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Status of DTPA-extractable micronutrients in soils of Samba district of Jammu and Kashmir in relation to soil properties

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ABSTRACT

The DTPA-extractable micronutrient cations (Zn, Cu, Fe and Mn) and their relationship soil with physico-chemical properties were investigated in four blocks namely Samba, Vijaypur, Ghagwal and Purmandal of Samba district in Jammu and Kashmir. The availability of micronutrients is particularly sensitive to change in soil environment. The status of DTPA-extractable micronutrients in these soils varied widely. The DTPA-extractable copper, zinc, manganese and iron in the surface (0-15cm) soils varied from 0.16 – 1.86, 0.06 – 1.11, 1.14 – 8.53 and 6.66 – 34.76 with mean values of 0.72, 0.29, 4.21 and 22.14 mg kg^{-1}, respectively. The available (DTPA-extractable) Cu had significant correlation with pH (-0.291), EC (0.389**) and organic carbon (-0.319*). The available (DTPA-extractable) Zn had significant negative correlation with EC (-0.321*) and positive with organic carbon (0.315*). The available (DTPA-extractable) Mn showed significant correlation with silt (-0.362*). Zinc deficiency was perceived in most of the surface samples (about 80%). Conversely, DTPA-extractable Mn and Fe in these samples were adequate. Hence, management of micronutrient Zn in soil is important to raise soil fertility in the area.*

Keywords: Available micronutrients, rice growing areas, soil characteristics

INTRODUCTION

Micronutrients play a vital part of the growth and development of crops. The availability of micronutrients is influenced by their distribution in soil and other physico-chemical properties of the soil (Sharma and Chaudhary, 2007). The status of micronutrient and their interrelationship with soil characteristic is supportive in understanding the natural capacity of soil to supply these nutrients to plant. Beside soil characteristics, land use pattern also plays a vital role in governing the nutrient dynamics and fertility of soils (Venkatesh *et al.,* 2003). There is a general lack of awareness among farmers on micronutrient deficiency problem. Micronutrient deficiency is considered as one of the major causes of the declining productivity trends observed in countries. Sodic, upland soils and calcareous coarse-textured soil with low organic matter content suffer from Fe deficiency, besides Zn and Cu deficiency.The total micronutrient content of soils is of limited value to plant growth and responses to their application. To match the levels of micronutrient in soil with plant requirement, their available contents in soils is determined. The available micronutrient status of soils is also highly variable (Singh, 2017). Soil properties exercise a considerable influence on the availability of micronutrients. Therefore, the extent of micronutrient deficiency varies not only in J&K state but also in different blocks within the same district depending upon the soil characteristics and other management conditions. Since no systematic information is yet available on status of micronutrient under different blocks in the Samba district of J&K, therefore the present work was conducted to assess the status of micronutrient in soils of Samba district.

MATERIALS AND METHODS

The study area is located in samba district of J&K (Latitude-32° 32' 59.99" N, to Longitude-75° 06' 60.00" E). Climate of this region is hot and dry in summer and cold in winter with the mean annual rainfall of 1233 mm.A study on DTPA-extractable micronutrients (Zn, Cu, Fe and Mn) was undertaken by collecting soil samples from different locations of Samba districtcomprising of four blocks(Samba, Vijaypur, Ghagwal and Purmandal).Sixty soil samples (0-15 cm) from various identified areas were collected and processed. These samples were analyzed for pH, EC, OC and CEC by standard methods (Jackson, 1973).These soil samples were also extracted with solution

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consisting of 0.005M DTPA, 0.01M $CaCl_2$ and 0.1 M Triethanolamine (pH 7.3) as per the procedure described by Lindsay and Norvell (1978) for available micronutrient cations. The Zn, Cu, Fe, Mn in extracts were estimated using atomic absorption spectrophotometer Model, Z2300 (Hitachi).

RESULTS AND DISCUSSION

Physico-chemical Properties

The results showed that majority of the soil sites were alkaline and neutral in reaction (Table 1). Since textural classes of most of the soils loam varied sandy clay loam to clay loam. Similar observations have been reported by Singh and Yadav (2017). The soil pH ranged between 6.24and8.44 with a mean value of 7.21 whereas electrical conductivity (EC) of these soils varied between 0.10 and 0.41 dSm^{-1} with a mean value of 0.22 dSm^{-1} (Tundup *et al.*, 2015). The soil organic carbon content ranged from 3.9 to 7.1 $gkg^{-1}$with overall mean value of 5.4 gkg^{-1}. The fertility of the soil with referred to amount of organic matter content in these soils showed was wide variation. The results are in accordance with those of Kumar *et al.*(2010) and Kumar and Sohan (2012). The values of CEC varied between 3.15 and 21.58 cmol (p^+) kg^{-1} with an average of 16.56 cmol (p^+) kg^{-1} for these soils. These observations were in accordance with the findings of Tundup *et al.* (2015).

Table 1: Range and average values of important physico-chemical properties of rice growing soils of Samba district

Block	pH	EC (dSm^{-1})	OC (g kg^{-1})	Sand (%)	Silt (%)	Clay (%)	CEC (cmol (p^+) kg^{-1})
Samba	6.73-8.44 (7.49)	0.11-0.41 (0.23)	3.9-6.9 (6.0)	22.00-38.08 (29.62)	11.52-43.60 (27.15)	20.32-66.16 (43.22)	5.56-21.58 (13.54)
Vijaypur	6.41-8.17 (7.35)	0.10-0.38 (0.22)	3.2-7.1 (5.4)	20.00-56.70 (37.30)	14.00-43.60 (29.61)	20.32-51.68 (32.68)	3.15-20.45 (12.21)
Ghagwal	6.71-7.30 (6.94)	0.14-0.29 (0.21)	5.1-6.1 (5.7)	30.16-45.10 (37.49)	24.00-31.90 (28.71)	30.90-39.60 (33.80)	6.81-16.34 (12.91)
Purmandal	6.24-7.49 (7.11)	0.11-0.32 (0.18)	4.2-5.9 (5.1)	30.40-45.10 (36.82)	24.00-39.60 (33.28)	26.32-31.80 (29.89)	5.54-19.14 (11.73)
Overall Mean	7.21	0.22	5.4	34.14	27.37	35.16	16.56

**Figure in parenthesis indicates mean value*

Micronutrients

DTPA- Cu: The DTPA- Cu ranged from 0.16 to 1.86 mg kg^{-1} with a mean value of 0.72 mg kg^{-1}.Relatively higher level of organic carbon maintained the higher Cu-availability (Ali *et al.* 2016). Copper and soil pH was negatively and significantly correlated (-0.288**) indicating that a decline in pH of the soil leads to significant increase in copper availability. Copper was also negatively and significantly correlated with organic carbon. (r = 0.327^*). Copper was also positively and significantly correlated with E C. (r = 0.395**). Correlation study indicated a negative relationship with CEC, silt and clay. Similar finding were also reported by Nazil *et al.* (2006). Considering 0.20 mg kg^{-1} as critical limit (Lindsay and Norvell, 1978), the studied soils samples were 8 per cent deficient and 92 per cent sufficient in DTPA-Cu all soil association of Samba district (Singh 2017).

DTPA-Zinc: DTPA- extractable zinc in the soil ranged from 0.06 to 1.11 mg kg^{-1} with an average value of 0.29 mg kg^{-1}. The higher value in Ghagwal soils might be due to higher content of organic carbon as well as finer fraction of soils leading to increase in the surface area for ion exchange and hence contributed to the higher amount of DTPA-Zn in these soils (Tundup *et al.* 2015). The available (DTPA-extractable) Zn had negative and positive significantly correlation with EC (-0.323*) and organic carbon (0.318*), respectively. These results were also supported by Yadav and Meena (2009). On the basis of the critical limits (0.6 $mgkg^{-1}$) suggested by (Lindsay and Norvell, 1978), 80 per cent soil samples were deficient and 20 per cent samples sufficient in available Zn in these soils. Singh (2017) also reported similar results.

Table 2: Status of DTPA-extractable cationic micronutrients ofrice growing area of Samba district

Block	Micronutrients (mg kg^{-1})			
	Cu	Zn	Mn	Fe
Samba	0.16-1.22 (0.61)	0.12-0.76 (0.33)	1.42-7.81 (4.37)	10.41-29.46 (21.93)
Vijaypur	0.22-1.86 (0.91)	0.06-1.11 (0.24)	1.61-8.53 (4.71)	6.66-34.76 (25.79)
Ghagwal	0.21-0.66 (0.42)	0.13-0.34 (0.23)	1.14-7.96 (1.42)	14.11-29.31 (17.93)
Purmandal	0.52-0.80 (0.63)	0.23-0.71 (0.33)	1.71-6.66 (3.81)	13.87-29.53 (21.59)
Range	0.16-1.86	0.06-1.11	1.14-8.53	6.66 – 34.76
Overall Mean	0.72	0.29	4.21	22.14

Figure in parenthesis indicates mean value

DTPA-Mn: The DTPA- manganese content of the soils varied from 1.14 to 8.53mg kg^{-1} with a mean value of 4.21 mg kg^{-1}. This higher value might be due to better supply of manganese to soils because Mn is soluble under relatively acidic and reducing conditions. Higher organic carbon may further increase the DTPA extractable Mn content in soil (Kirmani *et al.* 2011). The available (DTPA-extractable) micronutrient Mn had negative significantly correlation with silt (-0.367*). Manganese had negative correlation with soil pH, EC, organic carbon, sand, and clay. The result was positive non-significant. Similar results were also reported by Sharma and Choudhary (2007). Considering 2.0 mg kg^{-1} as a critical limit for Mn deficiency (Lindsay and Norvell 1978), 92 per cent of the soils has sufficient amount of available Mn to sustain rice crop (Singh and Yadav 2017).

Table 3: Correlation coefficients of DTPA -extractable cationic micronutrients with soil properties rice growing soils

Soil properties	Micronutrients			
	Zn	Cu	Fe	Mn
pH	0.141	-0.294*	-0.273*	-0.079
EC (dSm^{-1})	0.323*	0.395**	0.153	0.148
Organic carbon	0.318*	-0.327*	0.284*	0.044
CEC [cmol(p^+)kg^{-1}]	-0.012	0.009	0.126	0.184
Sand (%)	0.154	0.081	-0.056	-0.172
Silt (%)	0.102	-0.014	-0.107	-0.367*
Clay (%)	0.077	-0.054	0.102	0.014

**Significant at 5%level; **Significant at 1% level*

DTPA-Fe: The DTPA-iron content of the soils varied from 6.66 to 34.76 mg kg^{-1} with a mean value of 22.14 mg kg^{-1}. These results are in conformity with those of Kirmani*et al.* (2011) and Singh and Yadav (2017). DTPA-Fe showed negative and significant relationship with pH (r = -0.273*). It can be observed that Fe decreases with the increase in soil pH. These results were supported by Chinchmalatpure *et al.* (2000). DTPA-Fe was positively and significantly correlated with organic carbon (r= 0.284*). These might be due to formation of organic chelating agents which could have transformed in soluble phase of Fe into soluble metallic complexes (Patiram *et al.*2000). Considering critical limits of 4.5 mg kg^{-1}, (Lindsay and Norvell 1978), soil samples were 12 per cent deficient and 88 per cent samples sufficient in available Fe in these rice growing soils.

From the present study, it may be concluded that the deficiency of Zn is a chief constraint for soils in Samba district of Jammu and Kashmir; for higher crop production. The status of Fe, Cu, Mn and Zn was adequate for plants in these soils. The availability of micronutrients is affected with physical and chemical properties especially organic matter content and pH of the soils. The changes in soil pH, organic matter content and size fractions (clay and silt) had strong influence on the status of micronutrients.Therefore there is urgent need of proper management of available Zn in these soils of Samba district.

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