RESEARCH ARTICLE

GROWING STOCK ESTIMATION AND SOIL PHYSIO-CHEMICAL PROPERTIES UNDER TEAK AND SHISHAM PLANTATION OF DEHRADUN, UTTRAKHAND, INDIA

Reyaz Ahmad Bhat[1], Tahir Nazir*[2] and A.K. Uniyal[2]

[2]*Dolphin P.G Collage of biomedical and Natural sciences Manduwulla Dehradun Uttrakahnd India.*
[1]*Doon (PG) College of Agriculture Sciences & Technology, Selaqui, Dehradun*
Email: reyazahmadbhat@gmail.com

Abstract: The soils under two Plantations i.e Teak (*Tectona grandis*) and Shisham (*Dalbergia sissoo*) were analysed for physio-chemical properties and growing stock. 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 (102 ppm) in *Tectona grandis* plantation, whereas it was (32.00ppm) in shisham plantation. Similarly available phosphorus was highest in Teak (18.17ppm) whereas in shisham it was (2.75ppm). Organic carbon and total nitrogen were also maximum under teak 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 teak plantation. The average electrical conductivity in both the plantations was 0.03dsm^{-1}. The maximum growing stock was recorded under Teak. A positive correlation was found between G.S and soil organic matter and organic carbon.

Keywords: Organic matter, Growing stock, Teak, Shisham

INTRODUCTION

The growth and reproduction of forest cannot be under-stood without the knowledge of soil. 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 bio-chemical cycle in the soil–plant ecosystem.

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-Lechiwalla for Teak, Site 2-Sidduwalafor shisham) 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). Total nitrogen was determined by the colorimetric technique (Jackson 1993).

*Corresponding Author

The volume of individual tree species in various sample plots were calculated on the basis of existing volume tables or volume equations based on the Indian Forest records (FSI 1985 I & II) publications for the respective species. Following were the main standard volume equations used in the present study:-
Tecktona grandis V = 0.0645 + 0.2322 D^{2}H (Chaturvadi 1973)
Shorea robusta V = 0.08940* 2650 D^{2}H (Chaturvadi1973).

RESULT

The soil texture in *Tectona grandis* plantation was silty loam at 0-10cm depth and silty clay loam at the 10-30cm and 30-60cm depth respectively. The percentage of clay was found higher (40.0%) at 30-60cm depth. Thus this shows that there was the movement of clay from upper to lower horizons. The percent water holding capacity was fond higher (54.02%) at 0-10cm depth. The soil colour varied from dark yellowish brown to yellowish brown. The dark colour is usually related with higher content of organic carbon in the soil. The bulk density usually increase with increase in depth, but it showed a reverse trend in *Tectona grandis* plantation and was thus found higher (0.95%) at 0-10cm depth. The frequent forest fires would have been the reason for it. The soil porosity was found higher (68.84%) at 10-30cm depth (Table 1.1).
In *Tectona grandis* (Teak) plantation the soil pH was neutral and ranged from 7.06 to 7.17. The total nitrogen found, higher (0.30%) at 0-10cm depth. The available phosphorus was found maximum (22.5ppm) at 30-60cm depth and lower (18.0ppm) at 0-10cm depth. The available potassium was found

maximum (153ppm) at 0-10cm depth (Table 1.2). The electrical conductivity ranged from 0.03dsm-1 to 0.24dsm-1. The exchangeable calcium was found higher 0.26% at 10-30cm depth. The ex. Magnesium was found higher 0.09% at 30-60cm depth. The growing stock under teak was found 227.56m^3/ha (Table 1.2).

The soil texture in *Shorea robusta* (Sal) was silty clay loam at 0-10 and 30-60 cm depths respectively and silty loam at 10-30cm depth. The soil colour varied from pale brown to brownish yellow. The bulk density increase 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 depth respectively (Table1.3).

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 increase in depth that was 1.60% at 0-10cm depth, 0.34% at 10-30cm depth and 0.78% at 30-60cm depth respectively. The electrical conductivity ranged from 0.02dsm-1 to 0.57 dsm-1. The ex. Calcium was found higher 0.11% at 10-30cm depth.The exchangeable Mg was found higher 0.04% at 30-60cm depth. The growing stock for shisham plantation was 121.30m^3/ha (Table1.4).

A positive correlation was found between organic carbon and total nitrogen; growing stock and organic carbon; total nitrogen and Growing stock in all forest types (Table 1.5 &1.6).

DISCUSSION

The average pH (7.12) was found higher in case of Teak forest. The pH was negatively correlated to organic carbon, organic matter, were as it was positively correlated with phosphorus. Paudel and Sah (2003) also found out the same results while working on the Physiochemical characteristics of soil in tropical sal (*Shorea robusta* Gaertn.) forests in eastern Nepal.

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 reported under Sal fores*t*. The phosphorus was also found higher in the lower horizons of the *Teak* forest, which may be due to the leaching properties of the soils.

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.

Table 1. Physical properties of soil under (Site 1) *Tectona grandis* plantation

Teak	WHC %	Soil porosity %	Bulk Density %	Moisture Content %	Soil Texture %	Soil Colour		
						Hue	Value Chroma	Colour
0-10	54.02	63.46	0.95	4.4	Silty Loam	10/YR	4/4	Dark Yellowish Brown
10-30	52.47	68.84	0.81	10.1	Silty Clayey Loam	10/YR	5/4	Yellowish Brown
30-60	51.98	65	0.91	9.57	Silty Clayey Loam	10/YR	5/4	Dark Yellowish Brown
Mean	52.82	65.76	0.89	8.02				

Table 2. Chemical properties of soil under (Site 1) *Tectona grandis* plantation

Teak	Total Nitrogen %	Organic Carbon %	C/N Ratio	Available Phosphorus (ppm)	Available Potassium (ppm)	pH	EC dSm^{-1} (1:5)	Ca%	Mg%
0-10	0.308	2.021	6.56	18.0	153	7.06	0.24	0.25	0.04
10-30	0.266	1.603	6.02	17.5	84	7.17	0.06	0.26	0.03
30-60	0.238	1.186	4.98	22.5	69	7.14	0.03	0.19	0.09
Mean	0.27	1.60	5.85	19.33	102	7.12	0.11	0.23	0.05

Table 3. Physical properties of soil under (Site 2) *Dalbergia sissoo* plantation

Depths	WHC %	Soil porosity %	Bulk Density %	Moisture Content %	Soil Texture %	Soil Colour		
						Hue	Value Chroma	Colour
0-10	46.66	63.70	0.85	1.42	Silty Loam	10/YR	7/4	Very Pale Brown
10-30	38.45	66.15	0.88	1.72	Loam	10/YR	7/4	Very Pale Brown
30-60	23.38	56.15	1.14	1.52	Silty Loam	10/YR	6/4	Light Yellowish Brown
Mean	36.16	62	0.95	1.56				

Table 4. Chemical properties of soil under (Site 2) *Dalbergia sissoo* plantation

Depths	Total Nitrogen %	Organic Carbon %	C/N Ratio	Available Phosphorus (ppm)	Available Potassium (ppm)	pH	EC dSm^{-1} (1:5)	Ca%	Mg%
0-10	0.098	0.722	7.36	3.75	51	5.66	0.05	0.15	0.03
10-30	0.064	0.290	4.53	2.50	25	5.71	0.03	0.09	0.02
30-60	0.042	0.132	3.14	2.00	20	6.36	0.03	0.08	0.002
Mean	0.068	0.38	5.01	2.75	32	5.91			

Table 5. Statistical correlation between various parameters in *Tectona grandis* plantation

	T.N%	OC%	C/N R	AV.P	AV.K	pH	WHC%	Soil.P%	SOM	B.D	M. C %G.S
T.N%	1										
OC%	0.94**	1.00									
C/N R	0.87	0.98**	1.00								
AV.P	-0.58	-0.82	-0.91	1.00							
AV.K	1.00	0.94	0.86*	-0.57	1.00						
pH	-0.90	-0.70	-0.56	0.16	-0.91	1.00					
WHC%	1.00	0.96**	0.89*	-0.62	1.00	-0.88	1.00				
Soil.P%	-0.58	-0.28	-0.10	-0.33	-0.59	0.88*	-0.54	1.00			
SOM	0.94**	1.00	0.98**	-0.82	0.94	-0.70	0.96	-0.28	1.00		
B.D	0.58	0.28	0.10	0.33	0.59	-0.88	0.54	-1.00	0.28	1.00	
M. C %	-0.96	-0.82	-0.70	0.34	-0.97	0.98	-0.95	0.78	-0.82	-0.78	1.00
G.S	0.88	0.95	0.77	0.33	0.44	0.77	0.77	0.77	0.92	0.87	1.00

Table 6. Statistical Correlation between various parameters in *Shorea robustra* forest.

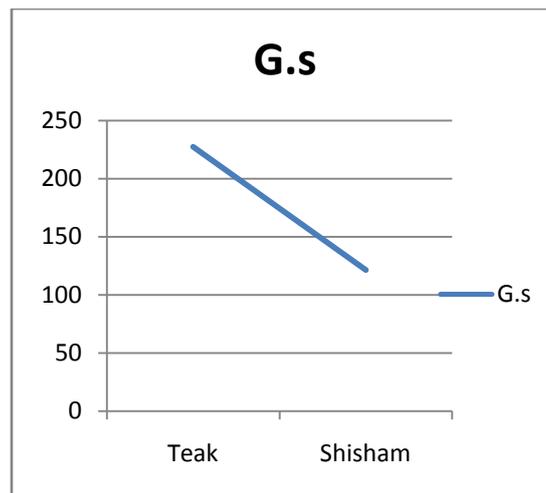|	T.N%	OC%	C/N R	AV.P	AV.K	pH	WHC%	Soil.P%	SOM	B.D	M. C %
T.N%	1.00										
OC%	1.00	1.00									
C/N R	0.99**	1.00	1.00								
AV.P	0.69	0.75*	0.76	1.00							
AV.K	0.96**	0.93	0.92	0.45	1.00						
pH	0.39	0.48	0.49	0.94**	0.11	1.00					
WHC%	0.42	0.33	0.31	-0.37	0.66	-0.67	1.00				
Soil.P%	0.42	0.50	0.51	0.95	0.14	1.00	-0.65	1.00			
SOM	0.99**	1.00	1.00	0.76*	0.93	0.48	0.32	0.51	1.00		
B.D	-0.42	-0.50	-0.51	-0.95	-0.14	-1.00	0.65	-1.00	-0.51	1.00	
M. C %	-0.53	-0.61	-0.62	-0.98	-0.27	-0.99	0.55	-0.99	-0.62	0.99	1.00
G.S	0.88	0.77	0.88	0.22	0.33	0.65	0.88	0.89	0.55	0.66	100

Fig.1. Growing stock m³/ha under teak and shisham plantations.

REFERENCES

Singh, A.K., Prasad, A. and Singh, B. (1986). Availability of Phosphorus and Potassium and its relationship with some physico-chemical properties of some forest soils of Pali-range, (Shahodol, M.P.). *Ind. For.* **112**: 1094-1104.

Wilde, S.A., Voig, G.K. and Iyer, J.G. (1964). SOil and plant Analysis for Tree Culture. Qaford publishing House. Calcutta, India.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd. New Delhi.

Chaturvedi, O.P. and Singh, J.S. (1987). The structure and function of pine forest in Central Himalaya II. Nutrient Dynamics. *Ann. Bot.* **60**:253-267.

Gupta and M.K. and Sharma, S.D. (2008). Effect of tree plantation on soil properties, profile morphology and productivity index. 1. Poplar in Uttarakhand. *Ann. For.* 16 (2): 209-224 .

Brady, N.C. (1996). The nature and properties of soils, 10th edn. Prentice Hall New Delhi.