## Pedology of Oak and Pine Forests in Indian Central Himalaya

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**Abstract:** For the analysis of physicochemical properties of soil it was taken from two different forest sites (*P. roxburghii* Sarg. and *Q. leucotrichophora* A. Camus) that are degraded and non-degraded forests at Lamgarha block of Almora district in Kumaun Central Himalaya. Soil texture varied from loamy to sandy loam. Soil moisture ranged from 6.6-18.1% and showed fixed seasonal pattern and maximum in rainy season (Mid-September) followed by winter and summer. Water holding capacity was more or less similar in all the sites. The soil was acidic with pH ranging from 5.5-6.5 across the sites. Soil nutrient concentration also varied across the study sites. [Nature and Science. 2009;7(7):113-115]. (ISSN: 1545-0740).

**Key words:**  Physicochemical analysis, degraded forest, non-degraded forest.

### Introduction

Nature and composition of soil vary considerably with geological formations, aspect, and degree of slope, climate and vegetation (Saxena and Srivastava, 1973). In the Himalayan state of Uttaranchal (India) the rich alluvial soil of Tarai is quite different from poor bare soil of mountain and almost desert like soil of trans-Himalayan zone (Negi, 1990).

This paper is an attempt to study physicochemical properties of soil in different status of forest viz., degraded and non-degraded forest sites or natural sites in Guna Van Panchayat (VP) at Lamgarha block in Almora District.  It varies from 79°43.2 E longitude, and 29°33.04 latitude and altitudinal variation from 1800 m to 1900 m. It is located about 29 km far from main Almora town. In these study sites, various forage development and carbon sequestration related forestry based projects were implemented. It is also a research site for a NGO i.e. Central Himalayan Environmental Association (CHEA), Nainital. The site being a hilly region comprises of numerous hills and forests. Some of the important forests were locally named as chir pine (*P. roxburghii* Sarg.) forests and banj oak (*Q. leucotrichophora* A. Camus) forest. They are categorized as Guna banj oak degraded and non-degraded forest sites and Guna chir-pine degraded and non-degraded forest sites.

Climate is warm temperate with moderate summers and severe winters with annual rainfall in 2004 was 832.0 mm and in 2005 was 921.9 mm (Lamgarha block office, 2005). Three seasons: warm and wet rainy season (June-September), cool and dry winter season (October-February) and hot and dry summer season (March-May) is quite distinct here.

### Materials and Methods

For the present study fieldworks were done in peak rainy/ growth season (September) in 2004, in winters 2004 (December) and in summers 2005 (April). Depending upon vegetational conditions and extent of degradation the whole study area was distributed in the following degraded and non-degraded sites as-
 Guna non-degraded oak forest (site 1), Guna degrade oak forest (site 2), Guna non-degraded pine forest (site 3) and (site 4) as a non-degraded pine forest.

In order to collect soil samples (0-30 cm depth) grasses, mosses, litter and other plant residues were removed from soil surface. Thereafter 100 g of soil was collected in a plastic bag which was sealed and labelled properly. Soil texture was determined by using sieves of various size classes, whereas soil moisture content on dry weight basis, soil pH by potentiometer method and soil nitrogen, phosphorus, potassium, soil carbon and organic matter were analyzed at Niglat soil testing laboratory of ICAR (Indian Council of

Agriculture and Research, New Delhi) at Bhowali of Nainital district of Uttaranchal (India). In all three seasons the soil moisture and water holding capacity were measured by Zobel et al. 1987. Besides soil moisture content remaining soil parameters were measured only during December.

**Results and Discussion**

Soil moisture showed fixed seasonal trend, i.e. maximum in rainy season followed by winter and summer showing direct relationships with precipitation. In the study site it ranged form 6.56±0.16 to 18.07±0.44 (Table 1). Almost sites facing north aspect, soil moisture was comparatively higher favouring the growth of mosses.

Amount of sand, silt and clay were estimated to be 43.74±2.41%, 52.08±2.49% and 4.17±0.28% respectively at Guna non-degraded oak forest site, 41.04±2.25%, 53.34±2.94% and 5.61±1.20% respectively at Guna degraded oak forest site (Table 2). It was estimated as 45.88±2.01%, 49.56±2.09% and 4.55±0.24% for sand, silt and clay respectively at Guna non-degraded pine forest site, 83.29±1.39%, 8.35±0.69% and 8.35±0.69% respectively for sand, silt and clay at Guna degraded pine forest site (Table 2). Hence, soil texture was loam at degraded sites and sandy loam at non-degraded sites. Water holding capacity was more or less similar irrespective of seasons but slightly higher in winters followed by rainy and summer seasons. It was found in the range of 43.34±1.26% to 45.27±0.72% (Table 1), which was more or less similar to the reported value of Rikhari et al. (1991) i.e. 52% to 67% found in Kumaun Himalaya. It was found to be the highest at degraded or regenerating sites.

Soil porosity was 38.93±2.95% to 54.39±1.46%, while the bulk density was ranged between 1.24±0.12% to 1.94±0.24% g/cm$^3$. It was found to be the highest at non-degraded forest sites. Soil pH was 5.5±0.0 - 6.5±0.0 at degraded forest sites (Table 2). This clearly indicates the acidic nature of the soil. The pH value at non-degraded sites was within the reported range of Rikhari et al. (1991) which was from pH 4.7 to 6.8 in Kumaun Himalaya and near to Teare (1986) that was from pH 4.62- 5.9 at different sites of Lalitpur district. Organic matter varied from 2.84±0.26% at degraded pine forest site to 5.05±0.17% at non-degraded oak forest site (Table 2). It was within the reported range of Shrestha (1979) which was from 1.68% to 17.0% at Godawari. Nitrogen ranged from 0.13±0.07% at degraded pine forest site to 0.33±0.12% at non-degraded oak forest site (Table 2). It was also found to be in close findings of Baral (1983) that was from 0.137% to 0.385 at Phulchoki (Nepal) but higher then that of Shrestha (1979) who reported it to be in a range of 0.07% to 0.26% and Sah & Ram (1989)valued it from 0.16% to 0.22%. The higher value may be due to the fact that these forest sites possessed sand stone soil which was acidic in nature. This type of soil as stated by Rathore (1971) is usually rich in organic matter and nitrogen. Theses two soil nutrients were also highly related to each other as shown by Shrestha (1979) and Gupta et al. (1989). High values of both soil nutrients at relatively moist soils of non-degraded sites were due to high decomposition rate because of the high soil moisture, the decomposition rate is accelerated, as also shown by Rastvorova & Tereshenkova (1978). Available phosphorus at these sites varied from 42.12±9.07 kg/ha at degraded pine forest site to 56.00±10.85 kg/ha at non-degraded oak forest site (Table 2). It was within the reported range of Shrestha (1979) who found it to be from 1.03 to 71.15 kg/ha but lower than that of Baral (1983) that was from 44.66 to 90.66 kg/ha. Potassium ranged from 226.19±31.08 kg/ha at degraded pine forest site to 388.57±33.07 kg/ha at non-degraded oak forest site (Table 2). Both these soil nutrients were maximum at non-degraded oak forest site followed by degraded oak forest site and non-degraded pine forest site. The value of soil carbon ranged from 1.14±.003% at degraded oak forest site to 1.40±.007% at non-degraded pine forest site. It was found 1.17±.005% at non-degraded oak forest site while, 1.15±.003 at non-degraded pine forest site (Table 2).

**References**

Beral, S.R. 1983. Soil nutrients under different trees of Phulchoki hill. M.Sc. Thesis, Central Department of Botany, Tribhuvan University, Kathmandu, Nepal.

Negi, S.S. 1990. *Himalayan Forests and Forestry*. Indus Publishing Company, New Delhi, India.

Rathore, J.S. 1971. Studies in the forest soils of Sagar. *Tropical Ecology*. **12 (1)**:101-111.

Rikhari, H.C., Adhikari, B.S., Rawat, Y.S. and Singh. S.P. 1991. High altitude forest: Composition, diversity and profile structure in a part of Kumaun Himalaya. *Tropical Ecology,* **32(1):**86-97.

Sah, V.K. and Ram, Jeet. 1989. Biomass dynamics, species diversity and net primary production in temperate grassland of central Himalaya, India. *Tropical Ecology,* **30(2):** 294-302.

Saxena, H.O. and Srivastava, P.B.L. 1973. Forest communities of Mussoorie. *Tropical Ecology* 14(2):197-218.

Shrestha, P. 1979. The Vegetational analysis of a specified part of Godavari hill forest area, Kathmandu. M.Sc. Thesis, Central Department of Botany, Tribhuvan University, Kathmandu, Nepal.

Teare, J.A. 1986. Soil and site evaluations of selected plantation areas in the Kathmandu project area of the hill forest department project. FSRO soil survey report No. 2. Forest Survey and Research Office, Kathmandu, Nepal.

Zobel, D.B., Jha, P.K., Yadav, U.K. and Behan, M.J. 1987. *A practical manual for Ecology*. Ratna Book Distributors, Kathmandu, Nepal.

**Table 1** Seasonal Soil Moisture, Water Holding Capacity (W.H.C), Porosity and Bulk Density at different studied sites.

| Sites types | Soil moisture (%) | | | W.H.C. (%) | Porosity (%) | Bulk density (g/cm$^3$) |
|---|---|---|---|---|---|---|
| | September, 2004 | December, 2004 | April, 2005 | | | |
| Site 1 | 15.65±0.92 | 11.54±0.16 | 6.82±0.28 | 43.34±1.26 | 38.93±2.95 | 1.62±0.11 |
| Site 2 | 14.62±0.59 | 11.76±0.17 | 6.56±0.16 | 43.97±1.98 | 54.39±1.46 | 1.24±0.12 |
| Site 3 | 14.97±0.88 | 11.37±0.20 | 7.25±0.25 | 43.44±0.56 | 41.94±1.48 | 1.94±0.24 |
| Site 4 | 18.07±0.44 | 11.34±0.24 | 7.76±0.23 | 45.27±0.72 | 42.17±2.81 | 1.66±0.14 |

**Table 2** Physicochemical Characteristics of soil at different sites

| Parameters | Site 1 | Site 2 | Site 3 | Site 4 |
|---|---|---|---|---|
| pH | 5.50±0.00 | 6.20±0.00 | 6.50±0.00 | 6.50±0.00 |
| N (%) | 0.33±0.12 | 0.20±0.08 | 0.19±0.11 | 0.13±0.07 |
| P (kg/ha) | 56.00±10.85 | 50.00±10.38 | 48.36±8.42 | 42.12±9.07 |
| K (kg/ha) | 388.57±33.07 | 267.40±36.17 | 263.67±27.14 | 226.19±31.08 |
| C (%) | 2.93±0.021 | 1.85±0.017 | 2.76±0.023 | 1.65±0.013 |
| O.M (%) | 5.05±0.17 | 3.18±0.63 | 4.75±0.23 | 2.84±0.26 |
| Sand (%) | 43.74±2.41 | 41.04±2.25 | 45.88±2.01 | 83.29±1.39 |
| Silt (%) | 52.08±2.49 | 53.34±2.94 | 49.56±2.09 | 8.35±0.69 |
| Clay (%) | 4.17±0.28 | 5.61±1.20 | 4.55±0.24 | 8.35±0.69 |

(O.M. = Organic matter, N = Nitrogen, P = Phosphorus, K = Potassium, C = Carbon)

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