]. Natural regeneration takes place by seeds but is often affected by anthropogenic disturbances in the environment. The rate of regeneration gets poor *via* seeds under a higher degree of human interference and activities such as burning and forest-cutting [4,5]. The Sal forest is found in Himachal Pradesh, Haryana, Uttarakhand, Uttar Pradesh (UP), Bihar, Jharkhand, West Bengal, Sikkim, Assam, Meghalaya, Tripura, Orissa, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, and Maharashtra in India. The distribution of Sal forest across the India, Nepal, Bhutan, and Bangladesh is shown in (Figure 1).

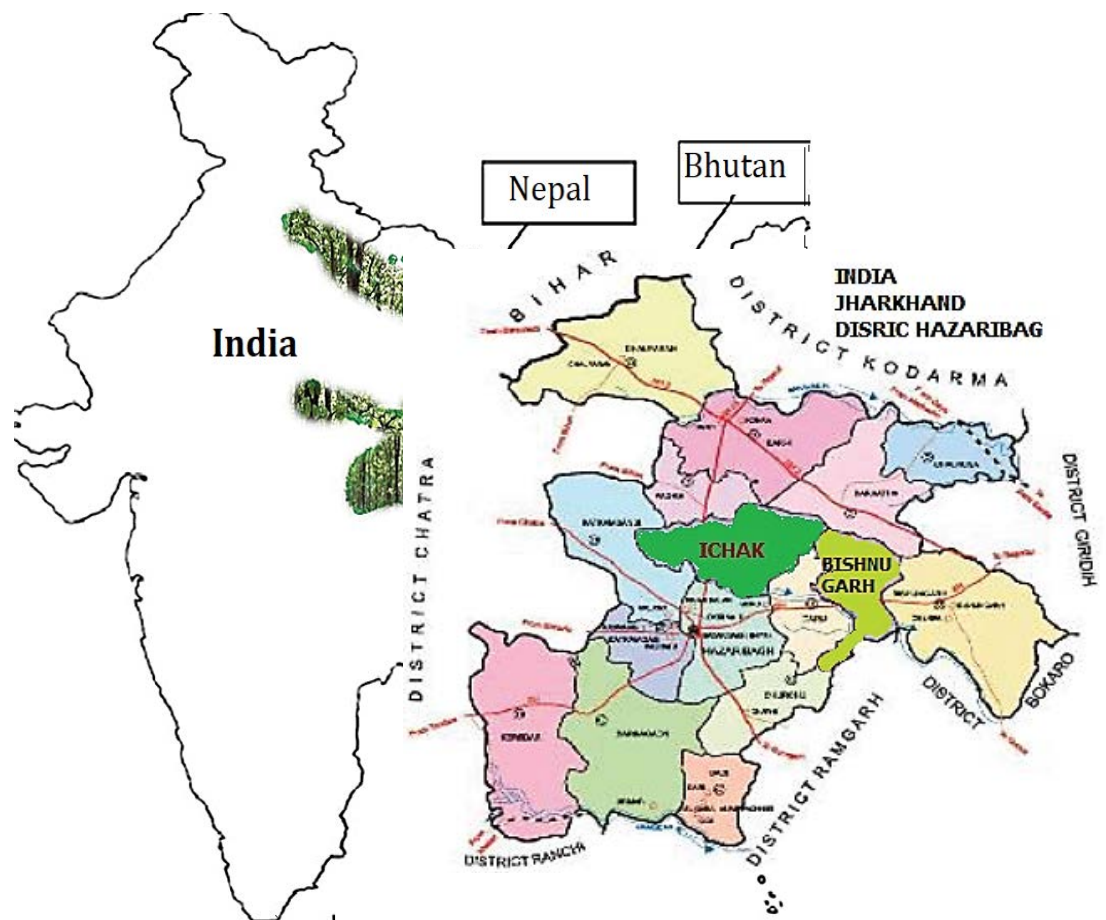


Figure 1: Natural zone of Sal forests

The Jharkhand state has a large area of Sal forest and these forests are originally spread out over thousands of square miles, especially in the districts of Hazaribagh, Singhbhum, Palamu, and Ranchi. These forests containing very dense and rich growth of Sal trees spread all over these areas [6]. The Sal forest area present in Ichak and Bishnugarh of Hazaribagh district is shown in (Figure 2).



Figure 2: Ichak and Bishnugarh Sal forest in Hazaribagh district

Several workers have worked on the interpretation of the growth of Sal forest with soil quality [7-15]. However, the literature survey revealed that the area Ichak and Bisnugarh have not been explored. This led us to work on the above-mentioned areas of Hazaribag as these areas are also dense with Sal forest.

MATERIALS AND METHODS

Four representative samples were collected at different locations of the forest covering 1 m × 1 m length from the centre of quadrat in both study sites at a depth of 10 cm-15 cm using a soil digger at each location from Ichak and Bisnugarh area and stored in polyethene bags for Physico-chemical analysis. These soil samples were mixed thoroughly. The soil samples were air-dried in shade in field as well as in the laboratory and debris of plants, stone, and objects other than soil were removed. About 200 g fine dried soils (passed through the sieve of mesh size 0.5 mm) were stored in an airtight polythene bag until laboratory analysis. There were altogether 10 soil samples from the study site representing different conditions. The analytical work has been mainly performed in the Department of Chemistry, Vinoba Bhave University Hazaribag, and State Geological Laboratory, Hazaribag, and Central Institute of Mining and Fuel Research Dhanbad. For each soil sample soil texture, pH, Organic Carbon (OC), Organic Matter (OM), total Nitrogen (N), total phosphorus (P), total potassium (K), Sodium (Na), Calcium (Ca) were analyzed and were estimated using the standard method.

RESULT AND DISCUSSION

The descriptive statistics of soil physicochemical properties under *Shorea robusta* in the Ichak forest range and Bisnugarh Hazaribag Forest have been summarized in (Table 1).

Table 1: The descriptive statistics of soil physicochemical properties under *Shorea robusta* in Ichak forest range and Bisnugarh Hazaribag Forest

Soil Properties	Ichak Hazaribag Forest	-	-	-	-	-	-	Bisnugarh Hazaribag Forest	-	-	-	-	-	-
-	IH1	IH2	IH3	IH4	Max	Min	Mean	BH1	BH2	BH3	BH4	Max	Min	Mean
Temp (°C)	20.5	19.7	21.6	22.8	22.8	19.7	21.25	16.6	20.5	27.4	23.9	27.4	16.6	22
Humidity (%)	69.56	68.8	68.56	67.96	69.56	67.96	68.76	68	62	67	76	76	62	69
Moisture Content (%)	11	10.9	10.7	10.8	11	10.7	10.85	7.2	9.3	13.2	10.6	13.2	7.2	10.2
Water Holding Capacity (%)	70	69	68	68	70	68	69	77.7	72.3	55.9	66.9	77.7	55.9	66.8
pH	6.05	6.2	5.9	5.86	6.05	5.86	5.95	5.94	6.31	6.66	5.74	6.66	5.94	6.3
Organic Carbon (%)	2.11	1.98	2.32	1.56	2.32	1.56	1.94	1.56	1.32	2.05	2.4	2.4	1.32	1.86
Organic Matter (%)	3.47	3.28	2.97	2.65	3.47	2.65	3.06	3.05	3.73	4.05	3.93	4.05	3.05	3.55
Total Nitrogen (%)	0.34	0.29	0.17	0.22	0.34	0.17	0.25	0.31	0.27	0.22	0.57	0.31	0.22	0.26
Phosphate (mg/L)	0.83	0.92	0.67	0.54	0.92	0.54	0.73	0.76	0.59	0.89	0.67	0.89	0.59	0.74
Sodium (mg/L)	5.3	3.9	4.7	2.5	5.3	2.5	3.9	4.57	3.64	4.93	5.27	5.27	3.64	4.45
Potassium (mg/L)	10.5	9.7	9.5	8.7	10.5	8.7	9.6	14.7	12.35	15.14	10.2	15.14	10.2	12.67
Calcium (meq/100 g)	7.4	7.23	6.97	6.3	7.4	6.3	6.85	6.98	6.77	6.55	7.12	7.12	6.55	6.83
Soil Fertility Index	21.02	20.57	21.32	21.57	21.57	20.57	21.07	18.31	17.2	19.27	18.83	19.27	17.2	18.23

From the above Table following physicochemical properties have been studied for the optimum growth of the Sal forest in Hazaribag.

Soil texture

Soil texture in the study areas was sandy loam type, suitable for high-quality Sal trees. This sandy loam texture was very common in the study sites of Ichak and Bisnugarh Sal forest which supports dense Sal trees. The supply of water to

plants increases as the soil texture becomes finer. Soil texture also affects the nutrient supply to the plants of both the Sal forest.

Moisture Content (MC)

The moisture content of the Ichak Sal forest was found to be in the range of 10.70% to 11.00% with an average value of 10.85% and the moisture content of the Bishnugarh Sal forest was found to be in the range of 7.20% to 13.20% with average value 10.20%. The average value of moisture content of Ichak Sal forest was higher than Bishnugarh Sal forest. Bishnugarh Sal forest has a large variation in moisture content because of different soil textures.

Water Holding Capacity (WHC)

The water holding capacity of Ichak Sal forest was found to be 68% to 70% with an average value of 69% while the water holding capacity of Bishnugarh Sal forest was found to be 55.90% to 77.70% with an average value of 66.80%. The water holding capacity of Ichak Sal forest is high due to more clay loam soil than the Bishnugarh Sal forest.

Soil pH

The soil found in the Ichak Sal forest is slightly acidic because the soil pH varied from 5.86 to 6.05 with a mean of 5.95 reports that most of the soil was acidic. The pH range in the Bishnugarh Sal forest was also acidic and it was also found in the range of 5.94 to 6.66 with a mean of 6.30. It shows that the soil of the Bishnugarh Sal forest was more acidic than the Ichak Sal forest of Hazaribag. This may be due to local environmental factors such as rainfall and vegetation composition.

Organic Carbon (OC)

The organic matter content of Ichak Sal forest ranged from 1.56% to 2.32% with an average of 1.94% while Bishnugarh Sal forest has ranged from 1.32% to 2.40% with an average of 1.86% indicated that the former has good soil fertility. It is a known fact that higher soil organic matter occurs more commonly in cooler than warmer climates.

Organic Matter (OM)

Organic matter in the Ichak Sal forest area was found to be varying from 2.65%-3.47% with a mean value of 3.06% and the Bishnugarh Sal forest was found to be in the range of 3.05%-4.05% with a mean value of 3.55%. It shows that the Bishnugarh Sal forest has better organic matter. Organic matter content increases with the maturation of the forest. But, in the study area, the forest canopy was open and the forest floor was burned back which reduces the organic matter content. In addition, due to the low organic input from the vegetation cover, the organic content is relatively low.

Total Nitrogen (N)

The nitrogen content ranging from 0.17% to 0.34% with an average of 0.25% was found in Ichak Sal forest while it ranged from 0.22% to 0.31% with an average of 0.26% in Bishnugarh Sal forest, which was almost similar to the values found in Ichak Sal forest. The low nitrogen content in soil at our study site may have been due to the continuous loss through leaching and run-off. In the floodplains, sandy loam soil is deficient in nitrogen.

Phosphorus (P)

From our two study forests, the forest of Ichak contained phosphorus ranging from 0.54 mg/L to 0.92 mg/L with an average range of 0.73 mg/L and Bishnugarh Sal forest contained Phosphorous 0.59 mg/L to 0.89 mg/L with an average range of 0.74 mg/L. Both the forest has a very close average value of phosphorous. Phosphorous is related to organic matter, if phosphorous increases organic matter will also increase.

Sodium (Na)

The sodium content of Ichak Sal forest was found to be 2.50 mg/L to 5.30 mg/L with an average value of 3.9 mg/L. On the other hand, sodium content in the Bishnugarh Sal forest was found to be 3.64 mg/L to 5.27 mg/L with an average value of 4.45 mg/L. The sodium content in the Bishnugarh Sal forest was high due to the very dense and long Sal trees found in these areas.

Potassium (K)

Potassium content was found in the range of 8.7 mg/L to 10.5 mg/L with the average value of 9.6 mg/L of Ichak Sal forest while in the case of Bishnugarh Sal forest Potassium content is found to be in the range of 10.20 mg/L to 15.14 mg/L with the average value 12.67 mg/L. Potassium content is also high in the Bishnugarh Sal forest than in the Ichak Sal forest.

Potassium content has a very important role in the seed germination of the Sal plant. The study sites of the Bishnugarh Sal forest had a good flourish of Sal regeneration, probably due to the presence of a higher proportion of potassium.

Calcium (Ca)

The Ichhak Sal Forest contained Ca in the range of 6.3 meq/100 g to 7.4 meq/100 g with an average value of 6.85 meq/100 g while Bishnugarh Sal forest contained Ca in the ranges of 6.55 meq/100 g to 7.12 meq/100 g with the average value of 6.83 meq/100 g. The Ichhak Sal forest contained more Ca than the bishnugarh Sal forest due to the greater amount of rock and stone found in these study sites.

Soil fertility index

The soil fertility index of Ichhak Sal forest was found in the range between 20.57 to 21.57 with an average value of 21.07 while Bishnugarh Sal forest has a soil fertility index in the range between 17.20 to 19.27 with an average value of 18.23. The soil fertility index is high in the study sites of Ichhak Sal forest than that of Bishnugarh Sal Forest in Hazaribag. Soil fertility under tree situation is improved due to increased input of organic matter through the litter.

CONCLUSION

Sal forest is an important forest of Jharkhand. The Sal tree has great importance not only for human beings is also important for the wild animals and different types of birds found in these areas. The whole properties of Sal trees like root, stem, branches, leaves, flowers, foods are used for different purposes as by the local people. Research in this field contributes to planning, conserving, and decision-making in natural forest management and development programs. The information can also be used for research and education or training. The study found that there are various factors like moisture, water holding capacity, organic carbon, organic matter, soil N, P, Na, K, Ca which support the Sal forest found in these areas. These factors not only provide the strength of Sal forest it also provides the natural regeneration in huge amount. Altogether, the comparative study of two different Sal forests has the same sandy loam type soil texture that is a little acidic. Soil Nutrient including Organic matter content, soil N, P, Na, K, and Ca plays an important role in the growth of Sal trees and their regeneration. The soil fertility index of both the Sal forest is a little low but other factors support the growth and regeneration of Sal plants and other species.

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