Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 18 (1) : 15-18 (January-2023), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Soil Profile Study in Plantation of *Bambusa vulgaris* in Khurda District of Odisha

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Abstract

The soil profile under Bamboo (*Bambusa vulgaris*) were studied for the physical, chemical characters and nutrient status in OUAT, Bhubaneswar. Soil samples were collected from 0-15, 15-30, 30-45, 45-60, and 60-75cm depths of the soil profile under bamboo plantation. Soil samples were air-dried, ground, passed through 2mm sieves and analysed. Soil texture at different layers of the profiles varied from sand to sandy loam. Sand content gradually decreased from surface layer (90.0%) to lowest at the bottom layer (84.8%). Silt and clay content increased with the depth of soil profile which ranged from 4.6 to 6.8% and 5.4 to 8.4% respectively. Bulk density and particle density varied from 1.50 to 1.6g/cm3 and little variation in particle density which remained around (2.66g/cm^3) with the depth of the soil profile. Pore space (%) decreased from 42.97% at 0-15cm to 39.85% at 60-75cm whereas water holding capacity gradually reduced with depth of the soil profile. The pH of the soil varied from 5.09 to 5.20 down the profile which was strongly acidic. at different layers of the profiles were strongly acidic. Electrical conductivity of the soils varied from 0.420 to 0.426 dS/m. Percentage organic carbon, mineralizable N, available P and K in different layers of the profile were low in the studied site. Attention should be given to the area to restore its physical, chemical properties as well as nutrient status to restore the vitality of the soil for better growth.

Key words : *Physical properties, chemical properties, nutrient status, bamboo plantation.*

Introduction

Soil plays a significant role in the ecosystem by providing nutrient for plant growth. promoting plant growth and production. Soil provides required nutrient to the plants which are added to the soil by decomposition of leaf litter and mineral recycling. The physico-chemical properties is required to determines the productive capacity of soil for growth of vegetation upon it. (1) reported growing attention is given on soil physico- chemical properties in the assessment of management practices, consequences on the quality of soil, sustainability of forest ecosystem functions and plant production system. These physio-chemical properties are related to soil fertility and soil productivity including, soil bulk density (BD), porosity, total nitrogen (TN), total phosphorus (TP) and total potassium (TK), available phosphorus (AP), and available potassium (AK), exchangeable cations capacity (CEC), electric conductivity (EC), soil pH, and organic carbon contents (SOC), (2).

Vegetation help in the soil formation process i.e. plant biomass (above and below ground), the main sources of soil organic matter, which influence soil physico-chemical properties such as pH, texture, bulk density and nutrient availability. The physical, chemical properties and nutrient contents in the forest soil profiles depend upon accumulation of leaf litter, removal of nutrients by the tree species up to a greater soil depth and mobilization of the nutrients from lower to the upper parts of the profile through leaf fall. Therefore, understanding the relationship between forest vegetation and soil nutrient dynamics is crucial for effective soil management (3). The soil is usually affected by the land management practices such as cultivation, harvesting, plantation, and deforestation (3). The effect of these management activities, changes in soil physico-chemical properties, and their stoichiometries require detailed investigation (4).

The organic matter content in the soil determines the pore space and water holding capacity of the soil by improving the infiltration of rain water and soil aeration. Thus it helps in enhancing the physical character of the soil. organic acids are released during decomposition which affects the chemical properties of the soil. Vertical distribution of nutrients of soil profiles is also influenced by nutrient cycling in plantation. Plants draws nutrient from deeper deeper layer and recycles on the surface layer through leaf fall. (5) reported that considerable amounts of nutrients are returned to the surface layer through leaf fall and total nutrient contents were higher in 0-15cm depth than those in 30-60cm depth in blue gum and black wattle plantation areas of Nilgiri (South India) after twelve years of recycling.

The total geographical area of Odisha is 155.71m.ha.of which 58.13m.ha. is occupied by forests. Information on the soil characteristics of the forest areas in Odisha is meagre. Bamboo occupies most part of the forests of Odisha. Nowadays, bamboo cultivation is promoted by the government through National bamboo

Received : October-2022; Revised : October-2022; Accepted : November-2022

mission. *Bambusa vulgaris* is one of the commercially important species cultivated by the farmers. Standardisation of cultural practices and nutrient management will be helpful in understanding the growth potential of *Bambusa vulagaris* as pure crop and/or in combination with crops in farmer's field. The present investigation has been undertaken to study the physical and chemical properties and nutrient status of soil profiles under *Bambusa vulgaris* plantation. This study will be helpful for soil and nutrient management in areas under Bamboo plantation as well as about scope of growing intercrops under it.

Materials and Methods

The soil profile was selected in the Bamboo plantation area at Ghatikia, Bhubaneswar. This was a twenty year old Bamboo plantation where plants are planted at a spacing of 6mx6m. The soil profiles were dug and soil samples were collected from 0-15, 15-30, 30-45, 45-60 and 60-75cm depths. Soil samples were air-dried, ground and passed through a 2 mm sieve .The sieved samples were preserved in polythene bottles for necessary laboratory analysis. Mechanical composition of soil was determined by Bouyoucos hydrometer method (6). Bulk density, particle density and % pore space in soil was determined by cylinder method. Water holding capacity of soil was determined by Keen Raczkowski box measurement. Soil pH was determined in 1:2.soil water ratio by a glass electrode Elico pH meter. Electrical Conductivity was measured in 1:2. soil water ratio. The contents were stirred several times during a period of 2 hours and was allowed to stand till soil particles completely settle down. The supernatant was filtered and the conductivity of the filtrate was measured by an Elico conductivity Bridge. Organic Carbon in the soils was determined by (7) method of heating by dilution of H_2SO_4. Mineralizable nitrogen in soil was determined by alkaline KMnO4 method (8). Available phosphorus in the extract was determined by Chlorostannus reduced molybdo-phosphoric blue colour method in hydrochloric acid system (9). Intensity of blue colour was measured at 660 nm wave length by an UV-VIS spectrophotometer. Available Potassium in the soils was determined in the neutral NNH4OAc extract of soil by a Flame photometer.

Results and Discussion

Important physical and chemical properties as well as the nutrient contents in forest soil profiles in the *Bambusa vulgaris* plantation area at Ghatikia, Bhubaneswar were studied. Perusal of the data in Table-1 showed that soil texture in the 1st layer of the profile was sand and the other layers were loamy sand. Sand content decreased from 90% in the 1st layer to 84.8% in the 5th layer. Silt content varied from 4.6% in the surface layer to 6.8% in the last layer. Clay content in the surface layer of profile was 5.4% with a slight increase to 8.4% in the 5th layer. Clay content in the profile increased slightly with depth indicating that the profile is yet to be matured. Increase in clay content with depth was due to migration of the dispersed clay particles from surface down the profile. Bulk density in the 1st and 5th layer of the profile varied from 1.5 to 1.6g/cm^3. There was gradual increase in the bulk density of the soils with increase in depth of the soil layers in the profile . Particle density of the soil profile was around 2.66gm/cm3. Particle density of the soils was 2.66 g/cm^3 in the profile indicating the dominance of quartz, feldspar, mica and the silicate clays in the mineral fraction of soil. Percent pore space decreased from 1st (42.97%) to 5th layers (39.85%) of the profile. There was small variation in percent pore space in soil in the profile which might be due to small variation in sand and clay contents in the profile. Water holding capacity of the soils in profile varied from 25.2 to 30.4% from surface layer to bottom layer (Table-1). The small variation in water holding capacity of the soils in the profile might be due to low organic carbon content and a narrow difference in sand and clay contents at different layers of the profile. (10) reported the difference in water holding capacity might be due to variation in clay and organic carbon content.

Soil pH in the profile varied from 5.09 to 5.20 (Table-2). It was 5.09 in the surface layer and 5.20 in the 5th layer. The soils was strongly acidic throughout the profile. The soil needs liming for growing different plant species in the interspaces of bamboo plantation. The increase in soil reaction values down the soil profile are in conformity with the findings of (11). Electrical conductivity varied from 0.420 to 0.426 dS/m from surface to bottom layer with gradual increase from surface to bottom layer. Electrical conductivity in different layers was very low in the profile indicating that the soils were almost free of soluble salts. Organic carbon content in the profile varied from 0.19 to 0.54%. It was highest of in the surface layer and decreased gradually with soil depth to the lowest of 0.19 % in the 5thlayer. Organic matter content was low in different layers of the profile in spite of continuous accumulation of leaves. This might be due to rapid decomposition of organic matter because of intense microbial activities due to light texture soils with improved soil aeration. Similar results have also been reported by (12, 13, 14).

Mineralizable N content in the soil profile varied from 61.3 to 93.8 mg/kg (Table-3). It was 93.8 mg/kg in the surface layer and gradually decreased with the soil depth to 61.3 mg/kg in the 5th layer. Mineralizable N content in the soils were low which might be due to low protein fraction in the soil organic matter. Nitrogen being a mobile

Table-1 : Physical properties of the soils in different layers of the soil profile in the Bamboo plantation.

Sl. No.	Layers (cm)	% sand (%)	% silt (%)	% clay (%)	BD (gm/c)	PD (gm/c)	PS (%)	WHC (% W/w)
1.	0-15	90±.94	4.6±.14	5.4±.57	1.50±.57	2.63±.05	42.97±.47	25.2±.94
2.	15-30	88.0±.47	5.6±.19	6.4±.14	1.51±.11	2.63±.01	42.59±.52	25.9±.61
3.	30-45	86.8±.94	6.4±.47	6.8±.94	1.53±.09	2.64±.13	42.05±.52	27.6±.14
4.	45-60	85.4±.28	6.8±.14	7.8±.47	1.58±.14	2.65±.05	40.38±.47	29.6±.61
5.	60-75	84.8±.47	6.8±.47	8.4±.61	1.60±.19	2.66±.05	39.85±.52	30.4±.75

Table-2 : Chemical properties of the soils in different layers of soil profile in the Bamboo plantation.

Layers	Depth (cm)	pH (1:2)	EC (dS/m)	OC %
1st	0-15	5.09±.19	0.420±.08	0.45±.12
2nd	15-30	5.10±.36	0.422±.06	0.41±.11
3rd	30-45	5.11±.47	0.423±.07	0.35±.05
4th	45-60	5.13±.24	0.425±.10	0.30±.07
5th	60-75	5.20±.37	0.426±.13	0.28±.11

Table-3 : MineralizableN, available P, and available K content in different layers of the profile in the Bamboo plantation.

Layers	Depth (cm)	Mineralizable N (mg/Kg)	Available P (mg/kg)	Available K (mg/kg)
1st	0-15	93.8±.19	2.82±.57	18.1±.33
2nd	15-30	87.5±.24	2.54±.11	16.1±.52
3rd	30-45	81.3±.14	1.69±.09	14.8±.28
4th	45-60	73.8±.28	1.41±.14	13.4±.28
5th	60-75	61.3±.24	1.34±.10	10.5±.24

element is also less returned to soil through leaf fall. (14, 15) reported that the availability of nitrogen in soil decreased with successive increase in soil depth from 0-15 cm, 15-30 cm and 30-45 cm under canopy of different tree species like *Populus deltoides*, *Anthocephalus cadamba* and *Madhuca indica.* Available P content in the profile varied from 1.34 mg/kg to 2.82 mg/kg. It was 2.82 mg/kg in the surface layer and decreased gradually with soil depth to 1.34 mg/kg in the 5th layer. Available P content in the soils were very low. Phosphorous being a mobile element is less returned to soil through leaf fall than absorbed by the tree from soil. Available K at different layers in profile varied from 10.5 to 18.1 mg/kg. It was 16.1mg/kg in the surface layer and decreased with soil depth to 10.5 mg/kg in the 5th layer. Available K content in the soil was very low which might be due to greater absorption of K by the trees and less return to the soil through leaf fall since K is a mobile element. Besides, the leaching loss of K is high since the soils were sand to sandy loam in texture.

It could be concluded that soil profile under Bamboo plantation was low in percentage organic carbon, mineralizable N, available P and K content. Attention should be given to the area to restore its physical, chemical properties as well as nutrient status to replenish the vitality of the soil for better growth of existing plantation and intercrops under its canopy.

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