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Soil Nutrient Status Under Different Agro-Climatic Zones of Kashmir and Ladakh, India

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ABSTRACT

An investigations on nutrient analysis of soil under the different agro-climatic zones of Kashmir and Ladakh viz Temperate (Pattan, Baramulla), Sub temperate (Gurez, Bandipora) and Cold Arid (Kargil, Ladakh) was carried out during 2012 and 2013.The studies revealed that soils were alkaline in their reaction with slightly higher pH (8.2) recorded at Kargil followed by Pattan (7.9) and Gurez (7.6). Electrical conductivity was highest (0.23 dSm^{-1}) at Pattan and least at Kargil (0.08 dSm^{-1}). Pattan soils were richer in organic carbon with an average value of 1.02%. Varied results were obtained with respect to available soil nitrogen, the highest being recorded at Pattan with an average value of 372.8 kg ha^{-1} Gurez recorded 251.5 kg ha^{-1} and Kargil 184.9 kg $ha^{-1.}$ Pattan recorded maximum (22.45 kg ha^{-1}) soil available phosphorus while the sulphur was recorded highest (53.40 kg ha^{-1}) at Kargil. Among the three agro-climatic zones, (187.30 kg ha^{-1}), exchangeable calcium (17.56 centimole) and exchangeable magnesium (5.54 centimole).

Key words: Soil, Nutrient status, agro-climatic zones.

INTRODUCTION

Jammu and Kashmir is home to several valleys such as the Kashmir Valley, Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Lidder Valley. The main Kashmir valley is 100 km (62 miles) wide and 15,520.3 km^2 (5,992.4 sq miles) in area. The Himalayas divide the Kashmir valley from Ladakh region of Jammu and Kashmir (India) while the Pir Panjal range, which encloses the valley from the west and the south, separates it from the Great Plains of northern India. Along the northeastern flank of the Kashmir Valley runs the main range of the Himalayas. This densely settled and beautiful valley has an average height of 1,850 metres (6,070 ft) above sea-level but the surrounding Pir Panjal range has an average elevation of 5,000 metres (16,000 ft). (Anonymous, 2011)

Because of Jammu and Kashmir's wide range of elevations, its biogeography is diverse. Northwestern thorn scrub forests and Himalayan subtropical pine forests are found in the low elevations of the far southwest. These give way to a broad band of western Himalayan broadleaf forests running from northwest-southeast across the Kashmir Valley. Rising into the mountains, the broadleaf forests grade into western Himalayan subalpine conifer forests. Much of the northeast of the state is covered by the Karakoram-West Tibetan Plateau alpine steppe. Around the highest elevations, there is no vegetation, simply rock and ice. The soil also differs and Jammu & Kashmir is having a wide variety of soils and soil texture varies from place to place and type of vegetation it supports also varies. Soil texture varies from rich deep alluvial soils to the thin and bare soils of high mountains. To ascertain the soil status under three agro climatic zones of Kashmir and Ladakh the present study was undertaken.

MATERIALS AND METHODS

The study was carried out during the years 2012 and 2013 at three different sites viz: Temperate Zone Pattan with latitude of 34° 09¹ and longitude of 74° 33¹ and 5306 ft asl (District Baramulla), Sub-temperate Zone Gurez with latitude of 34° 38¹ and longitude of 74° 44¹ and 9601 ft asl (District Bandipora) and Cold arid zone Kargil with latitude of 34° 34¹ and longitude of 76° 04¹and 10745ft asl (District Ladakh) with the annual rainfall of 890 mm, 1280mm and 110mm respectively. The design used for the experiment was RBD with twelve treatments and three replication for carrying out the study. Soil samples were collected at two different depths i.e. one feet and two feet from each agro-climatic zone by digging pits and taking a thin slice of soil. The samples were subjected to quartering and 200 g of each sample were collected, air dried in shade and then crushed with wooden mortar and pestle. The crushed samples were sieved through 2 mm sieve. A portion of each sample was sieved through 0.4 mm sieve for estimation of organic carbon. The samples were stored in sealed polythene bags. Soil pH and EC was measured in 1:2:5 overnight soil water suspension by conductivity meter and organic carbon was determined by Walkley and Black (1934) rapid titration method.The available nitrogen was estimated by alkaline potassium permanganate method given by Subbiah and Asija (1956), available phosphorus was estimated by method given by Olsen *et al*. (1954) available potassium was estimated by method given by Mervein and Peech (1950) and available sulphur was extracted with Morgans reagent having pH 4.8 and determined by turbidimetric method given by Chesnin and Yien (1951), also the exchangeable calcium and exchangeable magnesium was estimated by a method given by Black (1965).

RESULTS AND DISCUSSION

Soil samples collected under all the three different agro-climatic zones were analysed to test their status. The results obtained are given in Table 1

Soil pH

The soils at all the three sites were alkaline. Pooled data showed that at Gurez, the average pH was 7.6 whereas at Kargil, the pH was higher with an average value of 8.2 and at Pattan, average pH was 7.9 .However, no significant difference was observed among the three agro-climatic zones .

Electrical conductivity (dSm^{-1})

Electrical conductivity was highest in the soil of Pattan and least in the soils of Kargil. Soils at Gurez recorded average electrical conductivity of 0.14 and at Kargil average electrical conductivity was 0.08 whereas at Pattan it was 0.23. Differences between three zones were significant.

Soil organic carbon (%)

At Pattan soil was richer in organic carbon than other two sites under study. Pattan recorded organic carbon in the range of 1.01-1.14%. Kargil soils had the least value of 0.27 of organic carbon. Gurez recorded an average value of 0.32%.

Available soil nitrogen (kg/ha)

Soil nitrogen depicted a great variation in values as recorded in three zones. The highest soil nitrogen content was recorded at Pattan site with an average value of 372.8 kg/ha followed by Gurez with an average value of 251.5 kg/ha and least at Kargil recording soil nitrogen of 184.9 kg/ha.

Available soil phosphorus (kg/ha)

Pattan recorded maximum soil phosphorus during both the years of study with an average value of 22.45 kg/ha. This was significantly higher than the values recorded at Kargil (17.40) and Gurez (18.23).

Available soil potassium (kg/ha)

Soil potassium was highest at Pattan recording an average value of 187.3 kg/ha which was statistically at par with the value recorded at Gurez (178.2 kg/ha) and kargil recorded a value of 109.7 kg/ha

Exchangeable calcium (centimole)

Soil exchangeable calcium was maximum (17.56 $Cmolp^{+}$/100g) at Pattan. It was followed by Gurez (10.43 $Cmolp^{+}$/100g) and least in Kargil (7.33

Table 1: Soil nutrient status under three different climatic zones of Kashmir and Ladakh

ZonesèSoil nutrientsê	2012			2013			Pooled			CD
	Gurez	Kargil	Pattan	Gurez	Kargil	Pattan	Gurez	Kargil	Pattan	($p \leq 0.05$)
pH	7.5	8.1	7.8	7.2	8.2	7.9	7.6	8.2	7.9	NS
EC(dSm^{-1})	0.13	0.1	0.22	0.15	0.07	0.24	0.14	0.08	0.23	0.05
Soil organic carbon (%)	0.33	0.26	1.01	0.32	0.29	1.03	0.32	0.27	1.02	0.03
Soil nitrogen (kg/ha)	253.4	185.1	372.8	249.5	184.6	372.8	251.5	184.9	372.8	17.97
Available Soil Phosphorous (kg/ha)	18.38	17.16	22.99	18.08	17.65	21.92	18.23	17.40	22.45	1.31
Available Soil potassium(kg/ha)	178.5	109.3	188.4	177.9	110.4	185.7	178.2	109.7	187.3	18.25
Soil exchangeable calcium (centimole)	10.48	7.25	17.21	10.39	7.42	17.92	10.43	7.33	17.56	2.11
Soil exchangeable magnesium (centimole)	4.16	3.23	5.56	4.18	3.29	5.52	4.17	3.26	5.54	1.17
Soil available Sulphur (kg/ha)	41.8	53.5	40.4	42.1	53.4	39.93	41.9	53.4	40.2	0.51

Cmolp^{+}/100g). The values recorded during both years of study showed significant difference between three zones

Exchangeable magnesium (centimole)

Soil exchangeable magnesium was maximum at Pattan site (5.54 Cmolp^{+}/100g) whereas it was least (3.26 Cmolp^{+}/100g) at Kargil site. Gurez on an average recorded a value of 4.17 Cmolp^{+}/100g. The values at Gurez and Kargil were statistically at par.

Available sulphur (kg/ha)

Available sulphur in soil was recorded maximum at Kargil during both the years of study with an average value of 53.4 kg/ha being significantly different from other two zones which recorded average values of 41.9 and 40.2 kg/ha for Gurez and Pattan respectively .

The findings of soil status show variations under agroclimatic conditions. Soils generally differ in their salt content. The pH of Kargil soils could be attributed to leaching of basis and variation in organic matter as reported by Minhas and Bora (1982). The present findings are in conformity with the findings of Wani (2001) and Dar (2009) who have analyzed the soils of orchards of Kashmir valley. The variation in electric conductivity under three different agro-climatic zones could be attributed to leaching of soluble salts from surface to subsurface horizons. Similar reports have been given by Marazi (1988), while studying soils of apple orchards. Organic carbon is the index of soil fertility and productivity (Nagaveni *et al.*, 2003). Soil organic carbon appears to be an important parameter that controls sustainability of crop production (Lal, 2004). The organic matter in soil promotes the formation of desirable soil structure and thus influences the aeration and retention of moisture (Subbiah and Asija, 1956).

The presence of highest organic carbon in soil of Pattan area could be attributed to the mixing of crop residues and fallen leaves into soil system after the harvest as a large number of fruit orchards and other crops are cultivated in Pattan area in contrast to Gurez and Kargil where less crops are cultivated and thus depicting low organic carbon in the soils. These observations have also been reported by Lahiri and Chakravarti (1989). Further left over crop residues and fallen leaves have also resulted in increased interaction with soil microbial complex there by changing C:N ratio. The same has also been reported by Samanta *et al.* (2001).

Present findings showed higher available nitrogen,phosphorus and potassium in the soils of Pattan site followed by Gurez and least in Kargil. The decreasing nitrogen, phosphorus and potassium in three agroclimatic zones viz; Pattan, Gurez and Kargil respectively could be attributed to higher amounts of organic matter which is an important source of phosphorus and nitrogen; soils with more amount of clay absorb more phosphorus and potassium. The results are in conformity with findings of Najar *et al.* (2005).

The study further showed that soil exchangeable calcium and soil exchangeable magnesium was highest in the soils of Pattan site followed by Gurez and least at Kargil. The variation in calcium and magnesium content can be attributed to parent material of soil while as the higher sulphur at Kargil than other two agroclimatic zones can be attributed to increased crop yields, thus remove large amount of sulphur and immobilization of sulphur in organic matter. Present findings are in conformity with the studies of Najar (2002).

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