Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(2): 2351-2354
Received: 05-01-2020
Accepted: 07-02-2020

S Balaji Naik
Department of Silviculture and Agroforestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh India

Sourav Ranjan Mohapatra
Division of Genetics and Tree Improvement, Forest Research Institute, Dehradun, Uttarakhand, India

Dr. Vimal Chauhan
Department of Silviculture and Agroforestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh India

Kapoor
Department of Silviculture and Agroforestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh India

Corresponding Author:
S Balaji Naik
Department of Silviculture and Agroforestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh India

Influence of forest community and soil depth on soil physio-chemical properties of col Sher Jung national park, Himachal Pradesh

S Balaji Naik, Sourav Ranjan Mohapatra, Dr. Vimal Chauhan and Kapoor

DOI: https://doi.org/10.22271/phyto.2020.v9.i2am.11222

Abstract
The present study aimed to analyze the influence of forest vegetation and soil depth on soil physio-chemical characteristics of Col. Sher Jung National Park in Sirmour district of Himachal Pradesh. In each community, three replicates of composite soil samples were collected from two different soil layers (0-20 cm, 20-40 cm). Different parameters such as bulk density (g cm^{-3}), soil pH, soil electrical conductivity (dS m^{-1}) and soil organic carbon (%) was estimated. Results revealed that maximum bulk density was recorded under the pure *Shorea robusta* forest and minimum was observed under *Eucalyptus tereticornis* forest plantation. Further, bulk density of soil in every forest communities was significantly lower at depth 0-20 cm as compared to 20-40 cm depth of soil. Results regarding soil pH revealed that forest area was more or less neutral in both the depths of *Eucalyptus tereticornis* forest plantation and strongly acidic in pure *Shorea robusta* community. Soil organic carbon (%) was recorded maximum under the *Eucalyptus tereticornis* forest plantation and minimum under pure *Shorea robusta* forest community. Further, organic carbon (%) in all forest communities was significantly higher at 0-20 cm soil depth than the 20-40 cm depth of soil. Soil electrical conductivity value decreases with the increase in soil depth in all the vegetation types. Reported observation revealed that maximum electrical conductivity was recorded under the pure *Shorea robusta* forest community and minimum under *Eucalyptus tereticornis* forest plantation.

Keywords: Forest soil, forest community, soil depth, soil physio-chemical properties, col. Sher Jung national park

Introduction
Forest soil is a complex mixture of eroded rock, mineral nutrients, decaying organic matter, water, air, and billions of micro organisms (Miller; 2007) [6]. Structure, diversity, regeneration success and other silvicultural characters of forest stand are determined by forest soils. Besides this, Forest soil also plays an impactable role in the heterogeneity of habitats, thus contributing to physiognomic differentiation of floral vegetation (Oliveira and Ratter; 2002) [10]. Performance of soil relies on biogeochemical properties of soil; it implies that properties of soil are the determinant of soil performance. Soil physico-chemical properties regulate microbial biomass as well as their activity. In turn of it, Soil microbes regulate the decomposition rate, organic matter content and the overall biogeochemical processes of soil that governs the Productivity of forest ecosystems (Six *et al.* 2004) [14]. Nature of soil profile, pH, porosity and nutrient cycling between the soils and plants are the important dimensions to determine the forest site quality (Bhatt and Purohit, 2009) [2]. It has been reported that vegetation has a strong impact in soil formation (Chapman and Reiss 1992) [4] which decides physiochemical properties of soil such as pH, water holding capacity (WHC), organic carbon and nutrient availability. (Johnston 1986) [9]. Nutrient supply and physico-chemical characteristics of soil vary widely among forest communities (Binkley and Vitousek 1989) [3].
Many researchers have focused on the differentiation between forest communities in terms of vegetational composition. However little information was available regarding the relationship between vegetational community and soil physiochemical properties. In this context, one great example was Col. Sher Jung National Park, Where no information about soil properties was availed. Thereby study was formed to assess soil physico-chemical characteristics under different forest communities and depths in protected area.

Materials and Methods

Study site

The present study was carried out in the Col. Sher Jung National Park which encompasses an area of 27.88 sq. km in the Sirmour district of Himachal Pradesh. It is exactly located between latitudes 30^0 28’13’’N to $30^0$23’31’’ N and longitude $77^0$28’43’’E to $77^0$27’40’’E. It lies in Paonta valley of Himachal Pradesh which shares boundary with Kalesar National Park and Rajaji National Park.

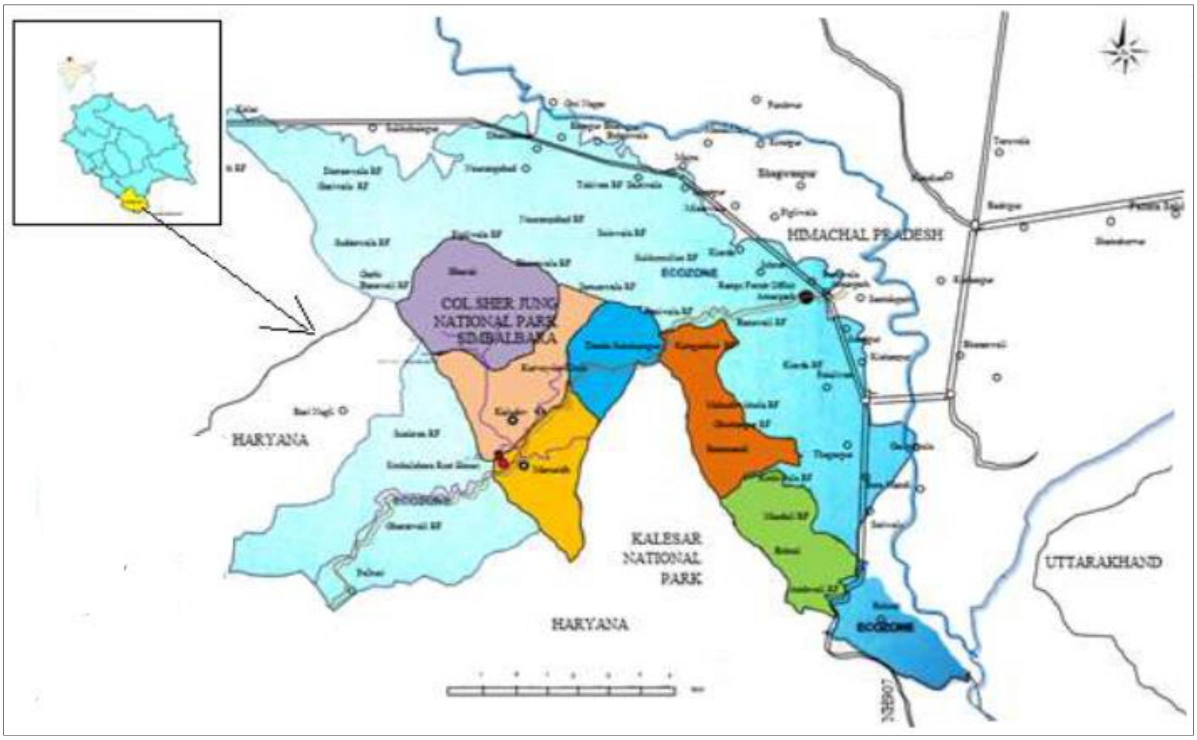
National park shows a wide geoenvironmental variation. In location; annual minimum and maximum temperature ranges from 3^oC - 40^oC, mean annual rainfall about 1200 mm and relative humidity varies from 26 per cent in summer to 90 per cent during monsoon. Studied area is having an elevatoinal range of 350amsl. to 700amsl.which is composed of unconsolidated siltstone, sandstone and conglomerate.

Sampling protocol

To study soil physicochemical characteristics under different forest communities of national park, eight communities were identified on the basis of their dominance *viz*. pure *Shorea robusta* (Sal) forest (T_1), *Eucalyptus tereticornis* plantation (T_2), pure *Syzygium cumini* (Jamun) forest (T_3), mixed *Shorea robusta* (Sal) + *Terminalia tomentosa* (Sain) forest (T_4), mixed *Shorea robusta* (sal) + *Eucalyptus tereticornis* forest (T_5), mixed *Shorea robusta* (Sal) + *Syzygium cumini* (Jamun) forest (T_6), mixed *Shorea robusta* (Sal) + *Diospyros melanoxylon* (Tendu) forest (T_7) and Mixed forest community (T_8). In each community, three replicates of composite soil samples were collected from two different soil layers (0-20 cm, 20-40 cm). Soil depth was measured as the vertical length from the soil surface and the samples were collected by auger.

Laboratory analysis

Composite soil samples were dried, grounded with mortar and pestles and sieved with 2mm mesh before analysis. Bulk density of soil was estimated through specific gravity method (Singh 1980) [13]. Soil pH was measured by combined glass–calomel electrode in 1:2.5 soil solution ratios (Jackson, 1973) [8]. Wet digestion method was used for estimating soil organic carbon (Walkley & Black; 1934). Electrical conductivity (dS m^{-1}) was determined by conductivity bridge as suggested by (Jackson, 1973) [8].



Source**:** Location map of Sirmour in H.P.

Fig 1: Detail map of Col. Sher Jung National Park, Simbalbara, Sirmour, H.P., India.

Statistical Analysis

Data obtained were subjected to Two-way ANOVA for the detection of statistical significant differences. Analysis was done by using the SPSS system software.

Results and Discussions

Soil Bulk Density

Perusal data presented in Table 1 showed that bulk density of soil was significantly influenced by both forest communities and soil depth. In 0-20 cm soil depth; Maximum bulk density was recorded under the *Shorea robusta* (T1) forest (1.49 ± 0.01g cm^{-3}), whereas minimum (1.16 ± 0.02 g cm^{-3}) was found in the *Eucalyptus tereticornis* (T2) plantation. Bulk density in 20-40 cm layer also varied significantly among the various communities. Maximum bulk density (1.58 ± 0.02 g cm^{-3}) was again recorded for *Shorea robusta* (T1) forest while the minimum (1.23 ± 0.01 g cm^{-3}) was observed under *Eucalyptus tereticornis* plantation (T2).

From the observation of above it is appeared that bulk density of soil was appreciably affected by different forest species. However among the different communities Eucalyptus has lowest bulk density and higher porosity followed by Jamun forest while minimum at pure Sal forest. It may be due to higher organic matter content under Eucalyptus forest as suggested by (Pratap Narain *et al;* 1995) [16]. Other researcher like (Hosur and Dasog, 1995; Contractor and Badanur, 1996) [7, 5] recorded reduction in bulk density under forest due to high organic matter deposition. Hence findings clearly indicated that the value of bulk density varies with species/vegetation types and soil depth.

Table 1: Status of bulk density (g cm^{-3}) and soil pH of forest communities at different soil depth.

Forest communities (Treatment)		Bulk density (Soil depth)		Soil pH (Soil depth)	
		0-20 cm.	20-40 cm.	0-20 cm.	20-40 cm.
Sal (T1)		1.49 ± 0.01	1.58 ± 0.02	5.28 ± 0.03	6.08 ± 0.02
Eucalyptus (T2)		1.16 ± 0.02	1.23 ± 0.01	6.86 ± 0.08	7.17 ± 0.16
Jamun (T3)		1.20 ± 0.04	1.29 ± 0.01	5.72 ± 0.10	6.08 ± 0.02
Sal + Sain (T4)		1.33 ± 0.02	1.38 ± 0.01	5.51 ± 0.04	6.64 ± 0.05
Sal + Eucalyptus (T5)		1.26 ± 0.02	1.36 ± 0.02	6.46 ± 0.07	7.11 ± 0.05
Sal + Jamun (T6)		1.32 ± 0.03	1.41 ± 0.01	5.56 ± 0.03	6.37 ± 0.03
Sal + Tendu (T7)		1.35 ± 0.01	1.46 ± 0.04	5.76 ± 0.08	6.84 ± 0.04
Mixed (T8)		1.31 ± 0.05	1.35 ± 0.03	5.93 ± 0.16	6.66 ± 0.05
$C.D_{0.05}$	Community (C)	0.120		0.120	
	Depth (D)	0.060		0.060	
	C*D	0.169		0.169	

Soil pH:

Data of soil pH revealed significant variation among different forest communities and depth. In 0-20 cm soil layer; the value of soil pH 6.86 ± 0.08 was noticed highest which is under *Eucalyptus tereticornis* (T2) plantation. While minimum was 5.28 ± 0.03 observed under *Shorea robusta* (T1) pure forest community. Soil pH in 20-40 cm. depth, varied significantly among different forest communities. pH in 20-40 cm soil depth followed the trend T2 > T5 > T7 > T8 > T4 > T6 > T3 > T4, respectively. The values of the soil pH enhanced with increasing soil depth at all the community type. (Table 1)

Investigation pertaining to soil pH, revealed that pH level under all the forest communities was slightly acidic to neutral it could be described due to decomposition of organic matter and release of organic acids during the decomposition of litter. Similar findings were also reported by Yadav (1963) [18] in Chakrata Forest Division, Saralch (1994) [12] for Eucalyptus.

Soil Organic Carbon

Soil organic carbon studied in 0-20 cm and 20- 40 cm soil depth varied significantly (0.037) under different forest communities. Maximum status of soil organic carbon (2.81 ±0.02) was observed under *Eucalyptus tereticornis* (T2) forest plantation; where as minimum (2.49 ± 0.03) was in *Shorea robusta* (T1) forest community under both the soil depth (0-20 cm. and 20-40cm.) (Table 3.). It is also observed that soil organic carbon varied significantly (0.019) in different depth of soil. Instance of which soil organic carbon (%) declined from top layer (0-20 cm.) to bottom soil layer (20-40 cm.) at all the forest community.

From the observation of above it is appeared that sal community has lower organic carbon status. It could be attributed due to lower decomposition of sal leaves in compared to others. Lower decomposability of sal leaves has also been reported by Tomar *et al.* (1987) [16]. Higher OC status under *Eucalyptus* plantation is also been observed by earlier worker like Hosur and Dasog; (1985) [7]. It may be due to highest litter fall among the others. Decline in the availability of OC towards the lower soil layers could be due to reduced root biomass in deeper soil layers and cycling of nutrients from lower layers to surface layer.

Table 2: Status of organic carbon (%) and electrical conductivity (dSm^{-1}) of forest communities at different soil depth.

Forest communities (Treatment)		Organic Carbon (OC) Soil depth		Electrical Conductivity (EC) Soil depth	
		0-20 cm.	20-40 cm.	0-20 cm.	20-40 cm.
Sal (T1)		2.49 ± 0.03	2.34 ± 0.02	0.25 ± 0.03	0.21 ± 0.01
Eucalyptus (T2)		2.81 ± 0.02	2.67 ± 0.02	0.16 ± 0.01	0.14 ± 0.04
Jamun (T3)		2.72 ± 0.02	2.50 ± 0.02	0.17 ± 0.03	0.15 ± 0.02
Sal + Sain (T4)		2.59 ± 0.03	2.43 ± 0.02	0.23 ± 0.02	0.19 ± 0.02
Sal + Eucalyptus (T5)		2.62 ± 0.03	2.38 ± 0.01	0.22 ± 0.04	0.17 ± 0.01
Sal + Jamun (T6)		2.67 ± 0.03	2.45 ± 0.05	0.20 ± 0.02	0.16 ± 0.03
Sal + Tendu (T7)		2.54 ± 0.02	2.37 ± 0.02	0.20 ± 0.02	0.18 ± 0.01
Mixed (T8)		2.53 ± 0.02	2.44 ± 0.04	0.19 ± 0.03	0.16 ± 0.04
$C.D_{0.05}$	Community (C)	0.037		0.018	
	Depth (D)	0.019		0.004	
	C*D	0.053		0.011	

Soil Electrical Conductivity

Electrical Conductivity (EC) in 0-20 cm soil depth was recorded maximum (0.25 ± 0.03) in pure *Shorea robusta* forest community (T1) followed by *Shorea robusta* + *Terminalia tomentosa* mixed forest community (0.23 ± 0.02) however minimum value (0.16 ± 0.01) of EC was reported in *Eucalyptus tereticornis* (T2) forest. In 20-40 cm soil depth, Maximum EC (0.21 ± 0.01) was again observed by pure *Shorea robusta* forest (T1) while minimum (0.14 ± 0.03) was observed in *Eucalyptus tereticornis* (T2). It is also figured out that value of EC decreases with the increase in soil depth in all the vegetation types.

According to (Bruckner; 2012) [1], Soil pH sharers negative correlation with Soil electrical conductivity as a result of which low soil pH encourage soil electrical conductivity. It may be the reason of higher electrical conductivity (EC) under pure Sal community and lower at Eucalyptus community. Value of EC decreases with the increase in soil depth under all the vegetation types was on line with Srikant *et al.* (2002) [15] and Jayabaskaran *et al*. (2001).

Conclusion

The present investigation concluded that both forest communities and soil depth had major impact on soil physio-chemical properties of forest vegetation. It is clear from the present finding and the past literature that soil bulk density and soil pH enhances with increase in soil depth. While status of soil organic carbon and electrical conductivity reduces towards the lower soil layer. The study supported negative influence of organic matter on soil bulk density and again a negative relation of soil ph with soil electrical conductivity. In our study, we noticed distinct diversity structure among the different forest communities. Therefore, future studies will include the distribution of species and their respective abundances in relation to edaphic variables in order to better understand the processes involved in the soil-vegetation relationship.

References

1. Bruckner MZ. Water and soil Characterization – pH and Electrical Conductivity, Microbial Life Educational Resources. Montana State University, Bozeman, 2012.
2. Bhatt VP, Purohit VK. Floristic structure and phytodiversity along an elevational gradient in Peepalkoti-Joshimath area of Garhwal Himalaya, India. Nature and Science. 2009; 7:63-74.
3. Binkley D, Vitousek PM. Soil nutrient availability. In: Pearey RW, J Ehleringer, HA Mooney and PW Rundel (Eds), Plant physiological ecology: Field methods and instrumentation. London: Chapman and Hall, 1989, 75-96.
4. Chapman JL, Reiss MJ. Ecology: Principles and applications. Cambridge: Cambridge University Press, 1992, 294.
5. Contractor RM, Badanur VP. Effect of forest vegetation on properties of a vertisol. Journal of the Indian Society Soil Science. 1996; 44:510-511.
6. Miller GT. Living in the Environment: concepts, connections and solutions. 13th edition. Yolanda cossio publisher, Belmont, USA, 2007, 635.
7. Hosur GE, Oasog GS. Effect of tree species on soil properties. Journal of the Indian Society Soil Science. 1995; 43:256-259.
8. Jackson ML. Soil chemical analysis. Prentice Hall of India Private Limited, New Delhi, 1973.
9. Johnston AE. Soil organic matter: effects on soil and crops. Soil Use Manage. 1986; 2:97-105.
10. Oliveira-Filho AT, Ratter JA. Vegetation physiognomies and woody flora of the cerrado biome. In Oliveira PS, Marquis RJ (eds). The Cerrados of Brazil: Ecology and Natural History of a Neotropical Aavanna. New York: Columbia University Press, 2002, 91-120.
11. Pratap N, Singh R. Behavior of nitrates under different land uses. Indian Forester. 1985; 111:230-239.
12. Saralch HS. Nutrient dynamics and biomass production of Eucalyptus tereticornis Smith, in high density short rotation systems. M Sc Thesis, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, H P, India, 1994, 99.
13. Singh RA. Soil physical analysis. Kalyani Publishers, New Delhi, 1980.
14. Six J, Bossuyt H, Degryze S, Denef K. A history of research on the link between (micro) aggregates, soil biota, and soil organic matter dynamics. Soil Tillage Research. 2004; 79:7-31.
15. Srikanth K, Srinivasamurthy CA, Siddaramappa R, Panama RVR. Direct and residual effect of enriched composts, FYM, vermiccompost and fertilizers on properties of an alfisol. Journal of Indian Society of Science. 2002; 48:496-499.
16. Tomar VPS, Narain P, Dadhwal KS, Singh R. Leaf mulches of perennial plants conserve soil moisture, add nutrients and give higher crop yields. Soil Cons. Newsletter. 1987; 6:5.
17. Walkley A, Black JA. Estimation of soil organic carbon by chromic acid filtration method. Soil Science. 1934; 37:38-39.
18. Yadav JSP. Studies on soil properties in Chakrata forest division of UP. Indian Forester. 1963; 89:18-38.