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Effects of Different Land Use Classes on Some Selected Physico-chemical Properties of Soil of District Ganderbal

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A B S T R A C T

The present experiment was conducted to study the effects of different land use classes on some selected physico-chemical properties of soil. Surface (0-20 cm) and Sub-surface (20-40cm) soil samples were collected from forest, agriculture and horticulture soils. The processed soil samples were used for laboratory studies i.e. texture, pH, EC, organic carbon, calcium carbonate and cation exchange capacity. The soils of District Ganderbal under different land use systems showed textural variation i.e., silt loam to silty clay loam in forest and horticulture soils while it showed silty clay loam to clay loam in agricultural soils.The forest, agricultural and horticulture land uses showed a pH of 6.7, 7.34 and 7.14 and 6.9, 7.34 and 7.34 in surface and sub-surface soils respectively. The EC of surface soils and sub-surface soils ranged between 0.16, 0.23 and 0.21dSm^{-1} and 0.23, 0.25 and 0.24 dSm^{-1} in forest, agricultural and horticultural soils respectively. The organic carbon content in surface soils and sub-surface varied from 1.80, 1.09 and 1.10 and 1.5, 0.67, 1.00 per cent in forest, agricultural and horticultural soils respectively. The calcium carbonate content in surface soils and sub-surface soils varied from 0.15, 0.57 and 0.61 and 0.19, 0.67 and 0.66 per cent in forest, agricultural and Horticultural soils respectively. The cation exchange capacity under selected land uses varied from 15.48, 15.64 and 15.11C mol$_c$kg^{-1} and in sub-surface soils from 15.99, 16.33 and 16.15C mol$_c$ kg^{-1} in forest, agriculture and horticulture respectively.

Keywords

Soil, Texture, Land use, Surface, Sub-surfaces

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Introduction

Soil is key to sustaining life, affecting air and water quality, the growth of plants and crops, and the health of the entire planet. Soil is the dynamic link between the biosphere and lithosphere and constitutes a practically non-renewable (very low rate of formation) natural resource, with a key role for the environment and for the agriculture (Moraetis *et al.*, 2016). Soil is a complex matter and comprises minerals, soil organic matter, water, and air. These fractions greatly influence soil texture, structure, and porosity. These properties subsequently affect air and water movement in the soil layers, and thus the soil's ability to function. Therefore, soil physicochemical properties have a great influence on the soil quality. The physical quality of the soil, which creates suitable environment for the availability and uptake of the plant nutrients, is generally ignored (Rasool *et al.,* 2008). Soil texture especially can have a profound effect on many other properties. Thus, soil texture is considered one of the most important physical properties of soil. The balance between cation and anion uptake by the plant affects the pH in the rhizosphere. The rhizosphere pH can change with the form and concentration of fertilizer, and the extent of the pH change around the root depends on the buffer capacity of the soil. Cation exchange capacity (CEC) of the soil is an important consideration in determining the amount and frequency of cations that need to be by the plant. In most agricultural soils and irrigation water, Ca and Mg are present in larger quantities than those taken up by any crop, and their supply is usually satisfied with water mass flow. Soil organic matter (SOM) strongly influences the crop growth and productivity by providing nutrients and modifying soil quality indices such as decreasing soil compaction, stabilizing soil structure due to increased soil aggregation, and controlling soil erosion (Ding *et al.*, 2012). This paper pays attention to the physical and chemical properties of soil due to their importance in plant growth and soil stability.

Materials and Methods

Surface soil samples (0-20cm) and sub-surface soil samples (20-40 cm) were collected from different land uses of district Ganderbal and from each land use a total of five soil samples were collected. The co-ordinates of the sites were recorded using GPS receiver (Garmin Oregon 650).The soil samples were air dried in shade, grounded with wooden mallet and passed through a 2mm sieve. For organic carbon determination, the soil was passed through 0.2 mm sieve. The processed soil samples were analyzed for physico-chemical and mechanical properties.

The pH of the soil was measured in 1:2.5 soil water suspension with the help of Digital Glass electrode pH meter by Jackson (1973). The electrical conductivity of the soil water extract (1:2.5) was read with the help of Conductivity meter by Jackson (1973). Organic carbon was determined by wet oxidation method given by Piper (1996). The mechanical analysis of the soil sample was done by following the International Pipette method as described by Piper (1966). Cation Exchange capacity of the soil was determined according to the procedure outlined by Rhoades (1982). Calcium carbonate was determined by the method given by Puri (1930).

Results and Discussion

The texture of the soils of district Ganderbal varied from silty loam to silty clay loam (Table 1). Surface soils of forest in the district Ganderbal had predominantly silt texture. Higher concentration of Silt in the surface soils of forests was obviously due to the impact of precipitation, snow melt and temperature on these soils that might have resulted in soil erosion and loss of humus. The results are corroborated by the findings of Yu yang *et al.,* (2017) who also reported higher silt in surface soils of forests.

Depth wise distribution of soil separates in different land uses revealed that the sand content was more noticeable at upper depth while as silt and clay were more concentrated at lower depths. This might be accredited to illuviation and translocation of clay to sub-surface layers. These results are in agreement with the findings of Bashir *et al.,* (2016) and Harsha and Jagadeesh (2017). Variation in the particle size distribution in horticulture soils might be due to land use pattern as orchards generally contained more fine soil particles (silt and clay) as demonstrated by Yusong *et al.,* (2017). These soils are relatively high in K due to the dominance of K bearing and associated minerals in clay and silt fractions. The results are corroborated by the findings of Srinivasarao *et al.,* (2013).

These soils were found to possess medium to moderately fine texture. Similar observations were also reported by Bangroo *et al.,* (2010). Mahapatra *et al.,* (2000) observed that the altitude and relief play a significant role in soil properties while working with Kashmir valley soils.

Table.1 Soil textural classes for different land uses

Land use	sample	depth	course sand	Sand	Silt	clay	textural class
Forest	S1	0-20	1.97	24.25	50.45	22.88	silt loam
		20-40	1.81	25.64	50.98	24.37	silt loam
	S2	0-20	2.12	22.6	48.24	24.86	silt loam
		20-40	1.82	22.95	51.48	27	silt loam
	S3	0-20	1	18.32	40.2	38.4	silty clay loam
		20-40	0.99	20.83	41.83	38.35	silty clay loam
	S4	0-20	1.42	18.2	40.33	39.92	silty clay loam
		20-40	1.32	18.48	40.81	40.99	silty clay loam
	S5	0-20	1.6	22.5	52.27	23.23	silt loam
		20-40	1.54	22.9	52.95	23.81	silt loam
Agriculture	S6	0-20	0.9	39.1	27.8	32.2	clay loam
		20-40	1.4	40.47	28.7	32.43	clay loam
	S7	0-20	1.1	37.24	40.23	19.67	loamy
		20-40	1.04	38.94	41.43	23.59	loamy
	S8	0-20	0.92	26.18	48.69	22.61	clay loam
		20-40	0.9	26.56	50.33	24.41	clay loam
	S9	0-20	1	37.9	27.7	32.4	clay loam
		20-40	0.99	39.19	29.7	33.12	clay loam
	S10	0-20	2	43.12	32.13	21.45	loamy
		20-40	1.99	43.84	32.99	21.42	loamy
Horticulture	S11	0-20	1.34	34.58	38.21	25.89	loamy
		20-40	0.99	35.12	40.8	26.09	loamy
	S12	0-20	1.93	24.51	49.8	22.76	silt loam
		20-40	1.48	25.82	51.04	24.66	silt loam
	S13	0-20	1.79	23.94	52.23	22.04	silt loam
		20-40	1.6	24.8	54.2	22.4	silt loam
	S14	0-20	1.04	38.49	29.02	31.45	clay loam
		20-40	1.03	39.32	30.8	32.85	clay loam
	S15	0-20	1	38.1	27.7	31.2	clay loam
		20-40	0.99	39.23	29.7	33.08	clay loam

Table.2 Physico-chemical properties of soils of District Ganderbal under land uses

Land use	sample	depth	pH	EC (dSm-1)	OC (%)	CaCo3 (%)	CEC
Forest	S1	0-20	7.24	0.15	1.86	0.85	17.4
		20-40	7.17	0.17	1.5	0.97	17.8
	S2	0-20	8.29	0.12	1.26	1.18	16.98
		20-40	8.17	0.14	1.09	1.49	17.85
	S3	0-20	6.81	0.15	2.01	1.05	17.82
		20-40	7.2	0.17	1.96	1.58	18.1
	S4	0-20	7.56	0.1	1.98	0.88	17.1
		20-40	7.3	0.12	1.86	0.9	17.9
	S5	0-20	7.82	0.09	1.9	0.79	16.8
		20-40	7.55	0.1	1.5	0.92	17.32
Agriculture	S6	0-20	7.41	0.23	0.63	0.4	15.5
		20-40	7.38	0.25	0.79	0.52	15.8
	S7	0-20	7.79	0.25	0.8	0.16	15.85
		20-40	7.27	0.26	0.54	0.19	16.68
	S8	0-20	7.26	0.28	0.76	0.17	16.23
		20-40	7.03	0.29	0.52	0.18	16.8
	S9	0-20	5.92	0.24	0.76	0.16	15.43
		20-40	6.54	0.25	0.52	0.2	15.65
	S10	0-20	8.83	0.21	0.63	0.19	16
		20-40	8.19	0.22	0.52	0.22	16.52
Horticulture	S11	0-20	7	0.15	1.14	0.16	13.47
		20-40	7.14	0.18	1.08	0.17	14.26
	S12	0-20	7.13	0.25	1.16	0.18	13.2
		20-40	7.24	0.27	1	0.2	14.83
	S13	0-20	6.6	0.21	1.27	0.2	14.38
		20-40	6.63	0.23	1.18	0.22	14.88
	S14	0-20	7.2	0.25	1.07	0.21	14.36
		20-40	7.28	0.28	0.98	0.24	14.82
	S15	0-20	7.36	0.22	0.88	0.22	13.18
		20-40	7.45	0.24	0.59	0.24	13.96

Soil reaction

The pH in the surface soils ranged from 6.17 to 7.30 in forest, 6.97 to 7.67 in Agriculture and 6.63 to 7.45 in Horticultural soils with mean value of 6.7, 7.34 and 7.14 respectively. Whereas in surface soils, the pH varied from 6.59 to 7.56, 6.97 to 7.67 and 7.14 to 7.63 with a mean value of 6.9, 7.34 to 7.34 in Forest, Agricultural and Horticultural soils respectively (Table 2). The soils were slightly acidic to neutral in reaction which may be due to high rainfall which results in leaching of salts from upper layers and higher organic matter content, which reduces pH by releasing organic acids. Excess leaching of bases from the soil profile due to heavy rainfall might be caused acidity in these soils (Sharma and

Singh, 2002). The variation may also be attributed to the amount of clay and organic matter in the soil. These results are in agreement with the findings of Bashir *et al.,* (2016).

Electrical conductivity (dSm^{-1})

Soil electrical conductivity (EC) is a measure of the amount of salts in soil. It is an excellent indicator of nutrient availability and loss, soil texture, and available water capacity. It affects crop yields, the suitability of the soil for certain crops, the amount of water and nutrients available for plant use, and the activity of soil micro-organisms, which influences key soil processes such as the emission of greenhouse gases, including nitrogen oxides, methane, and carbon dioxide.

Excessive salts hinder plant growth by affecting the soil and water balance. The results of the present study revealed a variation in the EC of surface soils and averaged between 0.16, 0.23 and 0.21 dSm^{-1} in forest, agricultural and horticultural soils respectively. Similarly sub-surface soils also exhibited a variation in EC with mean values of 0.23, 0.25 and 0.24 dSm^{-1} in Forest, Agricultural and Horticultural soils respectively (Table 2). However, The electrical conductivity was within the normal range across different land use systems as value were less than 1 dSm^{-1} and do not impact most crops and soil microbial processes.

The low electrical conductivity may be due to leaching of soluble salts to sub surface layers resulting from heavy precipitation in soils. The differences in electrical conductivity under different land uses may be attributed to soil management practices and altitudinal variation. These results are in conformity with the results of Parihar *et al.,* (2013).

Organic carbon (%)

The organic carbon content in surface soils varied from 1.26 to 2.01per cent with a mean value of 1.80 per cent in forest, 0.76 to 1.63 per cent with a mean value of 1.09 in agricultural soils and 0.88 to 1.27 per cent with a mean value of 1.10 in horticultural soils (Table 2). Organic matter in the soils had a faster rate of K adsorption. This is attributed to the presence of more accessible exchange sites of soil organic matter for K. While as in sub-surface soils, the organic carbon content varied from 1.09 to 1.96 per cent with a mean value of 1.5 per cent in forest, o.52 to 0.82 per cent with a mean value of 0.67 per cent in agricultural and 0.79 to 1.18 per cent with a mean value of 1.00 per cent in horticultural soils (Table 2). The higher amount of organic carbon in high altitudes may be due to plant biomass, litter quality and climatic factors like temperature, precipitation etc. Because of low temperatures at high altitudes are likely to limit decomposition and other soil processes, researchers have proposed that soil organic carbon (C) concentration may increase while as low values in lower altitudes owe to rapid mineralization and loss of carbon from soils (Sundqvist *et al.,* 2013). These results are in conformity with the findings of Pal *et al.,* (2013). Depth wise analysis for organic carbon showed a decreasing trend owing to the addition of plant residues to the surface layers. These results are in accordance with the findings of Karwade *et al.,* (2020).

Calcium carbonate

The data presented in table 2 revealed that the calcium carbonate content in surface soils under different land uses varied from 0.05 to 0.22 per cent with a mean value 0.15 per cent in forest, 0.40 to 0.69 per cent with a value of 0.57 per cent in agricultural and 0.56 to 0.68 per cent with a mean value of 0.61 in horticultural soils. While the calcium carbonate content in sub-surface soils varied from 0.08 to 0.26 per cent with a mean value of 0.19 per cent in forest, 0.52 to 0.78 per cent with a mean value of 0.67 per cent in agricultural soils and 0.62 to 0.70 per cent with a mean value of 0.66 per cent in horticultural soils.

A consistent increase in calcium carbonate content was observed with increase in depth of soils which might be accredited to the leaching down of calcium carbonate from upper soils surfaces. The results are in conformity with the finding of Karwade *et al.,* (2020) who also found low calcium carbonate in surface layers while working on soils of Himachal Pradesh and Kashmir, respectively.

Cation Exchange Capacity (CEC)

The results presented in table 2 revealed that the cation exchange capacity under selected land uses varied from 14.28 to 16.10C mol_c kg^{-1} in Forest, 13.43 to 16.70 C mol_c kg^{-1}in Agricultural, 14.47 to 15.38 C mol_c kg^{-1} in horticultural soils with a mean value of 15.48, 15.64 and 15.11C mol_c kg^{-1} respectively. Where as in sub-surface soils it varied from 14.85 to 16.90 C mol_c kg^{-1} in forest, 14.65 to 17.52 C mol_c kg^{-1}in agricultural and 26 to 16.99C $mol_c kg^{-1}$ in horticultural soils with a mean value of 15.99, 16.33 and 16.15C $mol_c kg^{-1}$ respectively. The higher content of cation exchange capacity can be ascribed to higher organic matter content and clay. Wani *et al.,* (2010) also reported a higher range of cation exchange capacity in soils attributed to their corresponding high content of organic matter and clay. Depth wise analysis of these soils for cation exchange capacity showed an increasing trend owing to the variation in organic carbon and clay content in the sub-surface soils. This is further in agreement with the findings of Takele *et al.,* (2014).

In conclusion, pH was almost neutral to slightly acidic in all land uses. Organic carbon and was high in Forest followed by horticultural soils and the agricultural soils. EC, Calcium carbonate was high in agriculture and horticultural soils as compared to forest soils. CEC was almost same in all land uses. Most of the parameters are quite higher or lower than acceptable limits. From the study it is concluded that further study should be carried out about the mineralogical composition of the clays to better understand the quality of soil by different parameters.

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