Comparative Soil Physical Analysis of Nagal Hatnala Region Dehradun, Uttarakhand

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ABSTRACT Presence of plant elements in soil would give good information towards the knowledge of nutrient cycling and bio-chemical cycle in the soil–plant ecosystem. Present study has been conducted in three (03) land forms namely Forest area, Orchard, open land Dehradun district of Uttarakhand, India. Present study shows maximum sand percentage (54.66%) in open land area while minimum percentage (39.27%) in orchards. Maximum and minimum silt percentage recorded from forest area (39.27%) and open land area (32.80%) respectively likewise orchards area and forest shows maximum and minimum clay percentage i.e. 22.37% and 9.72% respectively. Forest area and orchards shows maximum and minimum bulk density i.e. 1.20g/cm^3 and 0.97 g/cm^3 respectively. Maximum and minimum water holding capacity was recorded at orchards (18.29%) and open land area (8.18%) respectively. Orchards shows maximum porosity (63.04%), pH (6.8) while maximum moisture content was recorded (16.28%) at forest area. As per above observation this can be estimated that forest area and orchards having better soil physical properties as compare to open land, it is due to over constriction and deforestation around open land area.

Keywords: Soil, Orchards, Forest area, open land, conservation.

INTRODUCTION Soil is defined as, an independent body in nature with a unique morphology from the surface down to the parent material as expressed by the sample profiles (Tan; 1995), which has been derived from the Latin word "Solum". The study of soil is known as the 'Pedology' (pedos means earth) or 'Edaphology' (edaphos means soil). Soil may also be defined as the part of the earth crust in which humus is present (Shukla and Chandel; 1991). Soil can also be defined as "A dynamic natural body on the surface of earth, in which plants grow composed of materials and organic materials and living forms."

Presence of plant elements in soil would give good information towards the knowledge of nutrient cycling and bio-chemical cycle in the soil–plant ecosystem (Pandit and Thampan 1988, Binkley and Giardina 1998). Moreover, different tree species can differ significantly in their influence on soil properties as well as soil fertility (Augusto *et al.,* 2002). The forest of Garhwal region of central Himalaya has vast variations in the climate, topography, and soil conditions, which form a very complex ecosystem. Since, the vegetation zones in the Garhwal region clearly reflect edaphic and climatic variations (Bhatt and Purohit 2009) and at the same time the knowledge of physical and chemical properties of soils and climatic conditions of different forest types of temperate region of Garhwal and Kumaun region of central Himalaya is meagre (Upreti *et al.*,2016, Upreti *et al.*,2017, Upreti, 2018Upreti et al 2019 a,b,c). Therefore, to study adequate theoretical and practical knowledge of climatic, various forest soils, and the complex relationship between the lives of various plants of the forest is necessary to study.

MATERIAL AND METHODS

Selection of site: Present study has been conducted in three (03) land forms namely Forest area, Orchard, Open land Dehradun district of Uttarakhand, India.

Physical Examination: Samples collected from four different depths viz., (i) upper (0–10 cm), (ii) middle (11–20 cm) and (iii) lower middle (21–30 cm) for assessing the physical properties of the soil in all the selected areas. All the samples were brought separately to the laboratory in polythene bags for the analysis of physical properties.

Soil moisture: Generally soil moisture is the water that is held in the spaces between soil particles. (Bouyoucos, 1921).

$$\text{Moisture content (\%)} = \frac{\text{Fresh weight of the soil- Dry weight of the soil}}{\text{Dry weight of the soil}} \times 100$$

Soil bulk density: Bulk density of soil is usually determined from a core sample, which is taken by driving a metal corer into the soil at the desired depth and horizon. This gives a soil sample of known total volume. Soil bulk density was calculated by following formula(Black, 1965):

$$\text{Bulk density} = \frac{\text{Mass (g)}}{\text{Volume (cm}^3\text{)}}$$

Soil porosity: The porosity of soil or geologic materials is the ratio of the volume of pore space in a unit of material to the total volume of material. Soil porosity was calculated by following formula(Gupta and Dhakshinamoorthy, 1980):

$$\text{Porosity (\%)} = \frac{\text{Bulk density}}{\text{Particle density (2.65)}} \times 100$$

Soil water holding capacity: The plant available moisture storage capacity of a soil provides a buffer, which determines a plant's capacity to withstand dry spells. Water is held in soil in various ways and not all of it is available. WHC determined by the following formula (Piper, 1950):

$$\text{WHC (\%)} = \frac{W_2 - W_3 - W_4}{W_3 - W_1} \times 100$$

Where,

W_1 =weight of sieve + filter paper
W_2 = weight of sieve + filter paper + wet soil
W_3 = weight of sieve + filter paper + oven dried soil
W_4 = water absorbed by filter paper

Statistical Analysis: The value for each sample was calculated as the Mean, SE, SD. were tested on mean values by one way ANOVA; using SPSS 22.

RESULT AND DISCUSSION

Forest Area

Soil texture: Results shows maximum sand percentage (51.01%) at the depth of 0-10 cm and minimum (39.81%) at the depth of 21-30 cm. Maximum silt percentage (39.27 %) at the depth of 0-10 cm and minimum (35.22%) at the depth of 11-20 cm while maximum clay (21.84%) at the depth 0f 21-30 cm and minimum (9.72%) at the depth of 0-10 cm was recorded.

Bulk Density: Results shows maximum bulk density (1.20g/cm^3) at the depth of 21-30 cm while minimum (1.04 g/cm^3) at the depth of 0-10 cm was recorded.

Water holding capacity: Results shows maximum water holding capacity (16.72%) at the depth of 21-30 cm depth while minimum (11.81%) recorded at the depth of 0-10 cm.

Porosity: Results shows maximum porosity (60.76%) at the depth of 0-10 cm while minimum (54.75) at the depth of 21-30cm.

Moisture content: Maximum soil moisture content (16.28 %) at the depth of 21-30cm and minimum (8.70%) at the depth of 0-10cm.

Orchard

Soil Texture: Result shows maximum sand at the depth of (0-10 cm) i.e. (52.96%) and minimum at the depth of 11-20 (39.27%), maximum silt percentage at the depth of (21-30 cm) i.e. (38.38%) and minimum at the depth of 11-20 (38.36%) and maximum clay percentage at the depth of (11-20 cm) i.e. (22.37%) and minimum at the depth of 0-10 cm(12.17%) was recorded.

Bulk Density: Result shows maximum bulk density percentage at the depth of (21-30 cm) i.e. (1.10g/cm^3) and minimum at the depth of 0-10cm (0.97 g/cm^3).

Water Holding Capacity: Result shows maximum water holding capacity at the depth of (21-30 cm) i.e. (18.29%) and minimum at the depth of 0-10 cm (13.0%)

Porosity: Maximum porosity percentage at the depth of (0-10 cm) i.e. (63.04 %) and minimum at the depth of 21-30 cm (56.29%) was recorded.

Moisture Content: Result shows maximum moisture content percentage at the depth of (21-30 cm) i.e. (13.97%) and minimum at the depth of 0-10 cm (6.68%).

Open Land

Soil Texture: Result shows maximum sand percentage at the depth of (0-10 cm) i.e. (54.66%) and minimum at the depth of 11-20 cm (40.65%)**,** maximum silt percentage at the depth of (11-20 cm) i.e. (37.85%) and minimum at the depth of 0-10cm (32.80%) and maximum clay percentage at the depth of (11-20 cm) i.e.(21.50%) and minimum at the depth of 0-10 cm (12.54%).

Bulk Density: Result shows maximum bulk density at the depth of (21-3- cm) i.e. (1.09g/cm^3) and minimum at the depth of 0-10 cm (1.02g/cm^3).

Water Holding Capacity: Result shows maximum water holding capacity at the depth of (0-10 cm) i.e. (10.44 %) and minimum at the depth of 21-30cm (8.18%).

Porosity: Result shows the maximum porosity at the depth of (0-10 cm) i.e. (61.60%) and minimum the depth of 21-3- cm (59.04%).

Moisture Content: Result shows maximum moisture content at the depth of (21-30 cm) i.e. (14.21%) and minimum at the depth of 0-10 cm (4.17%) (Table1. Fig.3).

CONCLUSION

Present study shows maximum sand percentage (54.66%) at 0-10 cm depth in open land area while minimum percentage (39.27%) at 11 – 20 cm depth in orchards. Maximum and minimum silt percentage recorded from forest area (39.27% at 0 -10 cm depth) and open land area (32.80%, 0-10cm depth) respectively likewise orchards area and forest shows maximum and minimum clay percentage i.e. 22.37% (11-20cm depth) and 9.72% (0-10cm depth) respectively.

Forest area and orchards shows maximum and minimum bulk density i.e. 1.20g/cm^3 (21-30cm depth) and 0.97 g/cm^3 (0-10cm depth) respectively. Maximum and minimum water holding capacity was recorded at orchards (18.29%, 21-30cm depth) and open land area (8.18%, 21-30cm depth) respectively. Orchards shows maximum porosity (63.04%, 0-10cm dpth), pH (6.8, 21-30cm depth) while maximum moisture content was recorded (16.28%, 21-30cm depth) at forest area. As per above observation this can be estimated that forest area and orchards having better soil physical properties as compare to open land, it is due to over constriction and deforestation around open land area.

Table 1: Comparative Soil Physical Properties of different land forms, Nagal, Dehradun.

BD = Bulk Density, WHC = Water Holding Capacity

Depth (cm.)	Sand	Silt	Clay	BD	WHC	Porosity	Moisture content	pH
Forest area								
0-10	51.01±0.53 ^{e}	39.27±0.48 ^{d}	9.72±0.57 ^{a}	1.04±0.04 ^{bc}	11.81±0.53 ^{d}	60.76±0.17 ^{e}	8.70±0.32 ^{c}	5.4±0.31^{a}
11-20	43.72±0.57 ^{d}	35.22±0.27 ^{b}	21.05±0.19 ^{c}	1.11±0.03 ^{d}	14.75±0.13 ^{f}	58.16±0.21 ^{c}	13.64±0.23 ^{e}	5.9±0.24^{ab}
21-30	39.81±0.19 ^{ab}	38.35±0.25 ^{cd}	21.84±0.47 ^{cd}	1.20±0.01 ^{e}	16.72±0.26 ^{g}	54.75±0.32 ^{a}	16.28±0.21 ^{f}	6.4±0.22^{c}
Orchards								
0-10	52.96±0.42 ^{f}	34.87±0.45 ^{b}	12.17±0.23 ^{b}	0.97±0.02 ^{a}	13.00±0.11 ^{e}	63.04±0.26 ^{g}	6.68±0.25 ^{b}	6.2±0.18^{a}
11-20	39.27±0.24 ^{a}	38.36±0.10 ^{cd}	22.37±0.26 ^{d}	1.02±0.02 ^{ab}	15.42±0.22 ^{f}	60.16±0.16 ^{e}	11.98±0.47 ^{d}	6.4±0.42^{b}
21-30	39.90±0.66 ^{ab}	38.38±0.24 ^{cd}	21.72±0.33 ^{cd}	1.10±0.02 ^{cd}	18.29±0.16 ^{h}	56.29±0.27 ^{b}	13.97±0.21 ^{e}	6.6±0.31^{b}
Open land								
0-10	54.66±0.21 ^{g}	32.80±0.55 ^{a}	12.54±0.14 ^{b}	1.02±0.02 ^{ab}	10.44±0.34 ^{c}	61.60±0.19 ^{f}	4.17±0.20 ^{a}	5.9±0.51^{a}
11-20	40.65±0.05 ^{bc}	37.85±0.33 ^{c}	21.50±0.33 ^{cd}	1.05±0.01 ^{bcd}	9.23±0.49 ^{b}	60.50±0.21 ^{e}	8.15±0.35 ^{c}	6.5±0.24^{b}
21-30	41.76±0.31 ^{c}	37.36±0.17 ^{c}	20.88±0.38 ^{c}	1.09±0.01 ^{cd}	8.18±0.41 ^{a}	59.04±0.25 ^{d}	14.21±0.62 ^{e}	6.2±0.26^{c}

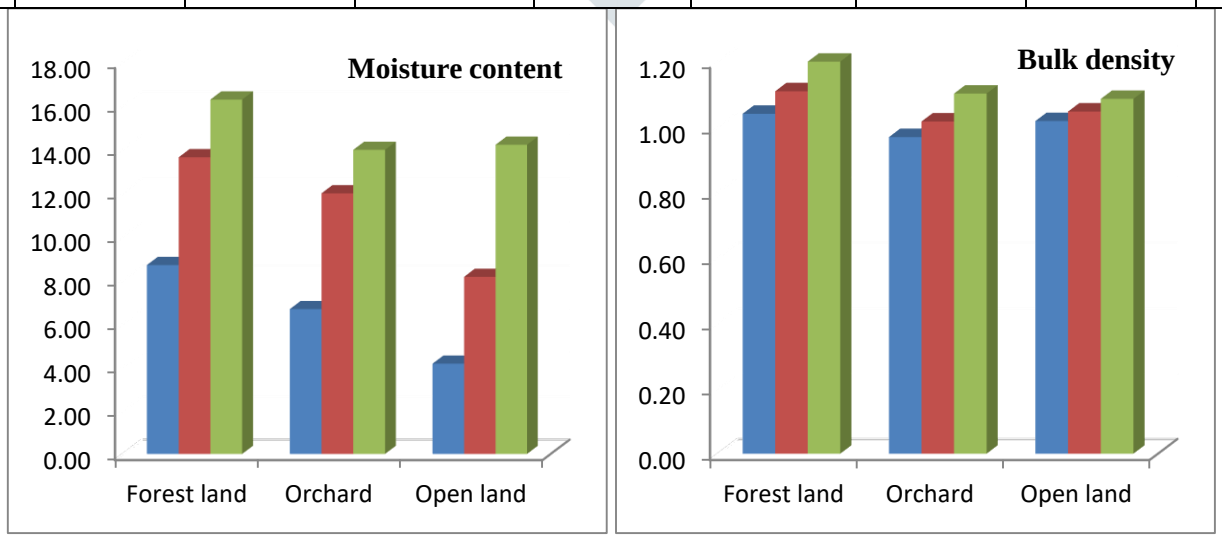

Fig 3: Soil moisture content and Bulk density in selected area Nagal Hatnala, Dehradun

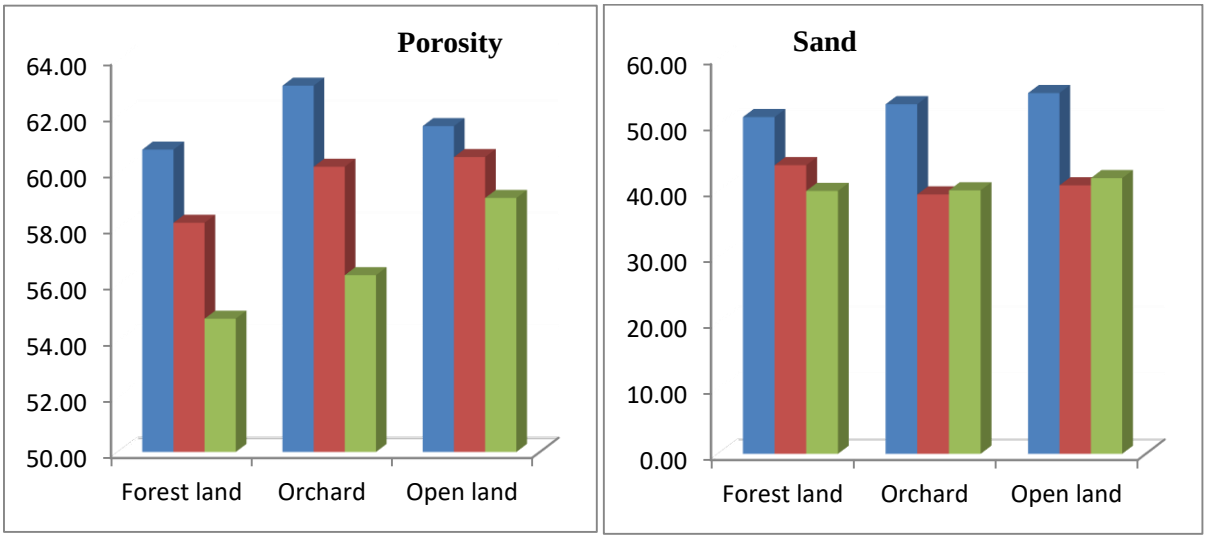

Fig 4: Soil Porosity and sand percentafe percentage in selected area Nagal Hatnala, Dehradun

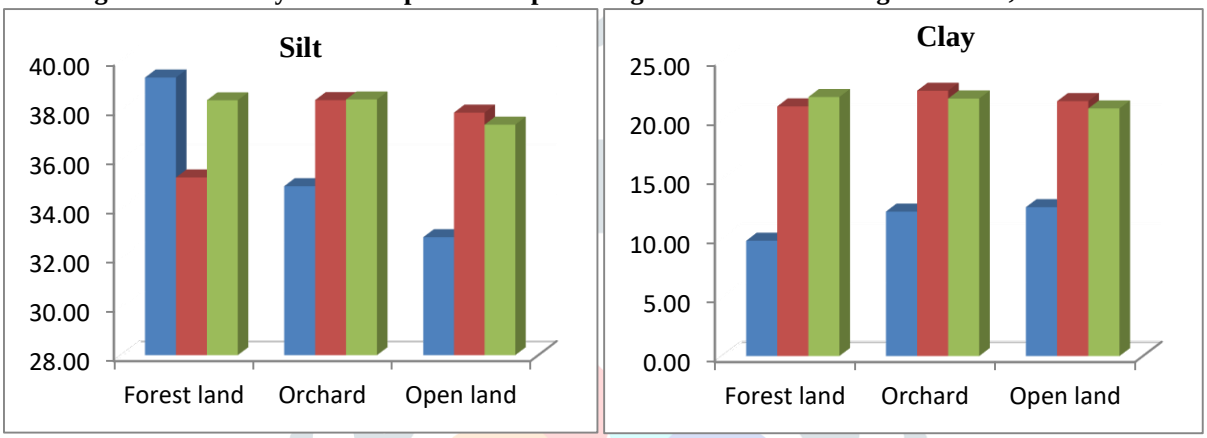

Fig 5: Soil silt and clay percentage in selected area Nagal Hatnala, Dehradun

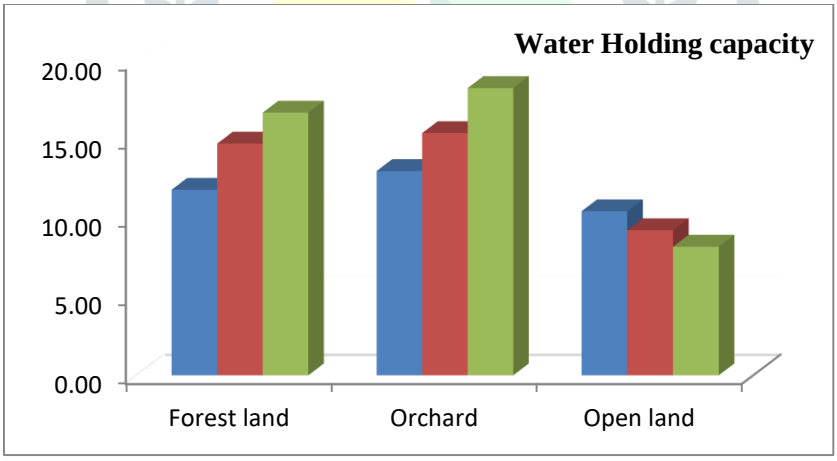

Fig 6: Soil water holding capacity in selected area Nagal Hatnala, Dehradun

0-10cm

11-20cm

21-30cm

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