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Vertical Distribution of DTPA Extractable Zn, Fe Cu and Mn in Old and Recent Flood Plains of Ghaggar and Yammuna Rivers

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ABSTRACT: An investigation was undertaken to study the vertical distribution of DTPA extractable Zn, Fe, Cu and Mn in recent and old flood plains of Ghaggar and Yammuna rivers. The different pedon sites were delineated through visual interpretation of IRS-ID satellite data. The selected pedons representing recent and old flood plains were sampled to enumerate the distribution of available content of Zn, Fe, Cu and Mn. The soils were classified according to Soil Taxonomy. The soils of recent flood plains (Ghaggar and Yammuna) were Typic Undorthents/ Ustorthents and old flood plains (Ghaggar and Yammuna) as Typic Eutrodepts/ Haplustepts.
The content of micronutrients (Zn, Fe, Cu and Mn) were found in sufficient amount in all the surface horizons of these pedons. The vertical distribution of all these nutrients was uneven. The physicochemical characteristics of these soils were correlated with micronutrient contents. A significant correlation of these micronutrients (except Zn) was found with organic carbon contents of the soils. Whereas non-significant correlation of these nutrients was observed with Electrical Conductivity, Cation Exchange Capacity, silt and clay content of these soils.

Keywords: DTPA extractable, Flood plains and Micronutrients.

INTRODUCTION

Haryana, a small state situated in northwest of India was carved out of the then Punjab on Nov. Ist, 1966 and covers about 4.4 million hectare land area about 3.9 million hectare is arable. In the North, the state bound by shiwalik range of mountains and in east by the river Yamuna. In the northwest, the Ghagger river forms part of the boundary with Punjab. The Haryana plains (recent and old flood plains) constitute a major part of the state. So, it was taken for the present study.

Micronutrients have assumed increasing importance for crop production in Indian agriculture. Intensive cropping, use of chemical fertilizers, high yielding cultivars of crops have resulted in rapid depletion of essential micronutrients from the soils. Gupta *et al.* (1992) stated the assessment of micronutrient status of soils is a pre-requisite for crop production. Because of the imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs the response (production) efficiency of chemical fertilizer nutrients has decline tremendously under intensive agriculture in recent years. The results of numerous experiments in different parts of India have therefore, indicates "Fertilizer induced unsustainability of crop productivity" (Yadav, 2003). The stagnation of crop productivity cannot be boosted without judicious use of macro and micro nutrient fertilizers to overcome existing deficiencies. In Haryana, farmers do not give proper consideration to micro-nutrients. This has resulted in overall low yield. The purpose of the present study was to know the distribution of micro nutrients and the relationship between DTPA-extractable micro-nutrients and other soil properties in recent and old flood plains of Yamuna and Ghagger rivers of Haryana.

MATERIALS AND METHODS:

For the present investigation six soil profiles along with soil surface samples were taken up from the recent and old flood plains of Yamuna and Ghagger rivers areas to study the distribution of available, Zn, Fe, Cu and Mn in the areas of Haryana.

The samples were air dried, ground in wooden pestle to pass through a ' 0.5 mm sieve and analysed for texture, organic carbon, Cation Exchange Capacity, Electrical Conductivity, pH and micronutrients. The texture of the soil (silt and clay) was determined by international pipette method (by Richards 1954 given in USDA Hand book 60. Organic carbon was determined by Walkley & Black rapid titration method described by Jackson (1968). The available Zn, Fe, Cu and Mn were extracted by DTPA (Lindsay and Norwell 1978) and estimated on atomic absorption spectrophotometer. The nutrients content was correlated to texture, organic matter, Cation Exchange Capacity, Electrical Conductivity and pH.

RESULTS AND DISCUSSION

A. Physical and chemical characteristics

The physico-chemical characteristics of pedons were analysed to know the organic carbon, Cation Exchange Capacity, Electrical Conductivity, pH and silt clay contents of soils of the study areas are presented (Table 1). The clay content was high in old flood plains (11.92-29.98%) as compared to recent flood plains (3.14 to 16.85%). The clay and silt fraction showed irregular distribution with depth may be due to stratification process in these areas. The soils of the study areas were non-saline with EC ranging from 0.16 to 0.71 dS/m and decrease with depth. Organic carbon of the padons varies from 0.07 to 0.61 per cent. The organic carbon content was generally low (< 1 %), mainly due to biological activity and the rapid decomposition of biomass under the prevalent hot conditions. The cation exchange capacity varied widely and increased with an increase in fine fractions of soils and ranging from 4.57 to 16.23 Cmol(p)/Kg.

Table 1: Physico-chemical properties of different Pedons of the study area.

Depth (CM)	pH (1:2)	E.C. dS/m	O.C. (%)	C.E.C. Cmol(p)/kg	Sily (%)	Caly (%)	Texture
Pedon-1. Recent flood plains (Ghaggar) Coarse Loamy, Calcareous, Typic Ustorthents							
0-26	8.05	0.94	0.51	15.00	23.50	26.35	Scl
26-54	8.90	0.59	0.21	12.00	16.15	16.85	L
54-86	8.85	0.52	0.13	10.90	12.02	11.30	Sl
86-112	8.80	0.47	0.10	10.20	12.85	12.55	Sl
112-190	8.10	0.46	0.09	13.10	8.44	11.56	
190-240	8.80	0.44	0.07	9.30	5.88	7.50	Ls
Pedon-2. Recent flood plains (Ghaggar). Coarse Loamy, Calcareous, Typic Ustorthents							
0-26	7.4	1.10	0.50	10.31	12.19	11.68	Sl
26-58	8.15	0.50	0.07	9.48	8.70	9.50	Ls
192-220	8.20	0.471	0.05	6.35	6.60	4.61	S
Pedon-3. Recent flood plains (Yamuna). Coarse Loamy, Typic Ustorthents							
0-16	7.30	0.75	0.42	12.60	25.34	16.94	Sl
16-45	7.50	0.58	0.41	11.50	26.04	16.97	Sl
45-65	7.80	0.26	0.26	6.65	3.00	5.56	S
65-127	8.00	0.26	0.20	4.57	1.81	4.42	S
127-165	8.00	0.30	0.20	6.95	1.80	3.14	S
Pedon-4. Old flood plains (Ghaggar). Fine Loamy, Calcareous Fluventic Haplustepts							
0-17	8.30	0.71	0.64	12.27	18.48	19.82	Sl
17-28	8.60	0.44	0.21	11.20	20.10	21.20	Scl
28-50	8.80	0.40	0.33	15.50	23.63	26.57	Scl
50-82	9.20	0.55	0.28	16.40	22.43	24.95	Scl
82-121	9.20	0.29	0.13	13.00	24.64	29.38	Scl
121-134	9.30	0.31	0.10	12.75	12.67	13.31	Sl
134-165	9.40	0.31	0.05	12.30	13.08	10.92	Sl
165-210	9.15	0.38/	0.09	16.23	22.47	25.23	Sl
Pedon-5. Old flood plains (Ghaggar). Fine Loamy, Calcareous, Typic Haplustepts							
0-21	8.10	0.50	0.30	6.20	12.79	16.46	Sl
21-61	8.30	0.24	0.24	9.10	19.10	21.00	Scl
62-110	8.30	0.20	0.13	12.10	13.20	22.00	Scl
110-176	8.15	0.16	0.10	6.90	15.10	16.71	Sl
Pedon-6. Old flood plains (Yamuna). Fine Loamy, Aquic Haplustepts							
0-21	7.10	0.38	0.43	9.82	11.60	16.80	Sl
21-41	8.00	0.29	0.13	8.85	13.40	12.80	Sl
41-72	8.30	0.24	0.12	13.10	19.80	21.52	Scl
72-164	8.30	0.26	0.12	17.00	27.16	34.00	Cl

B. Available Micronutrients in Soil Profiles

DTPA-Zn: The content of DTPA-Zn in the studied soils varied from 0.20 to 2.80 mg kg^{-1} (Table 2). A significant coefficient of correlation (r=0.26) was observed between organic carbon content and Zn with clay (r=0.20) followed by silt (r=0.I5) (Table 3), an observation supporting the findings of Katyal and Sharma (1991); Hundal *et al.* (2006). Negative significant coefficient of correlation between DTPA-Zn and electrical conductivity (r= -12 8) and pH (r=-118) (Table 3) was observed.

Table 2: Micronutrient distribution of the study area.

Depth (cm)	Zn (mg/kg)	F (mg/kg)	Cu (mg/kg)	Mn (mg/kg)
Pedon-1. Recent flood plains (Ghaggar). Coarse Loamy, Calcareous, Typic Ustorthents				
0-26	1.20	10.87	1.94	10.90
26-54	0.60	6.92	1.00	9.86
54-86	0.40	4.62	0.62	6.81
86-112	0.20	3.80	0.42	5.17
112-190	0.20	3.91	0.46	5.56
190-240	0.20	3.52	0.44	7.16
Pedon-2. Recent flood plains (Ghaggar). Coarse Loamy, Calcareous, Typic Ustorthents				
0-26	2.80	16.66	2.14	15.56
26-58	1.20	3.75	0.54	8.26
58-192	1.20	3.08	0.52	5.50
192-220	1.20	3.94	0.18	4.05
Pedon-3. Recent flood plains (Yamuna). Coarse Loamy, Typic Ustorthents				
0-16	1.02	15.74	2.87	5.76
16-45	0.37	12.74	2.50	7.28
45-65	0.13	4.16	0.79	2.04
65-127	0.13	4.16	0.79	2.04
127-165	0.11	6.24	0.87	2.00
Pedon-4. Old flood plains (Ghaggar). Fine Loamy, Calcareous Fluventic Haplustepts				
0-17	2.00	7.33	1.28	11.47
0 107-28	1.60	8.30	1.30	10.19
28-50	1.20	5.38	1.02	7.42
50-82	1.20	4.51	0.82	6.67
82-121	1.20	5.52	0.96	4.45
121-134	1.20	4.29	0.68	7.19
134-165	1.00	2.95	0.28	5.70
165-210	2.00	6.57	0.98	8.56
Pedon-5. Old flood plains (Ghaggar). Fine Loamy, Calcareous, Typic Haplustepts				
0-21	2.80	19.61	1.24	8.90
21-61	1.20	16.60	1.10	12.29
62-110	1.20	10.12	0.50	12.36
110-176	1.20	6.73	0.44	8.54
Pedon-6. Old flood plains (Yamuna). Fine Loamy, Aquic Haplustepts				
0-21	2.40	18.93	2.16	13.15
21-41	1.20	10.35	1.22	14.29
41-72	1.40	12.17	1.20	16.15
72-164	1.40	10.18	0.96	16.88

DTPA-Fe: The content of DTPA-Fe ranged from 2.95 to 18.93 mg kg^{-1} soil (Table 2). The Fe content was related to texture. As the texture become finer, the mean iron content increased. The correlation coefficient between DTPA-Fe and clay (r=-0.37) was observed. A significant correlation was observed between DTPA-Fe and pH (0.92) and cation exchange capacity (r = -0.32) showed in (Table 3). Similar findings were supported by Sharma *et al.* (1992); Sharma *et al.* (2003).

DTPA-Cu: The DTPA-Cu was more in old flood plains as compared to recent flood plains of the study area and varied between 0.18 to 2.87 mg kg^{-1} soil (Table 2). DTPA-extractable Cu was significantly correlated with organic matter (r=0.425), cation exchange capacity (r=0.25), clay (r=0.28) and silt (r=0.17) presented in (Table 3). The DTPA-Cu availability decreased in the coarse textured soils as compare to fine textured soils. Negative significant correlation was observed between DTPA-Cu and pH (r =-0.44). Similar results were reported by Singh *et al.* (1990).

DTPA-Mn: The content of DTPA-Mn varied between 2.00 to 15.56 mg kg^{-1} soil (Table 2). The significant positive correlation of DTPA-Mn with organic carbon (r=0.61) was observed. The significant negative correlation coefficient was observed between DTPA Mn and pH (r=-0.78) was observed. The DTPA correlation coefficient with clay (r=0.03) and cation exchange capacity (r= 0.05) was observed in (Table 3). which implies that DTPA-Mn is more available in fine textured soils as compared to coarse textured soils. Similar results were corborated by Benbi and Brar (1992); Sharma *et al.* (2003).

Table 3: Correlation Coefficient of micronutrient in relation to physico-chemical properties.

Physicochemical properties	Zn	Fe	Mn	Cu
OC	-0.111	0.643*	0.616	0.425
EC	-0.128	0.068	0.038*	0.079
pH	-0.118	-0.924*	-0.788*	-0.442*
CEC	0.140	-0.320	-0.005	-0.021
Clay	-0.002	-0.073	-0.026	-0.028

CONLCUSIONS

In conclusion, all the micronutrients were found in sufficient amount in surface horizon of all the studied pedon it may be stated that the amounts of DTPA-extractable micronutrients in soils of different areas are significantly related to organic carbon, cation exchange capacity and fine texture. Therefore, organic carbon content alongwith soil texture should be considered when interpreting results for micronutrient availability in soils.

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Conflict of Interest. None.

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