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Impact of different altitudes on distribution of micro-nutrients under different land use systems of district Kupwara

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Abstract
In order to study the "Distribution of Micro-nutrients at Different Altitudes Under Different Land Use Systems in district Kupwara" soil samples from four land uses of high, mid and low altitude areas of Kupwara were collected up to a depth of 0-20 cm. The soil samples were studied for various physico-chemical properties and micro-nutrient status. The study revealed that texture of soils ranged between clay Loam, Silty clay loam to sandy loam. The soils were slightly acidic to slightly alkaline in reaction with normal electrical conductivity. Bulk density and Particle density were decreasing with altitude increase. The organic carbon content was medium to high with higher amount in soils of high altitude. The pH, electrical conductivity, calcium carbonate, cation exchange capacity and organic carbon varied significantly with altitude. The DTPA-extractable zinc, copper, manganese and iron ranged from 0.81-2.87, 0.54-2.72, 5.75-50.2 and 21.78-53.43 ppm, respectively. The micro-nutrient status under study was almost medium to high and showed linear increasing trend with increase in altitude. All available micronutrients in soils exhibited significant differences with altitude. The correlation studies revealed that organic carbon showed positive and significant relationship with available micronutrients *viz* zinc, copper, iron and manganese. The pH and EC exhibited significant and negative relationship with available zinc, copper, manganese and iron. The calcium carbonate showed significant and negative correlation with available micronutrients. The OC and CEC content revealed significant and positive relationship with available micronutrients. These properties affect the availability of micronutrients in the soil.

Keywords: Land use, altitude, available nutrients

Introduction

Soil is a natural body which provides a medium for the growth of plants. The soils vary greatly due to climate, vegetation, altitude, parent material, topography etc. as they have pronounced effect on the proportion of mineral matter, organic matter, water and air of a soil. The mineral and organic fractions of the soil are responsible for supplying the various nutrients which are required for the growth and development of the plants besides maintaining the health of the soil. Altitude is an important ecological factor of soil formation and development. With the variations in altitude, climatic factors of an area also changes. The properties of climate which change with the altitude are temperature, precipitation and solar radiation. Further, with variations in altitude, there is a contrasting change in soil biota which results in a differential composition of soil organic matter in terms of quality and quantity. Leaching and run-off also affect the properties of soil and soil profile development. Soil fertility and plant nutrition are two closely related subjects that emphasize the forms and availability of nutrients in soils, their movement and their uptake by roots and the utilization of nutrients within plants (Foth and Ellis, 1997) [8]. Without maintaining soil fertility, one cannot talk about increment of agricultural production in feeding the alarmingly increasing population. Soil nutrients are important elements that support plant growth and crop productivity. Maintenance of soil nutrients at sufficient levels for macro- and micronutrients remains prerequisite in ensuring sustained crop yields (Campbell, 1998; Hazarika *et al*, 2016) [5, 11]. Usually macronutrients, required in large quantities, are the focus of many interventions, unlike micronutrients that are required in small quantities (Brady & Weil, 2010; Mowo *et al*., 1993) [4, 14]. Out of 17 plant nutrients, Zinc, Copper, Iron, Manganese, Molybdenum, Chlorine and Boron are referred as micronutrients (Nazif *et al*., 2006) [20]. These Micronutrients often act as cofactors in enzyme systems and participate in redox reactions, in addition to having several other vital functions in plants. Most importantly, micronutrients are involved in the key physiological processes of photosynthesis and respiration (Mengel *et al*., 2001) [16] and their deficiency can impede these vital physiological processes thus limiting yield gain (Patil *et al*., 2008) [21]. For example, for rice (*Oryza sativa* L.) Zinc deficiency is a major yield-limiting factor in several Asian countries (Wissuwa *et al*., 2006; Rehman *et al*., 2012) [29, 25]. On the world scale, it is estimated that Iron (Fe) and Zinc (Zn) deficiencies are widespread occurring in about 30 percent and 50 percent of cultivated soils, respectively (Cakmak, 2002) [6]. Micronutrients quantities required by plants are very small, and the thresholds for sufficient, deficient, and toxic levels are also very close. Several reviews have summarized and suggested the micronutrients range based on extraction methods (Brady and Weil, 2010; Sillanpaa, 1982) [4, 26]. Major sources of soil micronutrients are inorganic forms from parent material and organic forms within humus, though deficiency or toxicity can mostly be attributed to the parent material (Ritchie *et al*., 2007; Joy *et al*., 2015) [23, 13]. Furthermore, factors which play important roles in regulating micronutrients include soil pH, oxidation state, organic matter, mycorrhizae, organic compounds, and stability of chelates (Ali, 2014) [3]. Most soils vary in their micronutrient content, and deficiencies in supplying micronutrients are alarming (Meliyo *et al*., 2014) [17]. Deficiency of micronutrients can result in severe crop failure, hence attempts to improve crop production and soil management (Meliyo *et al*., 2014; Wani *et al*., 2013) [17, 30] must be in line with micronutrients amendments (Garcia-Ocampo, 2012) [9]. The intensive plant production practice and use of high analysis fertilizers resulting in deficiency of micronutrients in soils is receiving more attention throughout the world. Increasing evidences indicate that food grown on soils with low level of trace elements may produce low yields, besides, insufficient human dietary levels of certain elements as they play dominant role in activation of numerous enzyme systems. Very less work has been done on micronutrient distribution of the soils of valley in general, and these soils in particular.

Materials and Methods

The present investigation "Impact of Different Altitudes on Distribution of Micro-nutrients Under Different Land Use Systems of District Kupwara" was carried out. The study area (Kupwara) is a notified area committee carved out from Srinagar in the state of Jammu and Kashmir, India and has been recognized as separate district, which is situated at a distance of ninety km away from Srinager and located in the farthest northwest of Kashmir valley. It falls between 34°15′25″ and 34°49′30″N latitudes and 73°46′05″and 74°36′48″E longitude. The average elevation is 1,741 amsl, with an average annual temperature of 18.8 °C and average annual rainfall of 990 mm. The soil samples collected thereof were investigated for mechanical components, physico-chemical properties and the available micro- nutrient status. The micronutrient estimation was done by using the method outlined by Lindsay and Norvell (1978) using Atomic Absorption Spectrophotometer (AAS).

Result and Discussion

The micro-nutrients doesn't follow the regular trend in different land use systems however almost all the micronutrients are in sufficient range in all landuse systems but Zinc is low at some sites. Higher range of micronutrients were found at higher altitudes which may be due to high OM content. The mean value of Zn at high altitude 1.95, while at mid and low it was 1.64 and 1.34 ppm. Lowest and highest mean value of zinc was found in pasture and forestry. The results might be due to high available zinc and soil organic matter and suitable pH, adsorption of zinc, interaction with other nutrients, flooding, type of soil and climatic conditions. The results are in conformity with the findings of Jalali *et al*. (1989) [12], Rakshanda (2005) [22], Ganai (2014) [10] and Maqbool *et al*. (2018) [18]. The mean value of Cu at high altitude was 2.13 while at mid and low it was 1.80 and 1.50 ppm respectively. Lowest and highest mean value of Cu content was found in pasture and forestry, which may be attributed due to higher pH in pasture than forestry. The results might be due to high application of copper fertilizers and soil organic matter and suitable pH, occluded and co-precipitated copper interaction with other nutrients, type of soil and climatic conditions. The results are in accordance with the findings of Mushki (1994) [15], Wani (1994) [28], Anjum (2012) [2], Ganai (2014) [10], and Maqbool *et al*. (2018) [18]. Manganese content mean value at high altitude was 32.04, while at mid and low it was 26.84 and 24.17 ppm. In all LUSs lowest and highest mean value of manganese was in pasture and forestry at low and mid altitude, but at high altitude it was low in agriculture, almost all LUS are rich in manganese. The results might be due to high available manganese and soil organic matter and suitable pH. The results are in accordance with Dar (1994) [7]; Najar, 2002 [19]; Sheikh (2006) [27]; Ganai (2014) [10], and Maqbool *et al*. (2018) [18]. The result revealed that the mean value of Iron content at high altitude was 38.75 while at mid and low altitude it was 34.60 and 31.83 ppm respectively. In case of land uses lower and highest content of iron was in pasture and forestry in low and mid altitude, which can be due low pH of forests as compared to pasture. At high altitude it was low in agriculture and high in forests. The variation in the amount of iron may be due to chelation of iron, soil pH and bicarbonate content, excessive water and poor aeration, variable amount of organic matter, type of soil texture and presence of other cations (Najar (2002) [19], Ahmed (2003) [1], Rattan *et al*. (2008) [24] Anjum (2012) [2] Ganai (2014) [10], and Maqbool *et al*. (2018) [18].

Table 1: Status of available micro-nutrients (ppm) of soil at different altitudes in different land use systems of district Kupwar

Altitude	Landuse systems	Location	Zn	Cu	Mn	Fe
	Agriculture	Braripora	0.9	0.76	15.827	28.49
		Turkpora	1.4	1.84	7.4	27.28
		Tulwara	0.81	1.72	23.877	26.05
		Buhama	0.96	0.54	18.37	22.11
		Batergam	1.59	1.63	25.32	41.34
		Mean±SE	1.13±0.15	1.30±0.27	18.16±3.20	29.05± 3.25

LOW		95% C.I	0.85 -1.49	0.65-1.78	11.61 -24.60	24.08 -34.92
	Horticulture	Chogal	0.96	1.54	21.56	29.75
		Butkoot	0.89	1.09	19.67	32.47
		Neelpora	1.37	1.97	27.52	35.84
		Aarampora	1.44	1.02	16.53	27.06
		Hayan	1.07	1.06	18.93	28.34
		Mean±SE	1.15±0.11	1.34±0.18	20.84±1.85	30.69±1.57
		95% C.I	0.92 -1.40	1.04 -1.75	17.73 -24.54	27.70 -34.16
	Pasture	Neelpora	1.21	1.05	17.88	22.56
		Tikar	1.07	1.3	18.55	33
		Hiri bala	1.01	1.32	17	32.04
		Zachaldara	1.45	1.23	10.69	21.78
		Ashkenpora	0.85	1.47	24.45	29.55
		Mean±SE	1.12±0.101	1.27±0.06	17.71±2.19	27.79±2.36
		95% C.I	0.93-1.33	1.14-1.39	13.85 -21.50	22.17-32.52
	Forest	Zachaldara	2.18	1.78	48	47
		Kupwara	1.51	2.23	22.54	40.45
		Tikar	2.06	1.65	49.2	44.26
		Turkpora	1.95	2.42	40.97	43.38
		Ashkenpora	2.23	2.41	39.12	23.78
		Mean±SE	1.99±0.13	2.10±0.16	39.96±4.77	39.77±4.13
		95% C.I	1.73 -2.20	1.71 -2.41	30.83 - 48.60	32.12 - 45.63
Overall mean			1.34	1.50	24.17	31.83

Altitude	Landuse systems	Location	Zn	Cu	Mn	Fe
MID	Agriculture	Sogam	0.85	2.38	33.312	32.8
		Laribal	1.962	1.31	5.75	40.4
		Chandigam	1.877	2.09	35.03	31.4
		Badibera	0.89	1.35	16.66	34.26
		Malpora	1.45	0.65	15.72	25.52
		Mean±SE	1.41±0.23	1.56±0.31	21.29±5.60	32.88±2.40
		95% C.I	0.87 -1.92	0.98 -2.23	10.74 - 34.17	28.46 - 37.33
	Horticulture	Chinjimula	1.25	1.97	20.28	30.49
		Hayan	0.94	1.87	29.83	45.52
		Trehgam	1.55	1.68	15.81	31.43
		Villgam	1.65	0.99	20.88	37.9
		Sogam	1.7	1.38	33.94	23.65
		Mean±SE	1.42±0.143	1.58±0.18	24.15±3.34	33.80± 3.70
		95% C.I	1.09-1.67	1.18 -1.92	18.05 -31.89	27.07 - 41.71
	Pasture	Chandigam	1.35	1.42	21.41	24.55
		Guglusa	1.65	1.3	23.69	39.78
		Tulwara	1.54	2.05	22.56	40.46
		Chandigam	1.23	1.51	19.2	23.52
		Lasipora	1.15	1.45	16.88	29.56
		Mean±SE	1.38±0.09	1.54±0.13	20.74±1.22	31.57±3.64
		95% C.I	1.19-1.59	1.36 -1.78	18.04 -23.13	24.04 – 40.12
	Forest	Gundmaschar	1.99	2.46	22.85	32.68
		Gund gushi	2.39	2.69	47.82	43
		Chandigam	2.23	2.47	44.12	28.78
		Gundmaschar	2.56	2.49	50.2	46.99
		Sogam	2.65	2.65	40.97	49.38
		Mean±SE	2.36± 0.12	2.55±0.05	41.19± 4.85	40.17± 4.03
		95% C.I	2.11-2.60	2.46-2.67	31.91-49.01	30.73 - 48.19
Overall mean			1.64	1.80	26.84	34.60

Altitude	Landuse systems	Location	Zn	Cu	Mn	Fe
	Agriculture	Sogam	0.902	2.437	41.817	40.32
		Laribal	1.075	2.182	21.257	27.68
		Chandigam	2.6502	1.37	6.288	38.5
		Badibera	2.29	2.2	36.93	35.63
		Malpora	1.56	1.64	24.86	31.75
		Mean±SE	1.69± 0.34	1.97±0.20	26.23±6.25	34.78±2.29
		95% C.I	0.99- 2.47	1.50 -2.32	13.77-39.37	29.72 -39.41
	Horticulture	Chinjimula	1.52	2.04	32.78	45.7
		Hayan	1.64	1.84	17.08	32.58
		Trehgam	1.42	2.22	41.02	27.78
		Villgam	1.56	1.35	23.72	25.03
		Sogam	2.41	2.43	21.6	53.43
		Mean±SE	1.71± 0.179	1.98±0.18	27.24±4.29	36.90±5.45
		95% C.I	1.47-2.02	1.59 -2.32	19.34-36.90	26.41 - 49.57

HIGH	Pasture	Chandigam	1.85	1.58	19.2	38.52
		Guglusa	1.39	1.47	23.45	34.55
		Tulwara	2.88	2.85	41.02	52.14
		Chandigam	1.45	1.45	31.88	22.56
		Lasipora	1.54	2.55	32.56	45.46
		Mean±SE	1.82±0.28	1.98± 0.30	29.62± 3.81	38.65±5.02
		95% C.I	1.42- 2.36	1.46 -2.70	21.33- 36.79	28.56 -48.80
	Forest	Gundmaschar	2.87	2.72	38.23	39.82
		Gund gushi	2.65	2.65	38.97	49.38
		Chandigam	2.36	2.49	50.2	48.99
		Gundmaschar	2.36	2.45	50.2	46.26
		Sogam	2.69	2.65	47.82	39
		Mean±SE	2.59± 0.10	2.59±0.052	45.08± 2.69	44.69± 2.23
		95% C.I	2.36 -2.78	2.47-2.68	38.60 -50.20	39.41 - 49.19
Overall mean			1.95	2.13	32.04	38.75

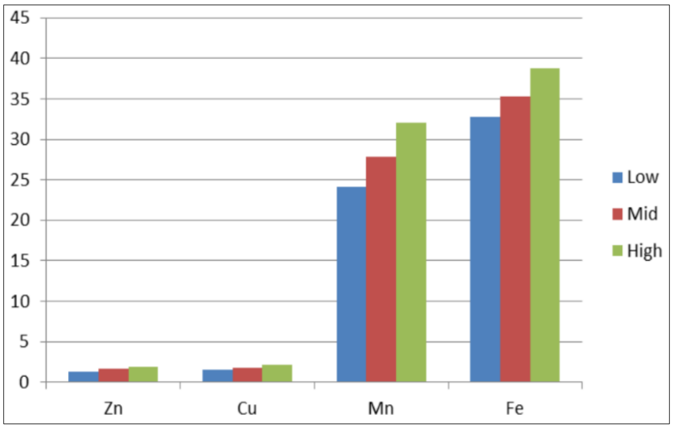

Fig 1: Distribution of DTPA extractable soil micronutrients at different altitudes of district Kupwara

Co-relation between physico-chemical properties and micronutrient

The correlation coefficient was worked out between physico-chemical properties at different altitudes in different LUSs and micronutrients (Table 2.) Perusal data revealed that pH showed negative and significant correlation with, Zn (r=0.368), Cu (r=0.561), Mn (r=0.537), Fe (r=0.470). EC showed negative significant correlation with Zn (r= 757), Cu (r= 693), Mn (r= 641) and Fe (r=587). OC showed positive significant correlation with Zn (r= 0.423), Cu (r=0.400), Mn (r= 632) and Fe (r= 0.518). CEC showed positive significant correlation with Zn (r= 548), Cu (r= 380), Fe (r= 275) and Mn (r= 487). Calcium carbonate showed negative significant correlation with Zn (r= 568), Cu (r= 636), Fe (r= 421) and Mn (r= 483).

Table 2: Correlation between Physico-chemical properties and available micronutrients

Available micronutrient	physico-chemical properties				
	pH	**EC**	**OC**	**CEC**	**CaCO3**
Zn	-.368**	-.757**	.423**	.548**	-.568**
Cu	.561**	-.693**	.400**	.380**	-.636**
Fe	-.470**	-.587**	.518**	.275**	-.421**
Mn	-.537**	-.641**	.632**	.487**	-.483**
Zn	-.368**	-.757**	.423**	.548**	-.568**

** Significant at 1% level of significance * significant at 5% level of significance

Conclusion

The micro-nutrients showed higher content at high altitudes but low at low altitude. In different LUSs they were low in pasture and agriculture and high in forests at all altitudes it may be due to low pH with high OC at high altitudes and forests.

References

1. Ahmad Z. Characterization and nutrient indexing of apple (*Malus domestica* Borkh) orchard soils of Bangil area of Baramulla District. M.Sc Thesis submitted to SKUAST-Kashmir Srinagar 2003, 1-104.
2. Anjum R. Characterization, classification and Evaluation of soil Resources in Dara Microwatershed. Ph. D thesis submitted to Sher-e-Kashmir university of Agricultural Sciences and Technology of Kashmir Shalimar, Srinagar 2012, 48-111.
3. Ali F. Effect of applied phosphorus on the availability of micronutrients in alkaline-calcareous soil. Journal of Environment and Earth Science 2014;4(15):143-147.
4. Brady NC, Weil RR. Elements of the Nature and Properties of Soils, Pearson Education, New Jersey, NJ, USA, 3rd edition 2010.
5. Campbell LC. Managing soil fertility decline. Journal of Crop Production 1998;1(2):29-52.
6. Cakmak I. Plant nutrition research: priorities to meet human needs for food in sustainable way. Plant and Soil 2002;247(1):3-24.
7. Dar MA. Nutrient status of cherry (*Prunus avium* L.) orchards of Srinagar district. M.Sc. Thesis submitted to SKUAST-Kashmir Srinagar 1994, 1-140.
8. Foth HD, Ellis BG. Soil fertility, 2nd Ed. Lewis CRC Press LLC. USA 1997, 290.
9. García-Ocampo A. Fertility and soil productivity of Colombian soils under different soil management practices and several crops. Archives of Agronomy and Soil Science 2012;58(1):55-65.
10. Ganai IH. Estimation of Soil Erosion for Himalayan Micro-watershed using GIS Technique. Ph.D. thesis submitted to Sher-e-Kashmir university of Agricultural Sciences and Technology of Kashmir Shalimar, Srinagar 2014, 47-108.
11. Hazarika S, Kumar M, Jha AK. Micronutrients for improving crop production on acidic soils of Northeast India. National Academy Science Letters 2016;39(2):85-89.
12. Jalali VK, Talib AR, Takkar PN. Distribution of micro-nutrients in some benchmark soils of Kashmir at different altitudes. Journal of the Indian Society of Soil Science 1989;37:456-469.
13. Joy EJM, Broadley MR, Young SD. Soil type influences crop mineral composition in Malawi. Science of the total Environment 2015;505(1):587-595.

14. Mowo JG, Floor J, Kaihurm FBS, Magoggo JP. Review of Fertilizer Recommendations in Tanzania. 2, S.F.R.N. 26, National Soil Service, Tanga, Tanzania 1993.
15. Mushki GM. Studies on apple (Malus domestica Borkh) orchard soil of Kashmir. M.Sc Thesis submitted to SKUAST-Kashmir Srinagar 1994, 1-229.
16. Mengel K, Kirkby EA, Kosegarten H, Appel T. Further elements of importance. Principles of Plant Nutrition 2001, 639-655.
17. Meliyo JL, Massawe B, Brabers L, Leirs H. Status and variability of soil micronutrients with landforms in the plague focus of western usambara mountains, Tanzania. International Journal of Plant & Soil Science 2014;4(4):389-403.
18. Maqbool M, Akhtar F, Najar GR, Peer FA, Baba ZA, Dar KR *et al*. Journal of Pharmacognosy and Phytochemistry 2018;7(3):1905-1911.
19. Najar GR. Studies on pedogenesis and nutrient indexing of apple (Red Delicious) growing soils of Kashmir Thesis submitted to SKUAST-Kashmir Srinagar 2002, 1-204.
20. Nazif W, Parveen S, Saleem I. Status of micronutrients in soils of district Bhimber (Azad Jammu and Kashmir). Journal of Agri. Bio. Sci 2006;1(2):35-40.
21. Patil BC, Hosamani RM, Ajjappalavara PS, Naik BH, Smitha RP, Ukkund KC. Effect of foliar application of micronutrients on growth and yield components of tomato (*Lycopersicon esculentum* Mill.). Karnataka. Journal of Agricultural Science 2008;21(3):428-430.
22. Rakshanda Z. Studies on nutrient status of paddy growing soils of district Srinagar. M. Sc. Thesis submitted to SKUAST-K, Shalimar 2005, 4-30.
23. Ritchie JC, McCarty GW, Venteris ER, Kaspar TC. Soil and soil organic carbon redistribution on the landscape. Geomorphology 2007;89(1-2):163-171.
24. Rattan RK, Datta SP, Katyal JC. Micronutrient management: research achievements and future challenges. Indian Journal of Fertilizers 2008;4(12):93-118.
25. Rehman H, Aziz T, Farooq M, Wakeel A, Rengel Z. Zinc nutrition in rice production systems. Plant and Soil 2012;361(4):203-226.
26. Sillanpaa M. Micronutrients and the Nutrient Status of Soil: A Global Study, FAO Soils Bulletin, FAO, Rome, Italy 1982.
27. Sheikh AM. Studies on micro-nutrient cation in paddy growing soils of district Kupwara. M.Sc. Thesis Submitted to SKUAST-Kashmir Srinagar 2006, 59-65.
28. Wani MA. Distribution and forms of micronutrient cations (Zn, Cu, Fe and Mn) in some saffron (*Crocus sativus* L.) growing soil of Kashmir. Thesis submitted to SKUAST-K, Shalimar 1994, 1-119.
29. Wissuwa M, Ismail AM, Yanagihara S. Effects of zinc deficiency on rice growth and genetic factors contributing to tolerance. Plant Physiology 2006;142(2):731-741.
30. Wani MA, Wani JA, Bhat MA, Kirmani NA, Wani ZM, Bhat SN. Mapping of soil micronutrients in Kashmir agricultural landscape using ordinary Kriging and indicator approach. Journal of the Indian Society of Remote Sensing 2013;41(2):319-329.