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Physico-chemical characteristics of the soils of open scrub areas of Dachigam national park, Kashmir

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ABSTRACT

Physico-chemical analysis was carried out on the soils of open scrub areas of Dachigam National park, Kashmir from winter 2010 to autumn 2010, at four sites with variations in vegetation covers and biotic stresses. The following soil characteristics were examined: temperature, moisture, organic carbon, pH, conductivity, total nitrogen, total potassium, and total phosphorus. The moisture content was found to be directly related to the vegetation cover with the highest value at protected (PS) site and lowest percentage at quarry (QS) Site followed by village (VS) site and farm (FS) site which were more affected by anthroprogenic pressures and hence less vegetation cover and probably more evaporation of soil moisture from the exposed site. The soils of all sites were slightly acidic in character with a fair amount of organic matter at protected site followed by farm site where controlled grazing and browsing takes place and reduced amount of organic matter at quarry site and village site probably due to overgrazing and overexploitation which causes much removal of vegetation cover by the grazers and local people. The values of major nutrients such as total NPK showed a gradual decrease from summer to winter except at protected site probably due to an increased vegetation cover and a fair amount of organic matter. © 2013 Trade Science Inc. - INDIA

KEYWORDS

Soil chemistry;
Scrub;
Anthropogenic pressures;
Dachigam;
Kashmir.

INTRODUCTION

Soil synthesized in profile form from a variable mixture of broken and weathered minerals and decayed organic matter serve a vital function in nature, providing nutrients for plant to grow as well as habitat for millions of micro and macro organisms. Healthy soil enables vegetation to flourish, releases oxygen, holds water and diminishes destructive storm runoff, breaks down waste materials, binds and breaks down pollutants and serves as the first course in the larger food chain. Nutrient availability not only affects spatial vegetation pattern but also the overall community structure and productivity[3]. On the other hand, vegetation strongly affects soil characteristics, including soil volume, chemistry and texture, which feed-back to affect various vegetation characteristics, including productivity, structure and floristic composition[2]. Hence, soil and vegetation exhibit an integral relationship, in that soil gives support (moisture, nutrient and anchorage) to vegetation to grow effectively on the one hand, and on the other hand, vegetation provides protective cover for soil, suppresses soil erosion as well as helps to maintain soil nutrient through litter accumulation and subsequent decay (nutrient cycling). Physical and chemical properties of the soil have been used to evaluate the ecological functions of the forest soils and have been extensively used to measure soil quality. However, these properties usually change very slowly and therefore, significant changes due to disturbance occur only over many years. Biochemical and biological properties of soil respond quickly to even small changes in soil characteristics, and infer rapid and accurate information regarding environmental stress[7]. Soil acts as a reservoir of nutrients and moisture for the production of forage and plant sp**ec**ies [21] soils are shallow and less rich than a forest as less amount of plant tissue (biomass) is added to the soils through decomposition every year. Soil chemistry involves the chemical reactions and process occurring in the soil which are important for the growth of plants, animals and of course human development. Therefore, understanding of soil chemical reactions and processes is essential for developing innovative resource management strategies, and understanding and regulating the behavior of the terrestrial ecosystem at regional and global scales[22]. The main aim of the present study was to assess the physico-chemical characteristics of the soils of the open scrub areas of Dachigam national Park,Kashmir, subjected to different biotic stresses.

MATERIAL AND METHODS

Study area

The present study was carried out on the soils of the open scrub areas of Dachigam national Park,($34^0$5'-34^0 10'N and 74^0.50-75^0.10 E) Kashmir, located at 21 km from the Srinagar City from winter 2010 to autumn 2010. Four study sites were chosen as is shown on Figure 1 Site I (QS) ($34^0$10'27.9"N and $74^0$55'16.8"E; Elevation 1962±5 m) was situated near the stone quarry area. Site II (VS) ($34^0$10'03.9"N and $74^0$55'28.1"; Elevation 1944 ±6 m) was selected near village site influenced by anthropogenic activities. Site III (FS) ($34^0$08'57.0"N and $74^0$55'52.1"E; Elevation 1818±6 m) was near Sheep breeding farm with occasional grazing and the Site IV (PS) ($34^0$08'11.7"N and $74^0$56'11.4"E; Elevation1816 ±6 m) selected in the heart of the national park representing the protected site.

Methodology

For the determination of various soil features, the composite surface soil samples were collected at a depth of 0-15 cm with the help of soil corer between 09:00-13:00 usually during middle of the month. The samples were air-dried, pulverized and passed through 2mm sieve before analysis[7]. Soil temperature was measured onsite under shade usually in between 1:00 and 2:00 PM IST with the help of soil thermometer (Model RT 0124; Raj Thermometers; India). Soil texture was determined through modified Udden-Wentworth Grade scale (sieve method) as demonstrated by Lindholm[13] by following USDA particle size classes Viz., sand (2.0-0.02mm), silt (0.02-0.002mm) and cal (<0.002mm). The soil moisture content was measured by gravimetric method where percent moisture content of soil was calculated by the following formula: (loss in weight/initial weight) X 100. Conductivity and pH were determined by electrometric method using conductivity meter and digital pH meter. Organic carbon (OC) was estimated by wet combustion method of Walkley and Black[24] The total nitrogen was estimated by Kjeldahl method by acid digestion. Total K and P nutrients were estimated by triacid digestion method by Flame Photometer (Model:AIMIL-046) and spectrophotometer (Model: Systronics-106) respectively.

RESULTS AND DISCUSSION

During the present study, the soil temperature depicted a progressively decreasing trend with highest being in summer followed by spring, autumn and lowest in winter season for both the years with a maximum value of 22°C recorded at quarry site in summer and the minimum temperature of 2°C found at protected site in winter (TABLE). Temperature also showed decreased values in winter, increased towards spring and summer and then again decreased in autumn. Increase in the absorption of solar radiations by mineral soils due to lesser vegetation cover has led to the warming of the soil, which in turn caused increased soil temperatures[18]. Plant cover and plant litter both providing shading effect to the underlying soils by intercepting the incoming radiation.

TABLE 1 : Physico-chemical characteristics of scrub soils of Dachigam national park, Kashmir

Parameter	Sites*	Seasons				Average	SD
		Winter	Spring	Summer	Autumn		
±Soil temperature °*C*	QS	5	12	22	7	11.50	±7.59
	VS	4	11	17	6	9.50	± 5.80
	FS	4	13	21	6	11.00	±7.70
	PS	2	11	16	6	8.75	±6.07
Moisture (%)	QS	15.07	18.52	17.32	4.22	13.78	±6.53
	VS	17.38	16.47	16.43	7.28	14.39	±4.76
	FS	22.24	20.22	17.54	17.2	19.3	±2.38
	PS	2.34	31.11	29.31	21.69	28.61	±4.77
pH	QS	7.4	6.9	6.24	6.5	6.76	±0.50
	VS	5.77	6.6	6.05	6.45	6.21	±0.37
	FS	7.44	7.4	6.02	6.4	6.81	±0.71
	PS	6.8	5.1	6.2	5.83	5.98	±0.71
Electrical Conductivity µS/cm	QS	300	220	160	340	225	±80.62
	VS	360	320	140	270	272.5	±95.69
	FS	401	150	370	220	285.25	±119.90
	PS	520	490	410	240	415	±125.56
Organic Carbon (%)	QS	2.48	2.09	3.19	3.62	2.84	±0.68
	VS	5.26	3.54	3.41	3.96	4.04	±0.84
	FS	4.52	3.27	4.12	5.96	4.46	±1.12
	PS	5.41	4.95	5.47	5.98	5.45	±0.42
Total Nitrogen (%)	QS	0.26	0.30	0.32	0.35	0.30	±0.037
	VS	0.33	0.28	0.40	0.33	0.33	±0.049
	FS	0.46	0.35	0.37	0.25	0.35	±0.086
	PS	0.40	0.42	0.39	0.36	0.39	±0.026
Total phosphorus (ppm)	QS	773	1201	1056	766	949.00	±215.57
	VS	855	880	1073	921	932.25	±97.69
	FS	768	1150	1107	839	966.00	±190.67
	PS	1022	1201	1226	757	1051.50	±216.33
Total Potassium (%)	QS	1.725	1.645	1.825	1.870	1.766	±0.101
	VS	1.800	1.650	1.725	1.750	1.731	±0.062
	FS	1.650	1.550	1.650	1.750	1.650	±0.081
	PS	1.850	1.675	1.710	1.850	1.771	±0.092

***QS – quarry Site (heavily disturbed site); VS–village site (regularly grazed site); FS –Sheep farm site (Controlled grazing site); PS –protected site (undisturbed site)**

The maximum soil moisture content of 32% was recorded for protected (PS) site during winter and the minimum value of 4.22% was found at quarry site during autumn. The highest value at protected (PS) site in winter could be attributed to the high precipitation in that season as well as more vegetation cover at the site, resulting in lesser amount of radiation being received at the surface and consequently less evaporation and transpiration rates results in less loss of moisture and finer soil particles than the rest of the three sites providing more film surface for the retention of water[3]. The lowest value of moisture content at quarry (QS) site and village (VS) site in autumn could be due to less precipitation and lot of evaporation takes place from the exposed site in hot days.

Soils being slightly acidic in nature, the highest pH of (7.44) was recorded at farm site during the winter could be due to absence of fresh litter, reduced vegetation cover, increased temperature high rate of decomposition, increase in base cations and the lowest value of (5.1) was recorded at protected site during spring due addition of fresh litter and presence of high organic matter content in these soil[10]. Higher values of pH in warm seasons may be due to high temperatures causing more mineralization and hence less acidity whereas low temperatures slow down the microbial activity causing low mineralization, hence high acidity[18].

Electrical conductivity of soil which gives a relative measure of the total quantity of ions in the solution is influenced by a number of factors like clay type, soil water capacity, ion concentration[4]. As compared to protected (PS) site, the lower electrical values by quarry (QS) site (160 μS/cm), village (VS) site (140μS/cm) and farm (FS) site (150 μS/cm) may be due to the lesser release of ions from mineral weathering under different temperature and moisture regimes[12] and low amount of soluble salts probably due to the leaching from surface to sub surface layers and the accumulation of these salts at the lower layers due to poor internal drainage[11].

Organic carbon values showed spatial as well as temporal variations with highest values shown by farm (FS) site (5.96%) in autumn season may be attributed to the rich litter deposition and due to lower temperature under the shade of dense shrub cover causing slow decomposition and low mineralization[17] and the lowest (2.48%) by quarry (QS) site during winter can possibly be a consequence of heavy grazing and leaching. However, the decomposition rates of OM tend to increase as weather warms towards summers and hence lesser OC values[18].

Overall the highest values of Total Kjeldal nitrogen were found at protected (PS) site with maximum of (0.42%) in autumn due to higher vegetation cover accumulating higher amounts of organic matter and lowered rates of nitrification due to inhibition of nitrifiers by acidity[1] and lowest (0.25%) for farm (FS) site in autumn. However, a higher value of TKN in spring and summer season is due to increase in nitrogen mineralization by increasing temperature[15].

Minimum values of 773ppm for total phosphorus at quarry (QS) site during winter might be due to the leaching, plant removal and increased surface run off due to steepness of slope of this site while as maximum values of 1226ppm during summer for protected (PS) site could be due to the high organic matter content which have better supplies of organic phosphates for plant uptake[16].

The values of total potassium were lowest (1.550%) at farm (FS) site during spring while those of quarry (QS) were highest (1.870%) during autumn might be due to the fact that soils with vegetation cover release more potassium due to dissolution of minerals in presence of organic acids.

Overgrazing is the most significant factor for degradation of grasslands among anthroprogenic factors[14]. The effects of overexploitation and overgrazing on the plant community and soils are considered deteriorating and destructive because of the reduction of canopy cover, the destruction of topsoil structure, and compaction of soil as a result of trampling[23]. These changes cause loss of fine fractions in soils influencing moisture, soil consistence, organic carbon and nutrient availability[9] Which infact affect the type, distribution and the amount of the vegetation of the area.

CONCLUSIONS

The study revealed the impact of change in landcover type on soil quality inferred by the changes in chemical and physical properties of different areas with varied degrees of biotic stresses. Heavy and uncontrolled grazing at quarry site and village site (unprotected area) apparently has resulted in a decrease in vegetation cover leading to a further exposure of surface soils to the effect of wind and water causing further increase in the sand and silt content of the surface soil, loss of moisture, organic carbon and other vital nutrients. Variations in such parameters indicate that multitudes of ecological stresses have disturbed the scrub ecosystems and hence the area is under the exigency of degeneration.

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