SOIL VEGETATION INTERRELATIONSHIP IN EUCALYPTUS AND SHISHAM PLANTATIONS OF DEHRADUN

Tahir Nazir* and Ajay Kumar Pundir

**Department of Forestry, Dolphin (PG) Institute of Biomedical and Natural sciences, Dehradun, (Uttarakhand) - 248001*
Department of Botany, Dolphin (PG) Institute of Biomedical and Natural sciences, Dehradun, (Uttarakhand) - 248001
Email: tahir_nazir@rediffmail.com

Received-19.01.2015, Revised-04.02.2015

Abstract: The soils under two Plantations i.e Eucalyptus (*Eucalyptus globulus*) and Shisham (*Dalbergia sissoo*) were analysed for physio-chemical properties and vegetation analysis. Soil samples were analyzed for texture, water holding capacity, pH, available potassium, available phosphorus, total nitrogen, organic carbon, electrical conductivity, calcium and magnesium. Average available potassium was maximum (73.00ppm) in *Eucalyptus globules* plantation, whereas it was (32.00ppm) in shisham plantation. Similarly available phosphorus was highest in Eucalyptus (18.17ppm) whereas in shisham it was (2.75ppm). Organic carbon and total nitrogen were also maximum under eucalyptus plantation. The soil pH under eucalyptus was near neutral, whereas it was slightly acidic in shisham. The average available calcium and magnesium were also higher in eucalyptus plantation. The average electrical conductivity in both the plantations was 0.03dsm^{-1}. The highest tree density was 733 trees ha^{-1} in shisham plantation, declining to 433 trees ha^{-1} in eucalyptus plantation.

Keywords: Eucalyptus, Nutrients status, Physico-chemical, Soil, Shisham, Vegetation

INTRODUCTION

The soil and vegetation have a complex interrelation because they develop together over a long period of time. The vegetation influences the chemical properties of soil to a great extent. The selective absorption of nutrient elements by different tree species and their capacity to return them to the soil brings about changes in soil properties (Singh et al. 1986). Concentration of elements in the soils is a good indicator of their availability to plants. Their presence in soil would give good information towards the knowledge of nutrient cycling and biochemical cycle in the soil–plant ecosystem (Pandit and Thampan, 1988). The yearly contribution of surface vegetation to soil, in the form of needles, leaves, cones, pollen, branches and twigs, gradually decomposes and becomes a part of the soil (Singh and Bhatnagar, 1997). Thus the present study was carried out to study the impact of *Eucalyptus globules* (eucalyptus) and *Dalberga sissoo* (shisham) vegetation covers on the physicochemical properties of soils.

MATERIAL AND METHOD

This study was carried out in two different vegetation types at Dehradun of Uttarakhand, which lies between 77 20'4"- 78 18'30" E longitude, 29 58'40"- 30 20'4" N latitude at an elevation of 620 m (a.m.s.l).The study was conducted at two different sites (Site 1-Manduwalla, Site 2- Sidduwala) of Dehradun Forest Division. Soil samples were collected at three different places, randomly selected in each selected site and thus nine pits were dug out (3 pits at each site) Soil samples were collected from three predetermined depths i.e. 0-10, 10-30 and 30-60cm by opening pits. The water holding capacity (WHC) was determined as per Mishra (1968), whereas the bulk density was estimated by the method of Wilde *et al*. (1964). Porosity was expressed in percent by volume calculated from the bulk density (BD) and particle density (PD) of soil (Brady 1996). Munsell Colour Chart was used to determine the soil colour. Walkley and Black rapid titration method as modified by Walkley (1947) was adopted for organic carbon estimation. The pH of soil was determined directly with using a Control Dynamics digital pH meter (model AP + 175E/C). Total nitrogen was determined by the colorimetric technique (Jackson 1993). Available potassium was extracted by neutral normal ammonium acetate (Morwin and Peach; 1951). Available phosphorus was determined in the soil by Olsen's method, (Olsen *et al*. 1954). The vegetation analysis was done by laying out quadrats. On each selected site 25 quadrats were laid (each 10 x 10 m) randomly to study tree components as described by Curtis and McIntosh (1950) and Mishra (1968).

RESULT

The soil texture in *Eucalyptus globules* was silty clay loam at 0-10 and 30-60 cm depths and silty loam at 10-30cm depth. The bulk density increased with the increase in depth. Moreover, due to the increase of bulk density with depth the porosity thus showed the reverse trend and decrease with the depth. The moisture content and water holding capacity was found higher (13.38%) and (52.77%) at 30-60cm

*Corresponding Author

depth respectively. The soil pH was slightly acidic and ranged from 6.97 to 6.30. The organic carbon content was found higher in the surface horizon and decrease with the increasing depth. The available phosphorus was found maximum (11.3ppm) at the upper horizon and decrease with increase in depth. Soil potassium was also found maximum (117ppm) at the surface of the soil and it also decreased with the increasing depth. Similarly the total nitrogen was also found higher (0.16) in the upper surface of the soil and decreased with increasing depth. The electrical conductivity ranged from 0.02dsm-1 to 0.57 dsm^{-1}. The exchangeable calcium was found higher 0.11% at 10-30cm depth. The exchangeable magnesium was found higher 0.04% at 30-60cm depth. (Table 1)

Similarly in *Dalbergia sissoo* (Shisham) plantation, the soil texture was found loamy at 10-30cm depth and silty loam at 0-10cm depth and 30-60cm depth respectively. The bulk density increased with the depth and the porosity in turn showed the reverse trend and decreased with the increased in depth. The water holding capacity (WHC) was found higher (46.66%) at 0-10cm depth. The WHC is influenced by the clay content, thus it was higher when the percent clay was high. The organic carbon was found maximum (0.72%) at the surface horizon of the soil and decrease when increase in depth. The soil pH was near neutral and ranged from 5.66 to 6.36. The phosphorus was found maximum (3.75ppm) at 0-10cm depth, whereas potassium was found maximum (51ppm) at the upper surface and decrease with increase in depth. The total nitrogen was also found maximum (0.098%) at the upper surface and decrease with increase in depth. The electrical conductivity ranged from 0.03dsm^{-1} to 0.5 dsm^{-1}. The ex. calcium was found higher 0.15% at 10-30cm depth. The exchangeable magnesium was found higher 0.03% at 0-10cm depth. (Table 2).

The tree density was recorded maximum 733 trees ha^{-1} for shisham plantation whereas, it was 433 trees ha^{-1} in eucalyptus vegetation. In eucalyptus plantation a highly significant correlation was found between OC and T.N (0.86). Similarly in shisham plantation a highly significant correlation was found between organic carbon and total nitrogen (0.99) and available phosphorus and total nitrogen (0.99). (Table 3 & 4).

DISCUSSION

The volume-weight relationship of soil in oven dry conditions is termed as the bulk density (Gupta and Sharma, 2008). In both the vegetation types of the present study the bulk density increased with the increasing soil depths because the lower layers were more compact under the weight of upper portion of soil and also due to the lower amount of organic matter in deeper layers (as was also suggested by Haans, 1977, Patil and Prasad, 2004). The water holding capacity increased with the increase in the clay content at all the sites and was low on the sites, where percent sand was higher. Sandy soils generally have less favorable moisture holding capacity and nutrient retention characteristics than non-sandy soils (Pastor and Post, 1986; Perry, 1994). In the present study a positive correlation was found between organic carbon, total nitrogen, organic matter and available phosphorus in all the vegetation types. Gupta and Sharma (2008) also showed that nitrogen, organic carbon and phosphorus were positively correlated chiefly because all these attributes are intimately linked with soil humus.

Potassium performs very vital processes like regulating transpiration and respiration, influencing enzyme action, synthesis of carbohydrates and proteins etc. (Brady, 1966). Potassium is not much influenced by soil organic matter because it is not the direct supplier of potassium (Gupta and Sharma, 2008). The maximum potassium was recorded under Eucalyptus plantation.

Table 1. Physio-chemical properties of soil under Eucalyptus plantation (site 1)

Depths	WHC %	Soil porosity %	Bulk Density %	Soil Texture %	Total Nitrogen %	Organic Carbon %	C/N Ratio	Available Phosphorus (ppm)	Available Potassium (ppm)	pH	EC dSm^{-1} (1:5)	Ca%	Mg%
0-10	48.2	63.84	0.94	Silty Clayey Loam	0.16	1.40	8.94	11.3	117.0	6.97	0.05	0.10	0.03
10-30	47.5	61.53	1.00	Silty Loam	0.084	0.78	6.34	7.5	67.5	6.75	0.02	0.11	0.03
30-60	46.1	57.30	1.11	Silty Calyey Laom	0.097	1.18	7.22	6.3	34.5	6.30	0.02	0.05	0.04
Mean	50.54	60.89	1.01		0.11	0.91	7.5	18.17	73.00	6.67	0.03	0.86	0.03

Table 2. Physico-chemical properties of soil under shisham plantation (Site 2)

Depths	WHC %	Soil porosity %	Bulk Density %	Soil Texture %	Total Nitrogen %	Organic Carbon %	C/N Ratio	Available Phosphorus (ppm)	Available Potassium (ppm)	pH	EC dSm^{-1} (1:5)	Ca%	Mg %
0-10	46.66	63.70	0.85	Silty Loam	0.098	0.722	7.36	3.75	51	5.66	0.05	0.15	0.03
10-30	38.45	66.15	0.88	Loam	0.064	0.290	4.53	2.50	25	5.71	0.03	0.09	0.02
30-60	23.38	56.15	1.14	Silty Loam	0.042	0.132	3.14	2.00	20	6.36	0.03	0.08	0.002
Mean	36.16	62	0.95		0.068	0.38	5.01	2.75	32	5.91	0.03	0.10	0.017

Table 3. Statistical Correlation between various parameters in *Eucalyptus globulus* plantation

	WHC	*P*	*B.D*	*TN*	*OC*	*AP*	*AK*	*pH*	*EC*	*Ca*	*Mg*
WHC	**1**										
P	**1.00**	**1.00**									
B.D	**-1.00**	**-1.00**	**1.00**								
TN	**0.64**	**0.66**	**-0.66**	**1.00**							
OC	**0.17**	**0.19**	**-0.19**	**0.86**	**1.00**						
AP	**0.89**	**0.90***	**-0.90**	**0.92**	**0.60**	**1.00**					
AK	**0.95**	**0.96**	**-0.96**	**0.84****	**0.46**	**0.98**	**1.00**				
pH	**1.00**	**1.00**	**-1.00**	**0.64**	**0.16**	**0.88**	**0.95**	**1.00**			
EC	**0.76**	**0.77**	**-0.77**	**0.99***	**0.77**	**0.97**	**0.92**	**0.75**	**1.00**		
Ca	**0.88***	**0.87**	**-0.87**	**0.21**	**-0.32**	**0.56**	**0.70**	**0.89**	**0.36**	**1.00**	
Mg	**-0.94**	**-0.94**	**0.94**	**-0.36**	**0.17**	**-0.69**	**-0.80**	**-0.95**	**-0.50**	**-0.99**	**1.00**

*significant at 1% level & **significant at 5% level

Table4. Statistical Correlation between various parameters in *Dalbergia sissoo* plantation

	WHC	*P*	*B.D*	*TN*	*OC*	*Av.P*	*Av.K*	*pH*	*EC*	*Ca*	*Mg*
WHC	**1.00**										
P	**0.83**	**1.00**									
B.D	**-0.97**	**-0.95**	**1.00**								
TN	**0.96**	**0.63**	**-0.85**	**1.00**							
OC	**0.91**	**0.52**	**-0.77**	**0.99***	**1.00**						
Av.P	**0.92**	**0.54**	**-0.78**	**0.99***	**1.00**	**1.00**					
Av.K	**0.86**	**0.42**	**-0.70**	**0.97**	**0.99***	**0.99**	**1.00**				
pH	**-0.96**	**-0.95**	**1.00**	**-0.84**	**-0.75**	**-0.76**	**-0.67**	**1.00**			
EC	**0.77**	**0.28**	**-0.58**	**0.92**	**0.97**	**0.96**	**0.99**	**-0.55**	**1.00**		
Ca	**0.85***	**0.41**	**-0.68**	**0.96**	**0.99**	**0.99**	**1.00**	**-0.66**	**0.99**	**1.00**	
Mg	**1.00**	**0.83**	**-0.96**	**0.96**	**0.91**	**0.92**	**0.86**	**-0.96**	**0.77**	**0.85**	**1.00**

*significant at 1% level & **significant at 5% level

T.N. = Total Nitrogen, OC = Organic carbon, AV.P = Available phosp, AV.K = Available potassium, WHC = Water Holding Capacity, Soil. P = Soil Porosity, B.D. = Bulk density,

Table 5. Phyto-sociological attributes of site -1 (*Eucalyptus globules* plantation)

S. No	Name of Tree spp.	Frequency %	Density plants/ha	Abundance	Dominance	Relative dominance %	Relative density %	Relative frequency %	IVI
1	**Eucalyptus**	**83.33**	**433**	**5.2**	**1454.98**	**100**	**100**	**100**	**300**

Table 6. Phyto-sociological attributes of site -2 (*Dalbergia sissoo* plantation)

S. No	Name of Tree spp.	Frequency %	Density plants/ha	Abundance	Dominance	Relative dominance %	Relative density %	Relative frequency %	IVI
1.	**Shisham**	**100**	**733**	**733**	**1754.54**	**100**	**100**	**100**	**300**

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