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Distribution of DTPA extractable micronutrients in soils of Telangana, Andhra Pradesh

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Abstract: Fifty four soil samples from ten pedons of Telangana region, Andhra Pradesh were studied for vertical distribution of DTPA extractable Zn, Cu, Fe and Mn and their relationship with some soil properties. Soil pH, calcium carbonate, organic carbon and particle-size fractions had strong influence on the distribution of these micronutrients. The content of micronutrient increased with the increase in organic carbon and decreased with increase in pH and $CaCO_3$. There was no definite trend for the distribution of these micronutrients with respect to depth. As per critical limit prescribed for Zn and Fe, 44 and 20 per cent of the soils could be rated as deficient in available zinc and iron respectively. Copper and manganese were found to be adequate.
Additional Key words: *DTPA extractable cations, black soils, critical limit*

Introduction

The inherent capacity of soils to supply the nutrients from lower horizons, knowledge of vertical distribution of micronutrient cations in soils is necessary Studies were conducted by different researchers (Dhane and Shukla1995, Chattopadhyay *et al.* 1996; Jagdish Prasad and Gajbhiye 1999; Sharma and Gupta 2001)to understand the content and distribution of the micronutrient cations in different soils and their relationship with soil properties. However, information in this regard for the soils of Telangana, Andhra Pradesh is scanty and therefore, an attempt has been made to assess the micronutrient status in these soils and their relationship with some important soil properties.

Materials and methods

The study area is covered by igneous(pink and grey granites and basalt) and metamorphic(granite gneiss and hornblende schist) rocks. North western plateau and interior rugged plains form the Telangana region in Andhra Pradesh. Climatically Northern Telangana zone falls under semi-arid(moist) tropics with an annual rainfall of around 1000 mm, whereas Southern Telangana zone falls under semi-arid (dry) tropics with an annual rainfall of around 740 mm. The moisture regime in the study area is *ustic* and soil temperature class is *isohyperthermic.* The crops grown in the study area are sorghum, rice, maize, cotton, red gram and pearl millet.

Horizon-wise soil samples were collected from the studied pedons. The samples were analyzed for pH, OC, $CaCO_3$ and particle-size distribution following standard procedures. The available micronutrient cations were extracted with AB-DTPA solution and determined with Inductively Coupled Plasma (Soltanpour *et al.* 1979).Simple correlations were calculated between DTPA-extractable micronutrient cations and soil properties.

Results and discussion

In general, the soils were alkaline and pH ranged from 7.2 to 9.2. Organic carbon content was low (0.06-1.14 %) and decreased with depth. Soils are calcareous and calcium carbonate content varied from 0.2 to 24.9 % in different horizons (Table 1). The soils were gravelly clay to clay in texture with clay content ranged from 30.9 to 78.0%. In general, higher content of micronutrients were found in surface layers might be due to their regular addition through plant residues, organic manure and fertilizers. There was no definite trend of distribution for micronutrients through depth (Table 1).

Zinc

DTPA-extractable zinc in the soils varied from 0.22 to 1.88 mg kg^{-1} . As per the critical limit of 0.6 mg kg^{-1} (Katyal 1985), 24 samples are deficient in zinc. Zinc deficiency was not observed in P4 and in P10, whereas soil samples of pedon 6, 7 and 9 are appeared to be deficient in Zinc. Zinc deficiency was noticed after 50 cm, 170 cm and 100 cm in P8, P2 and other pedons respectively. Lower content of zinc in black soils is due to its fixation by clay (Manohar 1974) or due to high soil pH values which have resulted in the formation of insoluble compounds of zinc (Tandon 1995). Available Zn content is significantly and negatively correlated (r=-0.43**) with calcium carbonate. Soil pH, sand and silt also had negative correlation but organic carbon and clay had positive influence on DTPA-Zn.

Copper

DTPA extractable Cu content in the soils ranged from 0.26 to2.0 mg kg^{-1} with a mean value of 1.02 mg kg^{-1}. Considering 0.2 mg kg^{-1} as critical limit for Cu for normal plant growth (Katyal and Randhawa 1983), the soils are rated adequate in available Cu. Soil pH and $CaCO_3$ content have significant negative correlation (r= -0.45**and -0.42** respectively) with Cu but organic carbon (r= 0.58**) and clay (r= 0.32*) had significant and positive correlation with Cu. These findings are in agreement with Dhane and Shukla (1995) and Chattopadhyay *et al.* (1996).

Table 1. Some Physical and chemical properties of the soils and DTPA-extractable cations

Location	Horizon	Depth (cm)	pH (1:2.5) soil : water	O.C. (g kg^{-1})	$CaCO_3$ (g kg^{-1})	Particle-size distribution Sand	Silt	Clay	DTPA-extractable cations Zn	Cu	Fe	Mn
						———	%	———	———	mg kg^{-1}	———	
P1: Very-fine, smectitic, isohyperthermic Typic Haplustert												
Jagtial	Ap	0-35	7.2	6.0	24	19.8	11.4	68.8	1.09	1.41	11	24
Mandal : Jagtial	Bw	35-64	7.7	5.0	22	22.1	8.8	69.1	0.98	1.48	15	26
Dt. Karimnagar	Bss	64-105	7.8	4.8	35	24.5	5.1	70.4	0.70	1.42	14	15
	BC	105-154	7.9	4.5	82	38.0	6.7	55.3	0.46	0.78	7	23
	Crk	154-200	Weathered granite with calcretes									
P2: Fine, smectitic, isohyperthermic Typic Haplustert												
Rudrur	Ap	0-31	7.9	4.5	25	26.9	18.9	54.2	1.88	1.19	12	36
Mandal : Varni	Bw1	31-62	8.2	2.5	26	26.5	17.1	56.4	1.28	1.40	19	24
Dt. Nizamabad	Bw2	62-97	8.3	2.2	26	25.8	15.5	58.7	0.83	1.07	15	33
	Bss1	97-135	8.3	2.1	4.3	26.1	15.8	58.1	0.79	1.09	25	24
	Bss2	135-172	8.1	1.5	51	26.0	16.0	58.0	0.62	1.02	14	22
	Ck	172-200	8.3	0.6	102	36.5	19.1	44.4	0.31	0.62	13	14
P3: Fine, smectitic, isohyperthermic Typic Haplustert												
Adilabad	Ap	0-24	7.8	5.6	39	32.9	6.8	60.3	0.72	1.20	38	39
Mandal : Adilabad	Bw	24-43	8.0	5.3	45	27.8	15.2	57.0	0.78	1.17	28	31
Dt . Adilabad	Bss1	43-79	8.3	4.6	102	23.5	23.8	52.7	0.40	1.28	28	33
	Bss2	79-115	8.6	3.7	97	20.4	28.0	51.6	0.68	0.84	19	29
	Bss3	115-152	8.9	2.2	115	17.7	32.6	49.7	0.42	0.72	26	24
	Bss4	152-200	9.2	1.7	115	15.3	40.0	44.7	0.52	0.48	23	22
P4: Fine, smectitic, isohyperthermic Chromic Haplustert												
Mudhol	Ap	0-18	7.7	3.7	75	18.4	34.6	47.0	1.22	1.85	18	6
Mandal : Mudhol	Bw1	18-48	7.7	3.7	72	20.2	33.4	46.4	1.01	1.21	17	12
Dt. Adilabad	Bw2	48-90	7.7	2.5	76	22.5	28.0	49.5	0.83	1.36	17	14
	Bss1	90-136	7.8	2.3	75	25.4	24.5	50.1	0.78	1.13	16	24
	Bss2	136-185	7.8	1.4	76	27.7	23.8	48.5	0.60	0.90	14	14
	Bss3	185-200	7.8	0.6	73	31.1	25.3	43.6	0.61	0.42	13	22
P5 : Fine, smectitic, isohyperthermic Sodic Haplustert												
Warangal	Ap	0-14	8.1	5.3	2	19.6	19.4	61.0	1.22	1.21	48	15
Mandal : Warangal	Bw1	14-48	8.4	4.1	2	22.1	20.0	57.9	1.11	0.58	34	13
Dt. Warangal	Bw2	48-82	8.7	4.3	46	20.5	20.5	59.0	0.70	0.38	44	21
	Bss1	82-110	8.8	3.7	50	26.2	20.5	53.3	0.68	0.56	33	21
	Bss2	110-144	8.8	1.0	48	25.5	22.0	52.5	0.54	0.67	24	13
	Bss3	144-200	8.6	1.4	83	29.1	20.7	50.2	0.29	0.47	24	13

Contd ...

P 6: Clayey-skeletal, smectitic, isohyperthermic Vertic Calciustept													
Wyra	Ap	0-21	7.6	8.8	123	37.9	19.9	42.2	0.34	0.82	13	22	
Mandal : Wyra	AB	21-34	8.0	1.4	167	39.5	22.0	38.5	0.22	0.56	3	19	
Dt. Khammam	BCk	34-64	8.1	0.6	243	42.4	24.1	33.5	0.33	0.26	3	12	
	Crk	64-104	Weathered hornblende schist with calcretes										
P 7 : Fine, smectitic, isohyperthermic Vertic Haplustept													
Madhira	Ap	0-20	8.0	7.2	70	35.9	18.5	45.6	0.46	1.28	4	22	
Mandal: Madhira	Bw1	20-64	8.0	4.1	84	31.3	20.1	48.6	0.52	1.24	4	19	
Dt.Khammam	Bw2	64-105	8.0	3.7	138	28.7	19.8	51.5	0.36	1.12	4	16	
	BCk	105-162	7.9	2.1	249	27.3	22.3	50.4	0.22	0.94	2	11	
P 8: Very-fine, smectitic, isohyperthermic Typic Haplustert													
Rajendranagar	Ap	0-20	8.1	11.4	67	4.1	23.3	72.6	0.68	1.97	39	48	
Mandal: Rajendra nagar	Bw1	20-50	8.6	5.8	65	4.0	22.6	73.4	0.64	1.80	15	39	
Dt. Ranga Reddy	Bw2	50.80	8.7	5.6	60	3.8	21.2	75.0	0.42	1.51	29	38	
	Bss1	80-120	8.6	5.3	64	3.5	20.3	76.2	0.40	0.56	29	46	
	Bss2	120-152	8.7	3.4	68	3.5	18.8	77.7	0.50	0.50	30	26	
	Bss3	152-185	8.7	2.4	64	3.2	18.8	78.0	0.40	0.48	25	25	
P 9: Fine, smectitic, isohyperthermic Chromic Haplustert													
Tandur Mandal:Tandur	Ap	0-26	7.4	9.5	2	19.0	23.7	57.3	0.52	1.51	4	22	
Dt.Ranga Reddy	Bw1	26-60	7.6	6.4	2	20.5	24.7	54.8	0.48	1.28	3	19	
	Bw2	60-97	7.8	6.4	32	21.9	25.1	53.0	0.42	1.54	3	14	
	Bss1	97-136	7.8	7.0	34	19.8	25.7	54.5	042	2.00	5	16	
	Bss2	136-170	8.0	7.6	32	22.7	26.0	51.3	0.36	1.68	4	11	
	Bss3	170-200	8.1	6.8	51	21.5	25.7	52.8	0.25	1.19	3	15	
P10: Fine, smectitic, isohyperthermic Vertic Haplustept													
Sangareddi	Ap	0-15	7.7	8.2	2	30.0	14.0	56.0	0.81	1.04	59	57	
Mandal : Sangareddi	Bw1	15-35	8.0	4.6	2	28.2	16.1	55.7	0.72	1.08	62	43	
Dt. Medak	Bw2	35-52	8.0	5.6	39	27.0	18.1	54.9	0.66	0.79	60	45	
	Bw3	52-71	8.0	4.6	47	24.1	22.3	53.6	0.63	0.71	45	32	
	Bw4	71-97	8.0	5.3	56	28.5	21.3	50.2	0.63	0.72	44	32	
	BC	97-120	8.1	4.2	145	30.8	23.4	45.8	0.71	0.43	40	34	
	Ck	120+	8.1	1.8	241	31.1	38.0	30.9	0.66	0.45	35	25	

Iron

DTPA extractable Fe content in these soils varied between 2 and 62 mg kg^{-1}. Considering the critical limit of 4.5 mg kg^{-1} for Fe (Lindsay and Norvell 1978), 11 samples, *i.e.*, 20 per cent soil samples were deficient in iron. The Fe was deficient in sub-surface layers of P6 and all the horizons of P7 and P9 due to higher pH and $CaCO_3$ (Yelvikar *et al.* 1996).

Manganese

DTPA extractable Mn content was found to vary between 6 and 57 mg kg^{-1} in different horizons which are above the critical limit (3 mg kg^{-1}) suggested by Takkar *et al.* (1989). Available Mn content was significantly and positively correlated with organic carbon (r=0.39**) and clay (r =0.40**).

In general, calcium carbonate decreased the availabilities of micronutrients owing to their insoluble hydroxides at higher pH (Sahoo *et al.*1995). Contrary to it, organic carbon had positive influence on DTPA- micronutrients due to complexation (Hodgson 1963; Katyal and Sharma 1991).

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