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Available Major, Sulphur and Cationic Micronutrients Status in Alluvial and Black Soils of Araziline Block in Varanasi District

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Abstract: In order to asses fertility status of the Indo-Gangetic plains, one hundred surface soil samples (0-15cm) were collected, 50 each from alluvial and black soils of wheat growing farmers' field in Araziline block of Varanasi district. Majority of the samples showed neutral reaction in alluvial soils and alkaline reaction in black soils. Organic carbon content was found to be higher in black soils as compared to alluvial soils. Both soils were rated medium in available nitrogen, phosphorus and potassium. However, available phosphorus content of black soils was higher to the tune of 50%. S deficiency was rated 38% in alluvial soils. Zn deficiency was wide spread to the extent of 66% in alluvial soils and 80% in black soils. Considering critical limits of available Cu, Fe and Mn in soils, all the samples of alluvial and black soils were found adequate. Available nitrogen, phosphorus and sulphur were found to be significantly and positively correlated with organic carbon.

Key words: *Indo-Gangetic plains, Available nutrients, alluvial and black soils*

Introduction

Varanasi district has mostly alluvial soils (*Typic Ustocherpts*) formed by deposition of alluvium and black soils (*Chromusterts*) formed under waterlogged conditions. The district is located in Indo-gangetic plain which is the most productive region of the country but imbalanced fertilization is causing deterioration in soil health and wheat productivity. Available nutrients in soils play pivotal role in determining fertility status and sustainable productivity of the soils. The present study was, therefore undertaken to study the status of major, sulphur and cationic micronutrients in wheat growing alluvial and black soils of Araziline block in Varanasi district of eastern Uttar Pradesh.

Materials and Methods

Altogether, one hundred soil samples (0-15cm) 50 each from alluvial and black soils were collected in the last week of October, 2014 from the farmers'fields of wheat growing areas of Shahanshahapur village in Araziline block of Varanasi district in eastern part of Uttar Pradesh. After drying at room temperature, broken clods were crushed into smaller particles with the help of wooden roller and finally passed through 2 mm sieve. The soil reaction (pH) and electrical conductivity (EC) were determined in 1:2.5 (soil: water) suspension as described by (Jackson 1973). Soil texture was determined by Bouyoucos hydrometer (Bouyoucos 1962). Organic carbon content was determined by wet oxidation method of (Walkley and Black 1934).Soil available nutrients in the processed soil samples were analysed following standard methods as described for available N (Subbiah and Asija 1956), available phosphorus (Olsen *et.al.* 1954), available potassium (Jackson 1973), available sulphur (Williams and Steinbergs 1959) by turbidity method of (Chesnin and Yien 1950). The available Zn, Fe, Mn and Cu were extracted with 0.005 M diethelenetriamine penta acetic acid (DTPA) extractant (Lindsay & Norvell 1978) and the concentration of nutrients was determined on Atomic Adsorption Spectrophotometer (AAS).

Results and Discussion

Important physico-chemical properties of alluvial and black soils are presented in (Table 1). The alluvial soils exhibited sandy clay loam texture and sand content varied from 40.80 to 56.80, silt from 10.0 to 25.0 and clay from 23.0 to 43.2%. On the other hand, black soils showed clay loam texture. Its sand content varied from 33.9 to 48.8, silt from 12.0 to 19.0,

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clay from 36.2 to 49.2%. Wide textural variations in these two soils might be due to variation in depositional cycle and translocation of clay by river Ganga. The pH of alluvial soils ranged from 7.1 to 7.9 and it ranged from 7.7 to 8.6 in black soils. The EC varied from 0.1 to 0.9 dSm^{-1} with a mean value of 0.42 dSm^{-1} in alluvial soils while it varied from 0.1 to 0.8 dSm^{-1} with a mean value of 0.37 dSm^{-1} in black soils. In alluvial soils, organic carbon was rated low ranging from 1.65 to 8.55g kg^{-1} with a mean value of 5.86g kg^{-1}, while it ranged slightly higher from 3.9 to 9.9g kg^{-1} with a mean value of 7.35g kg-1 in black soils. Organic carbon content in soils depends upon nature of soil, crop grown, parent material, activities of micro-organisms and management practices such as use of Farm Yard Manure, crop residues and other organic sources of plant materials adopted by the farmers.

Table 1. Physico-chemical properties of alluvial and black soils of Araziline block

Soil test parameters	Alluvial soils (50)*		Black soils (50)*	
	Range	Mean	Range	Mean
Sand (%)	40.8-56.8	50.1	33.8-48.8	41.6
Silt (%)	10.0-25.0	16.9	12.0-19.0	15.0
Clay (%)	23.0-43.2	33.0	36.2-49.2	43.4
Textural class	Sandy clay loam		Clay loam	
pH	7.1-7.9	7.7	7.7-8.6	8.1
EC (dsm-1)	0.1-0.9	0.42	0.1-0.8	0.37
Organic carbon (g kg^{-1})	1.65-8.55	5.86	3.9-9.9	7.35

*Figures in parenthesis indicate number of soil samples

The range and mean values of soil available N, P, K, S and cationic micronutrients are presented in (Table 2). Available N, P and K in alluvial soils varied from 376.20 to 501.60, 16.9 to 89.6 and 161.5 to 397.4 kg ha^{-1}, while in black soils these ranged from 363.2 to 476.5, 8.11 to 47.35 and 180.76 to 453.15 kg ha^{-1}. The available sulphur content of alluvial and black soils of the farmers field varied from 6.0 to 27.93 and 9.51 to 33.11 mg kg^{-1} with a mean values of 11.94 and 17.86 mg kg^{-1}, respectively. Poor content of organic matter coupled with higher sand fraction in alluvial soils seems to have contributed towards less availability of sulphur. The results are in conformity with the earlier findings of nutrients status in vegetables growing soils of Varanasi (Singh and Kumar 2012). The available Zn content of alluvial soils ranged from 0.23 to 1.36 mg kg^{-1} with an average value of 0.49 mg kg^{-1}, while in black soils this ranged from 0.20 to 1.38mg kg^{-1} with a mean value of 0.40 mg kg. Available Fe, Mn and Cu content were found at sufficient level in alluvial and black soils with mean values of 8.41, 2.04, 11.06 and 8.64, 2.08, 7.57 mg kg^{-1}, respectively.

Table 2. Contents of available nutrients in alluvial and black soils of Araziline block

Available nutrients	Alluvial soils		Black soils	
	Range	Mean	Range	Mean
Avail. N (kg ha^{-1})	376.2-501.6	435.31	363.2-476.5	425.2
Avail. P (kg ha^{-1})	16.9-89.6	43.63	8.11-47.35	20.19
Avail. K (kg ha^{-1})	161.5-397.4	224.44	180.76-453.15	266.01
Avail. S (mg kg^{-1})	6.0-27.9	11.94	9.51-33.11	17.86
Avail. Zn (mg kg^{-1})	0.23-1.36	0.49	0.20-1.38	0.40
Avail. Fe (mg kg^{-1})	5.43-11.58	8.41	5.99-13.03	8.64
Avail. Mn (mg kg^{-1})	1.04-3.03	2.04	1.24-2.59	2.08
Avail. Cu (mg kg^{-1})	7.54-23.48	11.06	5.23-15.65	7.57

Status of organic carbon, available N, P, K, S and cationic micronutrients of alluvial and black soils are presented in (Table 3). Majority of the soil samples were rated in medium status of available N and K in both soils. On the other hand, available phosphorus showed medium status (96%) in alluvial soils and high status (50%) in black soils. High level of available phosphorus in black soils may be probably due to alkaline reaction and presence of calcium carbonate, which favours for P fixation. Medium K status in alluvial soils may be probably due to presence of K bearing clay minerals such as Illite, Biotite, Microcline and Orthoclase. The wide spread S deficiency was found in about 38% in alluvial and 6% black soils. Low S availability in alluvial soils might be due to coarse textured, low content of organic matter and use of S-free high-analysis fertilizers by the farmers. (Tiwari *et al.* 2003) also reported wide spread S deficiency in soils of Varanasi region. The deficiency of Zn was rated up to 66% in alluvial soils and 80% in black soils. High level of Zn deficiency in these soils may be attributed to continuous mining of native Zn and no external addition of Zn through organic and inorganic sources in alluvial and black soils. Considering critical limits of available Cu, Fe and Mn in soils (0.2, 4.5 and 2.0 mg kg^{-1}, respectively), all the samples showed sufficient level in both soils.

Table 3. Status of organic carbon and available nutrients in alluvial and black soils of Araziline block

Soil test parameters	Alluvial soils			Black soils		
	(%) samples in each category					
	Low	Medium	High	Low	Medium	High
Organic carbon	30.0	62.0	8.0	2.0	38.0	60.0
Avail. N	-	100.0	-	-	100.0	-
Avail. P	4.0	96.0	-	4.0	46.0	50.0
Avail. K	-	90.0	10.0	-	64.0	36.0
	Deficient		Sufficient	Deficient		Sufficient
Avail. S	38.0		62.0	6.0		94.0
Avail. Zn	66.0		34.0	80.0		20.0
Avail. Fe	-		100.0	-		100.0
Avail. Cu	-		100.0	-		100.0
Avail. Mn	-		100.0	-		100.0

Correlation study of available nutrients with relevant soil properties are presented in (Table 4. Available nitrogen, phosphorus and sulphur were found to be significantly and positively correlated with organic carbon in alluvial soils (r = 0.295, 0.365 and 0.265) and black soils (r = 0.456, 0351 and 0.253) at 1% level of significance. Nitrogen, phosphorus and sulphur being integral part of organic matter, the amount of organic carbon determines available N, P and S status. S and exhibited negative correlation with available N, P, K, Zn and Mn and positive correlation with available S in both type of soils, However, pH was negatively correlated with these available nutrients in black soils.

Table 4. Relationships between available nutrients and relevant soil properties of alluvial and black soils

	Alluvial soils						Black soils					
	pH	EC	Organic carbon	Sand	Silt	Clay	pH	EC	Organic carbon	Sand	Silt	Clay
Avail. N	-0.037	-0.002	0.295*	-0.181	-0.209	-0.023	-0.094	-0.179	0.456*	-0.067	-0.023	0.081
Avail. P	0.017	-0.058	0.365*	-0.168	0.177	0.023	-0.061	-0.003	0.351*	-0.135	0.072	0.097
Avail. K	0.002	-0.034	-0.092	-0.045	-0.104	-0.060	-0.061	-0.016	0.162	-0.180	-0.222	0.104
Avail. S	0.342	-0.011	0.265*	0.092	-0.030	-0.168	-0.081	0.076	0.253*	0.123	0.096	0.073
Avail. Zn	0.224*	-0.181	-0.071	-0.105	0.122	-0.059	0.048	-0.011	0.211	-0.062	-0.030	-0.021
Avail. Fe	-0.127	-0.182	-0.239	0.025	0.030	0.185	0.051	-0.063	-0.249	0.048	-0.015	0.018
Avail. Mn	-0.063	-0.115	0.187	-0.129	-0.277	0.207	-0.083	0.067	0.273	-0.049	-0.146	-0.008
Avail. Cu	0.005	0.023	0.239	0.195	-0.31*	-0.088	-0.223	0.081	0.165	0.065	-0.281*	0.165

*correlation is significant at the 5% level of significance

Conclusions

It is concluded from the present investigation that wheat growing alluvial and black soils of Indo–Gangetic plains presented by Araziline block showed emergence of Zn deficiency. Alluvial soils of this area indicated S deficiency due to low content of organic carbon, coarse textured and use of S-free high analysis fertilizers.

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