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Available Nutrients status of soils of forest growing areas of Ganderbal district of Kashmir valley

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Abstract

A Survey was carried out to study available nutrient status of forest growing soils of district Ganderbal of Kashmir valley. Three locations were selected and surveyed (simple random survey) for the purpose of collection of soil samples. The samples were processed and analyzed for different nutrients. Soil reaction was slightly acidic to alkaline and the soluble salt concentration was negligible. The available nutrients nitrogen, phosphorus, potassium and Sulphur were medium to high in range and decreases with the increase in depth and similar trend was followed by micronutrients decreases with the increase in depth however Fe, Zn, Cu and Mn were medium to high in range.

Keywords: macro nutrients, micro, acidic, soil, samples

Introduction

Soils differ in their ability to supply the nutrients necessary to sustain forest productivity. Nutrients are added through natural processes such as weathering of primary and secondary soil minerals, mineralization of soil organic matter including the forest floor layer, fixation of nitrogen primarily through symbiotic microorganisms, and natural or induced atmospheric deposition. Nutrients become unavailable for plant uptake through immobilization by soil microorganisms and through chemical and mineralogical reactions including precipitation and adsorption reactions and ionic fixation within lattice structures of clay minerals. Soil is an important component in human's total stock of natural resources which underpins food production (Buol *et al.,* 2003) [2] and it was described as a product of its environmental factors of climate, vegetation/ organic matter, parent material, relief and time. The most important basic natural resource that determines the ultimate sustainability of any agricultural system is the soil. The inherent ability of soils to supply nutrients for crop growth and maintenance of soil physical conditions to optimize crop yields is the most important component of soil that virtually determines the productivity of agricultural system. A thorough and proper understanding of morphological, physical and chemical characteristics of the soils gives greater insight of the dynamics of the soil. Different land use systems viz. agriculture (irrigated and un irrigate) horticulture forestry, agri-horticulture, pastures and wasteland system lead to the change in physio-chemical properties and also change in nutrient content (Ally-said *et al*., 2015) [1]. Nutrient supply continually shifts with the rate and direction dependent on the prevailing processes in the soil system, but subject to overriding human influence. Over relatively short periods of time, the soil nutrient supply can be subject to seasonal fluctuations. The long-term stability of the soil nutrient supply is of increasing concern in the face of a diminished forest land base, increased demand for forest products, and reluctance to apply nutrients to many forest areas because of environmental or economic constraints.

Material and Method

Present study was undertaken in the forest growing areas of Ganderbal district of Kashmir valley. A longitudinal depression in the greater north western complex of the Himalayan district is located between 34^0 6′ to 34^0 27′ N latitude and 74^0 40′ to 75^0 35′ E longitudes covering an area of 1462.8 Km^2. The topography of the Ganderbal district is varied exhibiting altitudinal range from of 1590 to 2810 m above mean sea level fig. 1.

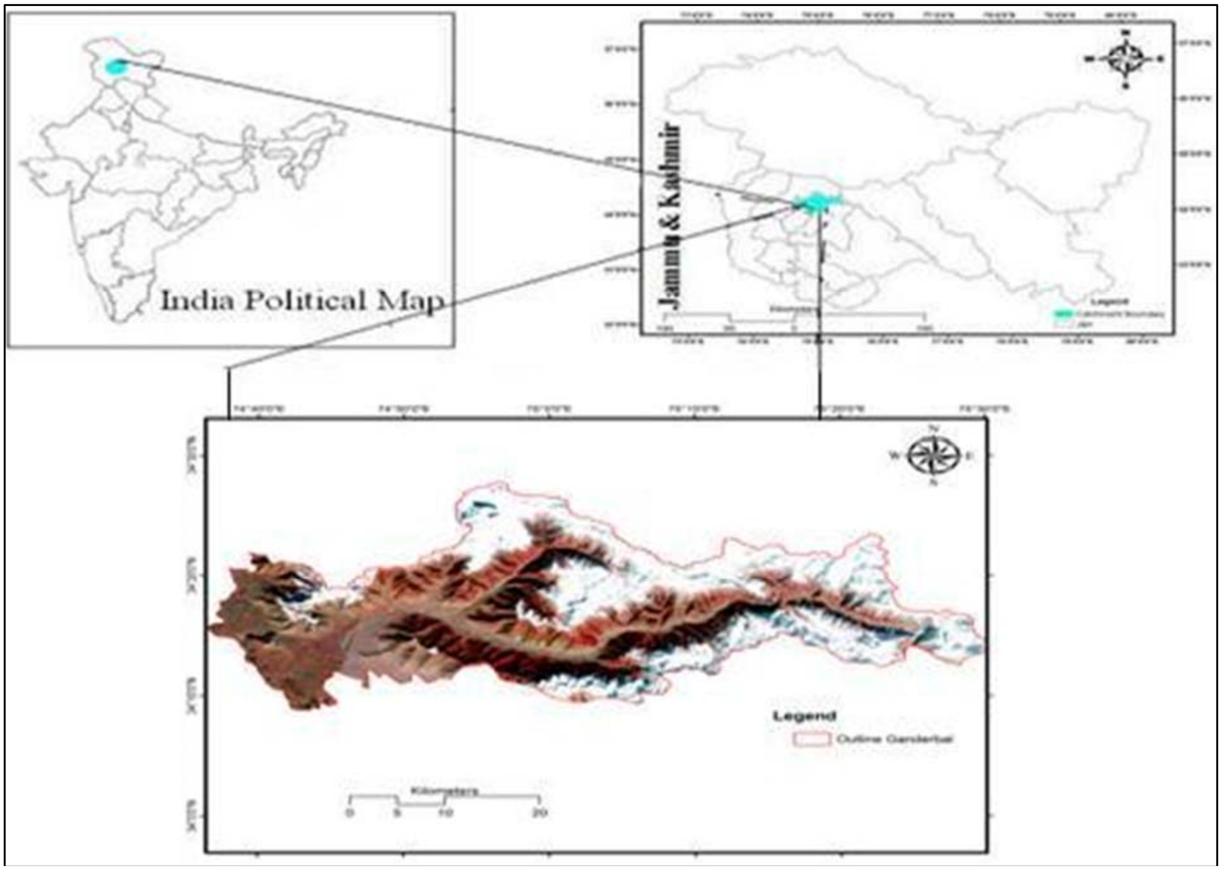

Fig 1: Geographic and LISS III image of Ganderbal district 2015

The soils are shallow to deep in depth. Soils are slightly acidic to neutral in reaction, high in organic carbon while as available nitrogen was estimated by alkaline permagnate method as given by Subbiah and Asija (1956) [15]. The available phosphorus was extracted by Olsen's Extractant (0.5 N $NaHCO_3$ at pH 8.5) and colour developed by stannous chloride. Intensity was measured with the help of spectrophotometer at 660 nm wave - length (Jackson, 1973) [7], available potassium was extracted by 1N ammonium acetate at pH 7 and then determined with the help of flame photometer using K-filter (Jackson, 1973) [7] and Available sulphur was determined turbidimetrically as Barium sulphate by the method of Chesnin and Yein (1950) [3]. The micronutrient estimation was done by using the method outlined by Lindsay and Norvell (1978) [11]. About 10 g of processed soil sample was shaken for 2 hours with 20 ml of extractant (0.005 M DTPA, 0.01 M $CaCl_2$ and 0.1 N TEA buffered at 7.3 pH) on electrical shaker and then filtrate was analyzed for zinc (Zn) copper (Cu), manganese (Mn) and Iron (Fe) using atomic absorption spectrophotometer (AAS).

Result and discussion

Perusal of data present in table 1 revealed that among macro nutrients the content of available nitrogen in studied land use with the confidential interval ranged from 374.36 to 468.09 kg ha^{-1} with a mean value of 421.22 kg ha^{-1}. All the profiles showed that the available nitrogen decreases with the increase in depth. Increasing trend of Nitrogen increased with the altitude. Soil fertility exhibits the status of different soils with regard to the amount and availability of nutrients essential for plant growth. The available N found to be maximum in surface horizons and decreased regularly with depth which is due to decreasing trend of organic carbon with depth and cultivation of crops are mainly confined to the surface horizon (Rhizosphere) only and at regular interval the depleted nitrogen content is supplemented by the external addition of fertilizers during crop cultivation. The available nitrogen was found higher in high altitude compared to mid and low altitude. This can be attributed to the high organic carbon/matter in high altitude soils. (Satish Kumar and Naidu, 2012 and Naidu and Sireesha, 2013) [14, 12].

The data in the table 1 revealed that the respective value of phosphorus with confidential interval ranged from 16.14 to 19.77 $kgha^{-1}$ with a mean value of 17.96, kg ha^{-1}. Phosphorus content decreases with the increase in depth. The highest available P was observed in the surface horizons and decreased with depth. It might be due to the confinement of crop cultivation to the rhizosphere and supplementing the depleted P by external sources *i.e.* fertilizers and presence of free iron oxide and exchangeable Al^{3+} in smaller amounts (Singh and Mishra, 2012; Naidu and Sireesha, 2013) [16, 12]. The lower phosphorus content in sub-surface horizons in these profiles could be attributed to the fixation of P by clay minerals and oxides of iron and aluminum (Thangasamy *et al*., 2005; Khanday, 2017) [19]. However, the data depicted that the available phosphorus was slightly high in low altitude soils which might be due to the continuous use of phosphatic fertilizers resulted in the built up of phosphorus in intensity cultivated low altitude soils (Sharma *et al.,* 2008) [17].

Available potassium was medium in surface horizons and showed a regular decrease with the depth. The confidential interval ranged from 269.75 to 386.67 $kgha^{-1}$ with a mean value of 328.21 $kgha^{-1}$. Potassium did not shown any trend with altitude. The highest available K was observed in the surface horizons and showed more or less a decreasing trend with depth. This might be attributed to more intense weathering, release of liable K from organic residues, application of K fertilizers and upward translocation of K from lower depths along with capillary raise of ground water (Sharma and Anil Kumar 2003, Kirmani, 2004, Naidu and Sireesha, 2013) [18, 10, 12].

Available sulphur content was low to medium in general and showed a regular decrease with the depth in all the profiles. The confidential interval ranged from 13.35 to 16.79 kgha^{-1} with a mean value of 15.07 kgha^{-1} respectively. The profiles showed decrease in sulphur down the profile increase in sulphur content in surface and sub-surface horizons which might be due to varying land use and parent material (Farida, 1997) [5]. The prevalence of high S content in surface horizons may be due to higher organic matter (Najar, 2002) [13].

The micro nutrient does not follow the regular trend however almost all the micronutrients are in sufficient range. The data in Table-2 reveals that all the profiles of the study area were medium to high in zinc content with a decreasing trend in the sub-surface horizons with the depth with confidential interval ranged from 1.19 to 2.16 mg kg^{-1} and with a mean value of 1.68 mgkg^{-1}. Vertical distribution of Zn exhibited little variation with depth. Considering 0.6 mg kg^{-1} as critical level (Lindsay and Norvell 1978) [11] these soils were sufficient in surface horizons The low available Zn was possibly due to high soil pH values which might be resulted in the formation of insoluble compounds of Zn or insoluble calcium zincate (Jagdish Prasad *et al.* 2009) [8]. Slight decrease in the content of zinc was noted with the increase in soil depth, which may be attributed to their positive and significant correlation with organic carbon. Similar findings were observed by Ganai *et al.,* (1999) [6] while working on cherry orchards of Kashmir valley. Similar results were reported by Devi *et al.,* (2015) and Khanday *et al.,* (2017) [4].

The DTPA-extractable Fe content varied from medium to high. According to critical limit of 4.5 mg kg^{-1} of Lindsay and Norvell (1978) [11]. The confidential interval ranged from 29.23 to 40.06 mg kg^{-1} with a mean value of 34.65, mgkg^{-1}. The distribution of available Fe in all the pedons decreased with the increase in depth. It might be due to reduction of organic carbon in the sub surface horizons. Surface horizons had higher concentration of DTPA-extractable Fe due to relatively higher organic carbon in surface horizons.

According to critical limit of 1.0 mg kg^{-1} of Lindsay and Norvell (1978) [11], the soils were sufficient in available Mn. The confidential interval ranged from 29.02 to 36.35 mg kg^{-1} with a mean value of 32.69 mg kg^{-1} and almost decreased with depth which might be due to higher biological activity and organic carbon in the surface horizons, the higher content of available Mn in surface soils was attributed to the chelating of organic compounds released during the decomposition of organic matter left after harvesting of crop.

Table 1: Macro nutrient status of forest growing soils of Ganderbal District.

Location	Horizon	Depth (cm)	Kgha^{-1}			
			N	P	K	S
P1 Pakhtoon	A	0-19	398.87	23.23	296.35	20.32
	AB	19-50	382.46	20.12	284.83	18.11
	Bt_1	50-78	365.88	18.46	263.24	16.34
	Bt_2	78-93	342.98	17.36	245.58	14.43
	C	93-115	332.54	15.24	234.78	12.98
P2 Babanagri	A	0-15	423.23	18.25	464.16	17.21
	Bw_1	15-36	412.54	16.76	458.67	15.15
	Bw_2	36-58	404.56	14.56	442.32	12.43
	BC	58-80	382.56	13.35	436.59	11.32
P3 Thajwas	A	0-22	510.34	21.54	280.69	16.32
	AC	20-47	496.12	19.32	272.46	14.32
	C	47-58	482.65	17.37	258.87	11.97
	Mean		421.22	17.96	328.21	15.07
	95% C.I		374.36-468.09	16.14-19.77	269.75-386.67	13.35-16.79

Table 2: Micro nutrient status of forest growing soils of Ganderbal District

Location	Horizon	Depth (cm)			mgkg^{-1}	
			Zn	Fe	Mn	Cu
P1 Pakhtoon	A	0-19	2.71	47.80	39.34	3.77
	AB	19-50	2.47	43.09	34.64	2.68
	Bt_1	50-78	1.33	36.03	31.79	1.68
	Bt_2	78-93	1.30	31.79	28.56	1.08
	C	93-115	0.84	28.28	22.37	0.65
P2 Babanagri	A	0-15	1.57	32.05	40.82	1.65
	Bw_1	15-36	1.27	29.58	34.80	1.30
	Bw_2	36-58	0.95	24.58	31.96	1.15
	BC	58-80	0.73	19.73	24.18	0.85
P3 Thajwas	A	0-22	2.89	44.20	38.58	2.24
	AC	20-47	2.44	41.82	35.39	1.64
	C	47-58	1.66	36.90	29.89	1.32
	Mean		1.68	34.65	32.69	1.66
	95% C.I		1.19-2.16	29.23-40.06	29.02-36.35	1.11-2.22

All these pedons were found to be sufficient in available Cu as all the values were well above the critical limit of 0.20 mg kg^{-1} soil as suggested by Lindsay and Norvell (1978) [11] with confidential interval ranged from 1.11 to 2.22 mgkg^{-1} with a mean value of 1.66 mgkg^{-1}. The variation in Cu content with the depth may also be attributed to the positive relation with organic carbon, clay content and cation exchange capacity of the soils (Yadav and Meena, 2009) [20].

Conclusion

Land use planning should be done on the basis of physico-chemical properties and nutrient status of different horizons of upland and lowland soil of the district. The available nutrients nitrogen, phosphorus, potassium and Sulphur were medium to high in range and decreases with the increase in depth and similar trend was followed by micronutrients decreases with the increase in depth however iron, zinc, copper and manganese were medium to high in range.

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