ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2018; 4(10): 30-33
www.allresearchjournal.com
Received: 05-08-2018
Accepted: 06-09-2018

Piyush Paul
Department of Botany,
Institute of Basic Science,
Bundelkhand University,
Jhansi, Uttar Pradesh, India

Correspondence
Piyush Paul
Department of Botany,
Institute of Basic Science,
Bundelkhand University,
Jhansi, Uttar Pradesh, India

Physico-chemical properties of soil under canopy of some important tree species in a mixed dry deciduous forest of Bundelkhand

Piyush Paul

Abstract
The present study is deal with physico-chemical properties of soil under canopy of some important tree species in a mixed dry deciduous forest of Bundelkhand. The soil was acidic under canopy of *Anogeissus pendula, Butea monosperma* and *Tectona grandis* whereas soil was basic in nature under canopy of *Bauhinia racemosa.* The electrical conductivity of soil varies under canopies of different tree species. The amount of available nitrogen and phosphorus in soil was in the low range whereas available potash was medium to high. The average values of organic carbon content, in soil, showed a wide variation under the canopies of different dominant tree species, varying from 0.47– 1.01 percent.

Keywords: physico-chemical properties of soil, bundelkhand, mixed dry deciduous forest

Introduction
The word soil represents one of the most active and complex natural systems on the earth's surface. It is essential for the existence of many forms of life and provides medium for plant's growth and also supplies the organisms with most of their nutritional requirements (Gaur, 1997) [5]. Soil is a complex system where in living soil organisms belonging to different taxonomic groups interact at different levels within the community and plays a significant role in maintenance of soil properties (Garbeva *et al.,* 2004) [4]. Forest soils are enriched with enormous nutrients due to the decomposition processes of the plants litter. So the soils in mountainous region are very well suited for the high productivity and sustainability. Altitude is often employed to study the effects of climatic variables on soil organic matter dynamics (Lemenih and Itanna, 2004) [10].
The physical properties of the soil depend upon the amount, shape, structure, size, pore spaces, organic matter and mineral composition of soil. The chemical proper ties of the soil are the interactions of various chemical constituents among soil particles and the soil solution. These physical and chemical properties are soil texture, bulk density, soil structure, soil colour, pH, electrical conductivity, cation exchange capacity, organic carbon & matter and soil nutrients. All soils have different properties and working with them requires understanding of these properties. The knowledge of the physical and chemical properties of soil helps in managing resources while working with a particular soil (Brady and Weil, 2002) [2]. The study of up-to-date status of soil properties is a very important tool for management of a forest ecosystem on a sustainable basis.
Therefore, the study was aimed to find out the difference in the physical and chemical properties of the soil under canopy of different dominant tree species of a mixed dry deciduous of Bundelkhand region.

Material and Methods
Study Site and Climate
The study was conducted at Orchha forest during July 2016 to June 2017. This forest is located nearly 18 km. from Jhansi, U.P. (25° 27' N latitude 78° 35' E longitude) on Jhansi-Tikamgarh road in Orchha range of Tikamgarh district, M.P. (24°26' and 25°40'N latitude and 78°26' and 79°26' E longitude).The climate of this forest is semi-arid and has a distinct seasonality. On the basis of distribution of rainfall and variation in temperature, the climate

of Tikamgarh can be said to be typically monsoonic and can be divided into three distinct season *viz.*, warm-wet rainy (mid - June to September); cool-dry winter (November to February) and hot–dry summer (April to June). March and October represent the transitional months between seasons, the major part of both being closer to the season following them.

Methods of Soil Collection and Analysis

The soil samples were collected from under the canopies of dominant tree species *viz., Anogeissus pendula, Bauhinia racemosa, Butea monoperma and Techona grandis*. The soil samples were taken out from three depth *viz.*, depth 1 (0-15 cm), depth 2 (15-30 cm) and depth 3 (30-45 cm). Before taking soil sample all plant material was cleared on the forest surface but not the plant roots and or organic matter embedded in A-horizon. The soil samples for physical and chemical parameters were taken from the study site in the month of October after completion of rainfall.

Soil pH was determined by using digital glass electrode pH meter at 1:2.5 soil water ratios. Electrical conductivity from supernatant of the soil solution was determined by using a conductivity bridge. Organic carbon was estimated by Walkley and Black's rapid titration method (Piper, 1996) [13]. Available nitrogen was determined following alkaline permagnate method described by Piper (1996) [13]. The available phosphorus was determined following Olsen *et al.*, (1954) [12]. The intensity of blue colour was read at 60 nm on Spectronic–20 against a blank. The amount of available phosphorus was calculated from the standard curve prepared with KH_2PO_4. The available potassium was determined by ammonium acetate extract method described by Piper (1966) [13]. The available phosphorus and potassium were expressed in the form of phosphate and potash, respectively.

Result and Discussion

I. Physical Properties

IA.P^H and electrical conductivity

The pH and electrical conductivity of soil under canopies of dominant tree species at different depths are presented in table 1. There was only a slight difference in pH under different tree species. The soil was acidic under canopy of *Anogeissus pendula, Butea monosperma* and *Tectona grandis* whereas soil was basic in nature under canopy of *Bauhinia racemosa*. There was not defined trend of increase or decrease in pH at different depths under a particular tree species.

The electrical conductivity of soil under canopies of *Bauhinia racemosa* and *Butea monosperma* was higher as compared to the soils of under *Anogeissus pendula* and *Tectona grandis.* Maximum (0.060 m mhos/cm) electrical conductivity was reported under *Bauhinia racemosa* in the upper layer (0-15 cm) of soil, while minimum (0.024 m mhos/cm) electrical conductivity was found to be under *Anogeissus pendula* in the middle layer (15-30 cm) of soil. As in pH, no define trend of increase or decrease in electrical conductivity was observed at different depths.

The pH has indirect effect on plant growth by influencing nutrient release by weathering, the solubility of all materials in the soil and the amount of nutrient ions stored on the cation exchange sites (Roy, 1996) [14]. Studies carried out in seventeen forest sites of Bundelkhand region by Singh *et al.* (1983) [15] revealed that the soils of these sites are slightly acidic in reaction, pH ranging from 5.6 to 6.8 which is quite favourable for nutrient availability. They also reported that *Anogeissus pendula* and *Tectona grandis* are found to occur in soils having a pH of 6.3 and 6.5, respectively. Yadav and Sharma (1968) [17] also reported that teak bearing area have acidic soil in Madhya Pradesh. This supports observation obtained in the present study.

II Chemical Properties

IIA. Available nitrogen

The data presented in table: 2 show that the amount of available nitrogen in soil was in the low range. Maximum amount of available nitrogen (245.74 kg/ha) was observed under canopy of *Butea monosperma* in the upper layer (0-15 cm) and minimum amount of available nitrogen (162.34 kg/ha) was found to be under *Bauhinia racemosa* in the lower layer (30-45). Maximum average available nitrogen (219.60 kg/ha) was recorded under *Butea monosperma* followed by *Tectona grandis* (186.95 kg/ha). *Anogeissus pendula* (182.11 kg/ha) and *Bauhinia racemosa* (178.85 kg/ha).Thus, values of average available nitrogen were show a wide variation under various tree species. Vertical distribution of available nitrogen was show decreasing trend with increasing depths.

The potential rate of nitrogen use by growing plants generally exceeds the rate at which nitrogen becomes available (Ensmiger and Pearson, 1950) [3]. Thus, the amount of nitrogen in the soil is in the low range. The absorption rate of nitrogen by plants in growing phase is not always the same and is subject to interaction of a number of ecological and physiological factors (Roy, 1996) [14]. So there was no definite trend of variation in available nitrogen with respect to depth. Hazra (1981) [9] reported that in general soils of Bundelkhand are poor in nitrogen. Mannikar (1981) [11] also studied fertility status of Bundelkhand region and observed that the red soils of this region are low to medium high in nitrogen.

IIB. Available phosphate

Data presented in table: 3 reveal that the available phosphorus in the soil was in the low range and maximum available phosphate (18 kg/ha) was occur under canopy of *Tectona grandis* in the upper layer (0-15 cm) of soil while, under canopy of *Bauhinia racemosa* minimum value (4.5 kg/ha) was recorded in the lower layer (30-45 cm) of soil. Vertical distribution of available phosphate was show decreasing trend with increasing depths. Maximum amount of average available phosphate (14.1 kg/ha) was recorded under *Tectona grandis* followed by *Butea monosperma* 11.8kg/ha). *Bauhinia racemosa* (9.7 kg/ha) and *Anogeissus pendula* (7.5 kg/ha).

The available phosphorus varies solubility, amount of solution present and the distance phosphate ion must move to reach the plant root that will absorb it. These three variables are in turn dependent on several other factors (Thomplson and Troeh, 1985) [16]. Hazra (1981) [9] reported that in general soils of Bundelkhand are low to medium in phosphate. Mannikar (1981) [11] also studied fertility status of Bundelkhand soils and observed that red soils of the region are low to medium in phosphorus.

II C. Available potash

The data on soil available potash is presented in table: 4 indicate that the upper layer (0-15 cm) of soil always contained more available potash than that of next two layers.

In the upper layer (0-15 cm) of soil maximum value (348.90 kg/ha) was recorded under canopy of *Butea monosperma* while, minimum value (250.50 kg/ha) was found to be under canopy of *Bauhinia racemosa* in lower layer (30-45 cm) of soil. The values of available potash presented in table: 4 indicates that amount of available potash was in medium to higher range. Maximum average amount (322.20 kg/ha) was recorded under canopy of *Butea monosperma* followed by *Tectona grandis* (306.32 kg/ha), *Anogeissus pendula* (303 kg/ha) then in *Bauhinia racemosa* (272.33 kg/ha).

Hazra (1981) [9] found that soils of Bundelkhand region are medium to high in potash. Mannikar (1981) [11] also studied fertility status of Bundelkhand soils and reported that red soils of this region are low to medium high in potash. According to Singh *et al.*, (1983) [15] fertility of forest soils, with respect to potassium, was higher than most of the cultivated areas of Bundelkhand region. Soils of all these forest can be rated as medium to high in available potassium. Depth correlation of soil potassium confirmed decreasing level with increasing soil depth. This is generally caused by the pattern of soil humus distribution on the one hand and leaching effect on the other. Soil nutrient concentration was more in upper layer and decreased down the soil profile (Gupta and Rorison, 1975) [7]. It is likely that more potassium released from the soil for absorption by the root and microbes etc. and due to biochemical activities of upper layer. The decreased soil potassium in lower layer may have been caused by lack of activity, low root demand and low moisture (Gupta *et al.*, 1990) [6].

IID. Organic carbon

The data present in table: 5 showed that the average values of organic carbon content, in soil, showed a wide variation under the canopies of different dominant tree species, varying from 0.47– 1.01 percent. Vertical distribution of organic carbon exhibited that percentage of organic carbon was higher at upper soil and gradually decrease in lower layers of soil. Soil under canopy of *Tectona grandis* contained maximum percentage (1.30 percent) of organic carbon content whereas minimum percentage (0.40 percent) of organic carbon content was found to be under *Bauhinia racemosa*. Soil supporting *Anogeissus pendula* and *Butea monosperma* had average 0.86 and 0.70 percent organic carbon content, respectively. Organic matter has marked effect on physic-chemical and biological properties of soils and on plant nutrition. This wide variation in organic carbon content may be due to amount of litter accumulating at soil surface under these tree species.

Organic carbon content was highest at upper layer and exhibited a decreasing trend with increasing depth. The gradual decrease in organic matter with respect to depth was also observed by Yadav and Sharma (1968) [17], Agarwal and Tripathi (1977) [1] and Gupta *et al.* (1991) [8]. Singh *et al.*, (1983) [15] have studied soil characters of forests of Bundelkhand. They reported that soils supporting *Anogeissus pendula*, *Anogeissus latifolia* and *Tectona grandis* were rich in organic matter while, *Acacia catechu* was found to be on sites having relatively low organic matter.

Table 1: pH and electrical conductivity (EC) of soil under canopies of dominant tree species.

Species	Depth (cm)	Physical Characteristics	
		pH	EC (m mhos/cm)
Anogeissus pendula	0-15	6.0	0.031
	15-30	5.9	0.024
	30-45	6.5	0.029
Bauhinia racemosa	0-15	7.3	0.060
	15-30	7.5	0.047
	30-45	7.4	0.050
Butea monosperma	0-15	6.2	0.051
	15-30	6.2	0.057
	30-45	6.1	0.049
Tectona grandis	0-15	6.0	0.039
	15-30	6.5	0.028
	30-45	6.1	0.034

Table 2: Distribution of available nitrogen (kg/ha) under canopies of dominant tree species.

Species	Depth (Cm)			Average
	0-15	15-30	30-45	
Anogeissus pendula	192.56	180.16	173.61	182.11
Bauhinia racemosa	201.74	172.48	162.34	178.85
Butea monosperma	245.74	210.11	202.97	219.60
Tectona grandis	205.29	190.29	165.29	186.95

Table 3: Distribution of available phosphate (km/ha) under canopies of dominant tree species.

Species	Depth (Cm)			Average
	0-15	15-30	30-45	
Anogeissus pendula	09	7.5	6.0	7.5
Bauhinia racemosa	13.3	11.5	4.5	9.7
Butea monosperma	14.5	12.0	9.0	11.8
Tectona grandis	18	13.5	11.0	14.1

Table 4: Distribution of available potash (K_2O) under canopies of dominant tree species.

Species	Depth (Cm)			Average
	0-15	15-30	30-45	
Anogeissus pendula	315.48	305.28	288.24	303
Bauhinia racemosa	298.80	267.70	250.50	272.33
Butea monosperma	348.90	314.74	302.98	322.20
Tectona grandis	321.12	303.60	294.24	306.32

Table 5: Percentage of organic carbon under canopies of dominant tree species.

Species	Depth (Cm)			Average
	0-15	15-30	30-45	
Anogeissus pendula	0.98	0.87	0.75	0.86
Bauhinia racemosa	0.55	0.46	0.40	0.47
Butea monosperma	0.79	0.70	0.61	0.70
Tectona grandis	1.30	0.95	0.79	1.01

Acknowledgement

The authors express gratitude to Dr. R.K. Agarwal (Retired, Head of Botany department, Bipin Behari College, Jhansi) for his scientific discussions and worthy suggestions.

Reference

1. Agarwal CB, Tripathi BR. Organic carbon and nitrogen status of typical soil profiles of Uttar Pradesh. Food Fmg. & Agric. 1977; 8:1-7.

2. Brady N, Weil R. The nature and properties of soils (13th ed.). Prentice Hall. Upper Saddle River, New Jersey, 2002, 960.
3. Ensminger LE, Pearson RW. Soil nitrogen. Adv. Agron. 1950; 2:81-111.
4. Garbeva P, Van Veen JA, Van Elsas JD. Microbial diversity in soil: selection microbial populations by plant and soil type and implications for disease suppressiveness. Annual review of phytopathology. 2004; 42:243-270.
5. Gaur G. Soil and soil waste pollution and its management. Sarup and Sons, New Delhi, 1997.
6. Gupta MK, Jha MN, Singh RP. Soil chemical properties of silver fir and spruce forests. Indian For. 1990, 901-916.
7. Gupta PL, Rorison IH. Seasonal differences in the availability of nutrients down a podzolic soil profile, J Eco. 1975; 63(2):521-524.
8. Gupta RD, Dev SP, Tripathi BR. Organic carbon and nitrogen status of some north western Himalayan soils as affected by the bio-climate sequence. J Tree Sci. 1991; 10:75-79.
9. Hazra CR. Physical condition of soils of Bundelkhand region-Limitations and potentilities. Indian J. Range Management. 1981; 2(1, 2):17-22.
10. Lemenih M, Itanna F. Soil carbon stocks and turnovers in various vegetation type and arable lands along an elevation gradient in southern ethiopia. Ge-oderma. 2004; 123(1, 2):177-188.
11. Mannikar ND. Soils of Bundelkhan region – problems and prospects. Indian J. Range Mgmt. 1981; 2(1, 2):9-16.
12. Olsen SR, Cole CV, Watanble FS, Deam LN. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. *USDA Circular*: 1954, 9-39.
13. Piper CS. Soil and Plant Analysis. *Hans publication*, Bombay, India, 1966.
14. Roy MM. Productivity of *Hardwickia binata* Roxb. Based silvipastures in Bundelkhand region. *Ph.D. Thesis*, Bundelkhand University, Jhansi, 1996.
15. Singh D, Srivas NC, Mannikar ND. Soil characteristics as influenced by closure of forests of Bundelkhand division and the native vegetation association with it. Indian For. 1983; 109:101-110.
16. Thompson LM, Troeh FR. Soils and soil fertility. Tata McGraw-Hill publishing Co. Ltd., New Delhi, 1985, 516.
17. Yadav JSP, Sharma DR. A soil investigation with reference to distribution of sal and teak in Madhya Pradesh. Indian For. 1968; 94:897-902.