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Vertical distribution of DTPA-micronutrients content of some selected pedons in Hydromorphic soils of Khagaria district

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ABSTRACT

An investigation was carried out to entitled on "Vertical distribution of DTPA-micronutrients content of some selected pedons in Hydromorphic soils of Khagaria district". The DTPA Fe content of selected pedons was ranged from 9.56 to 13.55 and 3.15 to 14.20 mg kg^{-1} soil at surface and sub-surface horizon. The DTPA-Mn content varied from 5.24 to 10.55 mg kg^{-1} soil in surface layer and 4.23 to 11.11 mg kg^{-1} soil in sub-surface layer. However, the available DTPA-Mn content increases towards depth except lower depth in all selected pedons (P_1 to P_6). The overall results have been indicated that DTPA-micro nutrient (Fe, Mn, Cu and Zn) contents show sufficiency level, and placed above their critical limits, which shows the congenial environment favoured for available micronutrients cations based on their geographical setting and suitable plant growth especially of hydromorphic areas.

Key words : *Hydromorphic soils, DTPA-Fe, Mn, Zn and Cu*

Introduction

Soil plays a major role in determining the sustainable productivity of an agro-ecosystem. The sustainableproductivity of a soil mainly depends upon its ability to supply essential nutrients to the growing plants. Soil testing offers heterogenous information about the nutrient availability of the soil upon which the fertilizer recommendation for maximizing crop yield is made. Micronutrient contents of soil and their availability to plant are assessed by the mineral present, weathering processes, and uptake of micronutrient either through negative or positive interactions (Fageria, 2001). The deficiency of micronutrients has become major constraint to productivity, stability and sustainability of soils (Bell and Dell, 2008). Iron (Fe), Manganese (Mn), Zinc (Zn) and Copper (Cu) are essential micro- nutrients for plant growth. Through their involvement in various enzymes and other physiologically active molecules, these micro-nutrients are important for biosynthesis of proteins, nucleic acids, growth substances, chlorophyll and secondary metabolites, metabolism of carbohydrates and lipids, stress tolerance, etc. (Singh, 2004; Rengel, 2007 and Gao *et al.,* 2008). Micro- nutrient availability to plants can be determined in direct uptake experiments or estimated with techniques that correlate the quantities of micro-nutrients extracted chemically from the soils (Kabata-Pendias, 2001). Micronutrient cycling is quite differ-

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ent among various terrestrial ecosystems (Han *et al.,* 2007). The state of permanent or temporary water saturation associated with reduced condition, and further is so called as Hydromorphism (Hussain *et al.,* 1974), and this state has brought considerable significant effects in composition, properties, genesis and their evolution in soil (Jacob and Otte, 2003). However, information of micronutrients content in different soil types at intensive level is still lacking at districts level, state level as well as at nationwide. Thereby, it is urgent need to study on "Vertical distribution of DTPA-micronutrients content of some selected pedons in Hydromorphic soils of Khagaria district"

Materials and Methods

General description of the study area

In soils of Bihar**,** a Hydromorphic soil was mostly observed in Khagaria and Bhagalpur district (Naryanpur block). The district spanning around 485.8 sq. km, is situated between North latitudes 25°15/ N and 25°44/ N and E longitudes 86°17/ E and86° 52/E, and block boundary of Khagaria district. The whole tract of Khagaria district was flat alluvial plain and abounds in marshy and swampy land.Out of three physiographic regions which was recognized in Bihar, and placed under lowland ecology of North of the river Ganges. The soils of study area have been developed from the fluviatile action of river Ganges, Kosi and Gandak as well as from the influence of back waters as a young alluvium.

Pedological study

Total six pedons was excavated which belongs to hydromorphic areas, and further classified based on 7th approximation of USDA classification (Table 1). Meanwhile, The DTPA-micronutrients namely, iron (Fe), manganese (Mn), zinc (Zn) and copper (Cu), were estimated by atomic absorption spectrophotometer as per described by Lindsay and Norvell (1978). The available Zn, Cu, Mn and Fe extracted with DTPA (Lindsay and Norvell, 1978) were determined on an Atomic Absorption Spectrophotometer.

Results and Discussion

DTPA-Fe (mg kg^{-1})

The DTPA Fe content was ranged from 9.56 to 13.55 and 3.15 to 14.20 mg kg^{-1} soil at surface andsub-surface horizon. Considering 4.5 mg kg^{-1} as critical level (Lindsay and Norwell, 1978), the entiresample was placed under above the critical limit except C horizon in P_4. Whereas, the irregular trends of available Fe content in all pedons were observed due to sedimentation of Gandakriver, and recharge the enormous amount of nutrient at sub-surface horizon thorough regular incessions of flood. It's further suggested thataccumulation of organic carbon was plainly evident at upper surface layer, and having more affinity towards suitability and their availability through chelating effect, and protected iron act as auto- oxidation and precipitation, and leads to increase the DTPA-Fe in surface horizon (Sharma *et al.,* 2007).

DTPA-Mn (mg kg^{-1})

The DTPA-Mn content varied from 5.24 to 10.55 mg kg^{-1} soil in surface layer and 4.23 to 11.11 mg kg^{-1} soil in sub-surface layer. However, the available DTPA-Mn content increases towards depth except lower depth in all selected pedons (P_1 to P_6). These relationships indicate, Mn availability governs by total basic cations at higher pH and proportionate amount of clay content. This variation might be due to nature of parent material, vagarious climatic condition and susceptible to change Mn in various oxidized to reduced state and vice-versa. These results further corroborated with Behera and Singh (2010).

DTPA-Zn (mg kg^{-1})

The DTPA extractable Zn content was ranged from 0.75 to 1.88 and 1.75 to 2.38 mgkg^{-1} at surface and sub-surface layers. Considering 0.6 mg kg^{-1} as critical level (Lindsay and Norwell, 1978), all the samples was above the critical limit. However, irregular trends were observed because of the variable intensity and pedogenic activity, and pose to form more complexing chelating with organic matter (Verma *et al.,* 2005). It might be another reason that presence of high organic matter enables to form chelated or complex which stimulates the availability of Zn (Kumar *et al.,* 2011; Patiram *et al.,* 2000) at surface layer.

DTPA-Cu (mg kg^{-1})

The trends of DTPA-Cu content varied from 1.11to 1.51 mg kg^{-1} and 0.53 to 1.87 mg kg^{-1} soil at surface and sub-surface layer, and tends to sufficient in nature based on their critical limits (0.2 mg kg^{-1}) (Lind-

say and Norwell, 1978). However, the available DTPA-Cu content increases towards downwards the depth except lower depth (P_1 to P_6). Results further noted that DTPA-Cu content did not follow any specific pattern towards downward the profile, and sufficient amount of available Cu observed in hydromorphic areas. These might be due to high intensive biological activity and chelating with organic carbon, and released during the decomposition of organic matter left after harvesting of crop (Verma *et al.*, 2005).

Conclusion

From ongoing discussion, we can conclude soils belongs to hydromorphic areas taxonomicclassified as *Fine, Illitic, Hyperthermic), Typic Haplaquent (P1), Fine, Mixed, Hyperthermic, Vertic Haplaquept (P2), Fine, Mixed, Hyperthermic, Vertic Haplaquent (P3), Moderately Fine, Clay loam, Hyperthermic, Vertic Fluvaquent (P4), Fine, Illitic, Hyperthermic, Typic Fluvaquent (P5), Fine, Mixed, Hyperthermic, Illitic Typic Fluvaquent (P6), and all selected pedons placed under Inceptiosls and Entisols, respectively.* While, DTPA-extractable micronutrient cations show highest in the surface hori-

Table 1. DTPA-micronutrients cations of pedons in Hydromorphic soils

Horizon	Depth (cm)	DTPA-Fe	DTPA-Mn	DTPA-Zn	DTPA-Cu
		Pedon-1 (Naraynpur): Fine, Illitic, Hyperthermic, Typic Haplaquent	(mg kg^{-1})		
Ap	0-13	13.55	10.55	1.88	1.15
$2A_1$	13-28	13.65	10.69	2.07	1.01
$2A_2$	28-50	14.09	10.97	1.96	1.36
$2C_1$	50-84	14.20	11.12	2.15	0.80
$2C_2$	84-150+	10.35	8.01	1.75	0.84
	Pedon-2 (Parbatta): *Fine, Mixed, Hyperthermic, VerticHaplaquept*				
Ap	0-13	9.56	6.21	1.72	1.49
Bw_1	13-48	10.04	6.52	1.81	1.71
Bw_2	48-90	10.54	6.85	1.90	0.60
C+	90-130+	9.38	6.09	1.69	0.53
	Pedon-3 (Gogri): *Fine, Mixed, Hyperthermic, VerticHaplaquent*				
Ap	0-12	10.35	6.35	1.75	1.51
$2A_1$	12-23	11.18	6.86	1.89	1.87
$2A_2$	23-63	12.07	7.41	2.04	1.26
$2C_1$	63-75	13.04	8.00	2.20	1.68
$3C_2$	75-94	14.08	8.64	2.38	1.14
$3C_3$	94-120	8.03	4.92	1.36	1.50
	Pedon-4 (Alauli): *Moderately Fine, Clay loam, Hyperthermic, Vertic Fluvaquent*				
Ap	0-13	9.75	5.24	0.75	1.25
$2A_1$	13-36	8.11	5.35	0.81	1.65
$3A_2$	36-107	8.60	5.67	0.86	0.81
C	107-116	3.15	4.65	0.84	0.94
	Pedon 5 (Mansi): *Fine, Illitic,Hyperthermic, Typic Fluvaquent*				
Ap	0-12	9.74	6.11	1.51	1.41
$2A_1$	12-41	10.32	6.48	1.60	1.61
$2A_2$	41-66	10.94	6.87	1.70	1.83
$2C_1$	66-110	11.60	7.28	1.80	1.06
$3C_2$	110-151	12.30	7.71	1.91	0.96
$3C_3$	151-170+	4.79	5.15	0.75	0.84
	Pedon-6 (Khagaria): *Fine, Mixed, Hyperthermic,Illitic, Typic Fluvaquent*				
Ap	0-11	10.75	8.06	1.65	1.11
A_1	11-42	11.40	8.54	1.75	1.36
$2A_2$	42-55	12.08	9.06	1.85	1.62
$3A_3$	55-86	12.80	9.60	1.97	1.90
$4C_1$	86-115	13.57	10.18	2.08	0.80
4CKm	115-179+	4.41	4.23	1.32	0.74

zons and decreased in subsurface horizons, and suggesting that micronutrients favoured the congenial environment for plant growth in these soils under hydromorphic conditions.

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