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Mehraj ud din Khanday
Division of soil science SKUAST-K, Srinagar, J&K, India

JA Wani
Division of soil science SKUAST-K, Srinagar, J&K, India

D Ram
Division of soil science SKUAST-K, Srinagar, J&K, India

Sandeep Kumar
Division of soil science SKUAST-K, Srinagar, J&K, India

Correspondence
Mehraj ud din Khanday
Division of soil science SKUAST-K, Srinagar, J&K, India

Depth wise distribution of available nutrients of soils of horticulture growing areas of ganderbal district of Kashmir valley

Mehraj ud din Khanday, JA Wani, D Ram and Sandeep Kumar

Abstract
The soil sampling was carried out in district Ganderbal in the year 2015 using toposheet (1:50,000) and LISS III image as base map using standard method of soil survey. Keeping in view the major land uses of Ganderbal district, Horticulture growing areas were selected and three profiles were exposed on the basis of soil heterogeneity, vegetation, Physiography, elevation, slope and soil colour. Available Micro and Macro nutrients were determined using standard techniques. The study revealed that the soils were shallow to deep with profile development from A-C, A-Bw-C to A-Bt-C in Foot hills, Low hill plateaus and Inland valley, respectively. The Organic carbon content was confined more in surface horizons than in sub-surface horizons. Soil reaction was slightly acidic to alkaline and the soluble salt concentration was negligible. The available nutrients nitrogen, phosphorus, potassium and Sulphur were medium 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: major nutrients, micro, macro, acidic, inland valley, Physiography

Introduction
The natural resources like soil, water and vegetation form an integral part of Himalayan ecosystem warranting due attention to ensure ecological security and sustainable socio-economic development. Management of these natural resources in the Himalayan region is critical as it concerns not only the inhabitant of the hills but also the livelihood and prosperity of large population in the down plains. 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]. Therefore an attempt has made to study different land use systems of district Ganderbal, which spread mostly in north-east direction of Jammu and Kashmir. As the soil properties change among all above mentioned land use systems which in turn leads to change in type of vegetation and productivity among different land use systems, therefore it is not possible to develop a single short list of soil properties which is suitable for all purposes. The study area is having high altitudinal variations with deep rock girt gorges, glaciers, forests, open grassy meadows and villages on dotted slopes. However, these natural resources are beautiful but environmentally very fragile and at present facing tremendous pressure due to varied anthropogenic activities in the region. Maintaining soils in a state of high productivity on sustainable basis is important for meeting basic needs of the people.

Material and Method
The present study was undertaken in the Ganderbal district of the north eastern part of Kashmir valley. The district is constituted into three tehsils (Gaderbal, Kangan and Lar) and four blocks viz Ganderbal, Kangan, Lar and Wakoora. 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.

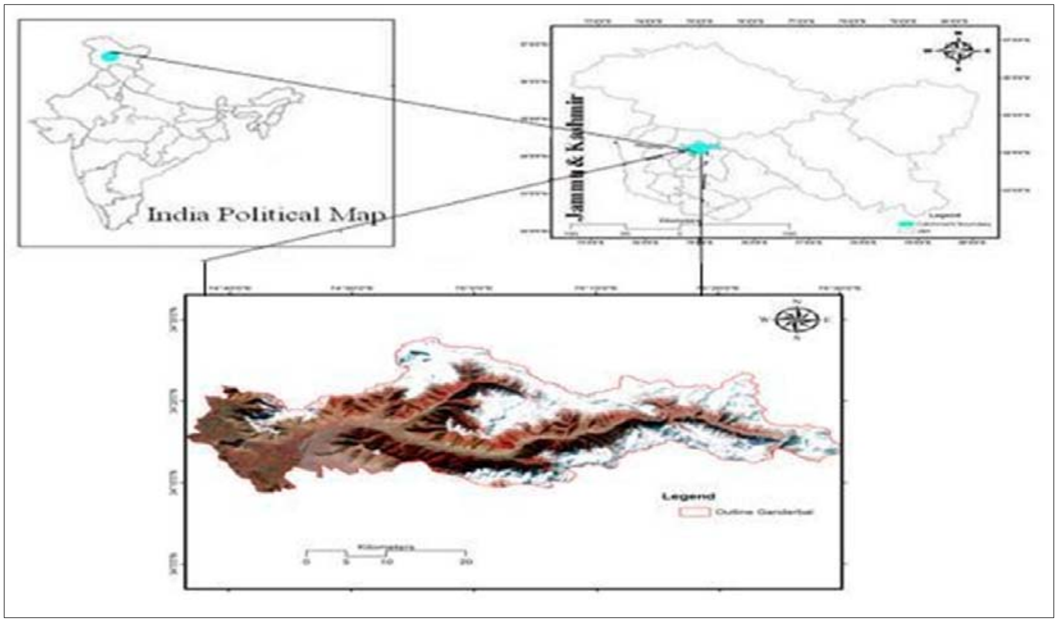

Fig 1: Geographic and LISS III image of Ganderbal district 2015.

The soils are shallow to deep in depth. Soils are slightly acidic to neutral in reaction, high in organic carbon. The wide variation in soil characteristics is mostly associated with variation in slope, vegetation cover, parent material and slop, aspect. The soils are mostly subjected to moderate to severe erosion and have moderate surface stoniness at some places these patches are dominantly associated with rock out crop 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 335.83 to 392.38 kg ha^{-1} with a mean value of 364.10 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 15.00 to 18.11kgha^{-1} with a mean value of 16.55, kgha^{-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 290.03 to 397.45 kgha^{-1} with a mean value of 343.74 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 13.15 to 17.11 $kgha^{-1}$ with a mean value of 15.13 $kgha^{-1}$ 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 in different land uses systems however almost all the micronutrients are in sufficient range. The data in Table-2 reveals that all the profiles of the study area were normal in zinc content with a decreasing trend in the sub-surface horizons with the depth with confidential interval ranged from 1.09 to 1.83 $mgkg^{-1}$ and with a mean value of 1.46 $mgkg^{-1}$. 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. The trend variation may also be attributed to the root distributional patterns of principle crops in soil profiles. Similar results were reported by Devi *et al.,* (2015) [4] and Khanday *et al.,* (2017).

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 27.93 to 36.90 mg kg^{-1} with a mean value of 32.42, $mgkg^{-1}$. 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 22.39 to 29.64 mg kg^{-1} with a mean value of 26.02 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 Horticulture growing soils of Ganderbal District.

Location	Horizon	Depth (cm)	$Kgha^{-1}$ N	P	K	S
P1 Gotlibag	A	0-15	332.43	22.21	392.26	15.32
	Bw_1	15-37	326.98	19.32	382.65	13.22
	Bw_2	37-59	319.65	17.43	376.54	12.21
	Bw_3	59-95	312.67	15.12	363.28	10.32
	BC	95^+	304.65	14.23	352.76	09.21
P2 Wangth	A	0-20	382.00	18.56	313.98	21.32
	Bt_1	20-46	376.23	16.67	257.43	20.13
	Bt_2	46-87	354.43	15.12	212.56	18.12
	C	87-105	342.43	14.23	208.65	16.24
P3 Kullan	A	0-16	456.32	19.34	484.29	17.43
	Bw_1	16-47	432.84	17.34	452.34	15.32
	Bw_2	47-76	420.32	16.34	426.59	14.56
	BC	76-85	408.22	13.45	394.61	13.21
	Mean		364.10	16.55	343.74	15.13
	95% C.I		335.83-392.38	15.00-18.11	290.03-397.45	13.15-17.11

Table 2: Micro nutrient status of Horticulture growing soils of Ganderbal District.

Location	Horizon	Depth (cm)	Zn	Fe	$mgkg^{-1}$ Mn	Cu
P1 Gotlibag	A	0-15	1.89	38.47	25.44	2.54
	Bw_1	15-37	1.56	32.23	23.12	1.63
	Bw_2	37-59	1.34	28.43	21.45	1.45
	Bw_3	59-95	1.22	24.21	19.67	1.21
	BC	95^+	1.12	18.62	17.43	0.78
P2 Wangth	A	0-20	2.32	45.61	33.80	2.48
	Bt_1	20-46	1.74	38.21	26.56	2.16
	Bt_2	46-87	0.80	34.57	23.10	1.65
	C	87-105	0.75	31.23	21.43	1.19
P3 Kullan	A	0-16	2.59	40.72	38.08	1.81
	Bw_1	16-47	2.05	34.27	32.43	1.63
	Bw_2	47-76	0.89	30.23	29.21	0.82
	BC	76-85	0.76	24.67	26.54	0.34
	Mean		1.46	32.42	26.02	1.51
	95% C.I		1.09-1.83	27.93-36.90	22.39-29.64	1.11-1.91

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 1.91 $mgkg^{-1}$ with a mean value of 1.51$mgkg^{-1}$. 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

The variability in nutrient status in the vertical distribution of soil profile has a long term bearing on the production and productivity in orchard of Ganderbal district. 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 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.

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