Nutrient Status of Soils of Some Typical Habitats of Dachigam National Park, Kashmir

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ABSTRACT

Physico-chemical characteristics of soil investigated for five sites in Dachigam National Park (34°05′ - 34°10′ N latitude and 74°50′ - 75°10 ′E longitude) for a period of six months (June-November, 2004) revealed high fertility for *Parrotiopsis* forest soils than other soil types. The nutrient status of the soils was found to be largely influenced by the vegetative cover.

Keywords: Physico-chemical, soil, Dachigam National Park.

INTRODUCTION

To a great extent, soil quality determines the nature and quality of ecosystems and the capacity of land to support animal life and society. Although some studies have been conducted on the physico-chemical characteristics of J & K soils (Gupta, 1974; Gupta *et al*., 1977, 80; Handoo, 1983; Talib, 1983, Jalali *et al*., 1989; Kher and Singh, 1993; Peer, 1994; Nakashgir *et al*., 1997), yet the forest soils have received very little attention. In view of this, it becomes, therefore, necessary to conduct a first study on the physico-chemical characteristics of soils in a protected forest area. Since Dachigam National Park encompasses a number of heterogeneous habitats and not much study on its soil characteristics have been conducted, this study was carried out in an attempt to assess the nutrient status of surface soils of these habitats.

STUDY AREA

Dachigam National Park is situated about 22 kilometers from Srinagar and comprises almost half of the Dal lake's catchment area. It is spread over an area of 141 km² and is approximately 22.5 km long and 5 km wide. The park lies between the geographical coordinates of 34°05′ - 34°10′ N latitude and 74°50′ - 75°10 ′E longitude. Dachigam is teemed with flora and fauna of varied kinds and comprises a variety of natural habitats.

For the present study, five sampling sites were selected, each representing a different vegetal type of the park (Fig. 1).

A: Riverine forest area situated along Dagwan Nallah with the dominant vegetation comprising of *Populus alba, P. nigra, Prunus armenica, Quercus robur,* and *Juglans regia*.

B: Pine forest area located along the north-facing slopes of Dachigam. The dominant vegetation of the area included *Pinus wallichiana*.

C: *Parrotiopsis* forest also located along the north-facing slopes of Dachigam. The vegetation was mostly dominated by *Parrotiopsis jacquemontiana*.

D: Protected grassland, located along the south-facing slopes, and the vegetation was dominated by *Themeda anathera*.

E: Open scrub, located along the south-facing slopes. The dominant vegetation included *Indigofera beterantha, Isodon plectranthus*, *Zizyphus jejuba, Berberis lyceum* and *Stipa siberica*.

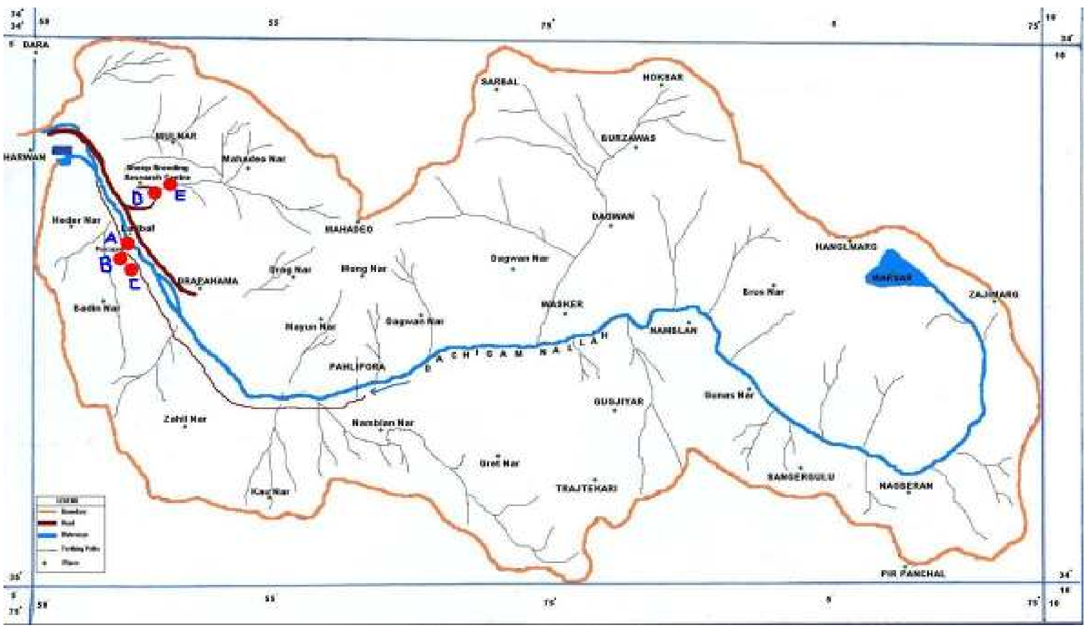

Fig. 1. Map showing study sites in Dachigam National Park.

MATERIAL AND METHODS

Composite soil samples (0 – 15 cm depth) were randomly collected from the five habitats of Dachigam on monthly basis for a period of six months from June to November 2004. The following recommended methods were adopted for determining the physico-chemical characteristics of soil samples during the laboratory investigations (Table 1).

Table 1: Different methods adopted for the laboratory investigations

S. No.	Parameter	Method
1	PH	1:1 soil-water solution, and the reading was recorded on a digital pH meter-Model 101E (Michael, 1984)
2	Electrical Conductivity	1:1 soil-water solution, and the reading was recorded on a digital conductivity meter (Gliessman, 1998)
3	Field Capacity	Filter paper method prescribed by Colman (1947)
4	Moisture Content	Gravimetric method given by Michael (1984)
5	Loss on Ignition	Muffle furnace ignition method prescribed by Hanna (1964)
6	Exchangeable Calcium/Magnesium	Shaking and filtration method given by Schollerberger and Simon (1945)
7	Organic Carbon	Walkley and Black (1934) titration method
8	Total Phosphorus	Stannous chloride method given by Bear (1964)
9	Total Nitrogen	Kjeldhal digestion method (Jackson, 1962)
10	Exchangeable Potassium	Flame photometer method prescribed by Schollerberger and Simon (1945)

RESULTS AND DISCUSSION

The data obtained on various physico-chemical characteristics of soil are presented in Table 2.

The pH values recorded at all the sites indicated that the soils were acidic to slightly alkaline in nature, as the said values for pH in all the forest classes is

Table 2: Physico-chemical characteristics of surface soils at Site A, B and C

Parameter	Site A						Site B						Site C					
	J	J	A	S	O	N	J	J	A	S	O	N	J	J	A	S	O	N
pH	7.65	7.58	6.68	6.67	6.83	6.85	6.10	5.92	5.51	5.34	5.50	5.73	6.50	6.53	6.05	5.89	5.94	6.16
Electrical conductivity (µS/cm)	314	340	600	713	831	514	347	292	610	510	630	318	374	396	630	530	530	310
Moisture content (%)	50	20	31	39	24	19	14	17	13	9	11	10	42	28	31	32	27	23
Field capacity (%)	33	32	28	31	16	30	13	19	14	18	26	31	23	25	31	33	46	37
Organic carbon (%)	2.73	2.34	3.69	0.97	1.29	5.81	2.52	3.12	5.12	2.10	2.70	5.82	1.17	5.07	4.50	2.34	4.23	6.34
Organic matter (%)	4.70	4.03	6.36	1.68	2.22	10.01	4.37	5.37	8.84	3.69	4.67	10.03	2.01	8.74	7.75	4.03	7.29	10.93
Loss on ignition (%)	17	10	14	11	13	13	14	15	13	16	12	16	22	15	16	18	17	15
Exchangeable Ca (meq/100gm)	5.25	3.25	6.30	5.11	5.57	5.29	5.75	3.70	4.60	5.18	6.10	6.86	4.12	4.40	5.46	4.30	6.83	6.30
Exchangeable Mg (meq/100gm)	2.52	1.81	2.31	1.11	2.10	3.30	6.35	4.10	3.12	1.14	1.00	0.90	3.87	2.40	1.21	2.13	2.91	1.01
Total phosphorus (ppm)	371	318	502	138	176	500	345	424	349	241	369	396	160	343	387	452	287	400
Available potassium (ppm)	195	167	263	70	90	208	181	222	366	152	193	215	84	362	321	168	302	275
Total nitrogen (%)	0.21	0.18	0.28	0.07	0.09	0.43	0.19	0.24	0.39	0.16	0.20	0.44	0.09	0.38	0.34	0.18	0.32	0.47

Site D and E

Parameter	Site D						Site E					
	J	J	A	S	O	N	J	J	A	S	O	N
pH	6.23	6.10	5.78	5.81	5.76	6.16	6.50	6.65	6.37	6.67	6.84	6.93
Electrical conductivity (µS/cm)	233	173	211	279	250	189	203	185	189	203	313	312
Moisture content (%)	10	8	11	21	16	17	6	5	8	10	18	13
Field capacity (%)	17	18	16	19	23	14	16	15	18	13	14	11
Organic carbon (%)	0.64	3.90	1.89	1.56	3.58	2.82	2.34	4.29	3.12	1.95	2.32	2.83
Organic matter (%)	1.10	6.72	3.25	2.68	6.17	4.42	4.03	7.39	5.37	3.36	3.99	4.87
Loss on ignition (%)	13	15	15	14	14	12	10	16	13	8	8	6
Exchangeable Ca (meq/100gm)	4.25	2.95	3.75	4.38	5.10	3.18	5.00	3.20	3.10	4.11	3.13	1.20
Exchangeable Mg (meq/100gm)	2.11	1.49	2.18	1.18	0.80	1.67	2.50	1.60	1.30	2.11	2.20	2.30
Total phosphorus (ppm)	189	433	257	212	488	332	262	250	249	218	259	316
Available potassium (ppm)	182	278	135	112	255	315	167	306	222	139	166	204
Total nitrogen (%)	0.04	0.30	0.14	0.12	0.27	0.18	0.09	0.16	0.12	0.07	0.17	0.10

an indication of a higher nutrient status especially in the top layer. Acidic pH values for the pine forest soils were recorded in all the six months in the range of 5.34 – 6.10. The acidic nature of the forest soils can be attributed to the decomposition of organic matter (largely in the form of pine leaf litter) and the subsequent release of organic acids. Jones *et al*. (2002) reported that the lower pH may also be attributed to higher rainfall and higher organic matter at the site.

Electrical conductivity, a measure of total salt concentration, showed a decreasing trend with an increase in altitude, which may be attributed to the leaching of soluble salts from higher altitudes.

Moisture content is one the most important determinants in the decomposition process. Percent moisture content (50) was recorded highest at the Riverine forest site. This may be due to the dependency of moisture regime of the stand based on different abiotic factors, which include rainfall, amount of radiation received on the forest floor, its acidity, humidity and temperature and biotic factors such as structure and function of the stand.

Highest field capacity (37%) was exhibited by the *Parrotiopsis* forest soils, which is one of the reasons for healthy nutrient status of the soil, as different cover types affect downward moment of water in the soil in different ways.

Total nitrogen, organic carbon and organic matter were recorded to be the highest in *Parrotiopsis* forest soils, being again attributed to the rich litter decomposition on the forest floor.

The higher content of organic matter in forest soils than grassland and scrub soils is attributed to forest vegetation and low mineralization due to low temperature under the shade of trees that slows down the decomposition of organic matter by restricting the microbial population, a fact well supported by Talib (1983) and Nakashgir *et al*. (1997). The values for the above parameter varied at different altitudes, which might be attributed to the climatic and altitudinal differences, helping the accumulation of organic matter (Narian and Singh, 1989). Comparatively higher values of loss on ignition, which, in a way, is an expression of the organic matter content of the soils, were recorded for the forest soils, as huge quantities of decomposing forest litter was available on the floor.

Exchangeable calcium and magnesium were recorded to be highest in Pine forest soils, as their uptake greatly exceeded annual requirement for both the deciduous and coniferous forest species indicating that magnesium accumulates in the older tissues of the trees. Exchangeable magnesium content was in the range of 0.80 – 6.35 meq/100gm, which may be due to the presence of chlorite and degraded illites in these soils. The presence of illite which is known to have Mg^{2+} within brusite layer was reported to be most dominant mineral in J&K soils (Gupta *et al*., 1977; Handoo, 1983).

Phosphorus content was found to be highest for riverine forest soils, as slightly acidic soils reduce the retention capacity, which may result in an increase in phosphorus concentration at the site.

Available potassium was highest for the pine forest soils. The higher values can be attributed to high clay content and to illitic nature of these soils (Gupta *et al*., 1977).

In conclusion, *Parrotiopsis* forest soils on the whole recorded higher nutrient values, which is the result of the accumulation of litter cover (mostly autumnized leaves) and its subsequent decomposition. Further, all the forest soils exhibited better nutrient status than grassland and scrub soils.

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