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Short Communication

FORMS OF IRON AND MANGANEASE IN SOILS OF PURWA TEHSIL OF UNNAO, UTTAR PRADESH

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Micronutrients are important for maintaining soil health and also increasing productivity of crops. The soil must supply micronutrients for desired growth of plants and synthesis of human food. Increased removal of micronutrients as a consequence of adoption of high yielding varieties and intensive cropping together with shift towards high analytical fertilizers has caused decline in the level of micronutrients in the soil to below normal at which productivity of crops cannot be sustained. Iron is a structural compound of porphyrin protein complex (cytochromes, peroxidase, catalase) and ferredoxin a number of electron transport system of chloroplast. It has a significant role in respiration and photosynthesis. Manganese, one of the essential micronutrients, activates the enzymes which are directly involved in the synthesis of chlorophyll. The deficiencies of micronutrients have become major constraints to productivity, stability and sustainability of soil. Therefore, an attempt has been made to study the status of forms of iron and manganese in Purwa tehsil soils of Unnao district. One hundred fifty surface (0- 20 cm) soil samples were collected from three blocks of Purwa tehsil of Unnao district. The soil samples were analyzed for various physico-chemical properties like pH, EC (1:2.5), organic carbon and $CaCO_3$ by adopting standard methods (Jackson, 1973). Total and exchangeable iron and manganese were determined following the standard procedure (Jackson, 1973). Available Fe and Mn in these soil samples were extracted with DTPA, as outlined by Lindsay and Norvell (1978) and estimated using an atomic absorption spectrophotometer.

Table 1: Physico-chemical properties and forms of iron and manganese in soils of Unnao district

Properties	Ashoha block		Hilauli block		Purwa block	
	Range	Mean	Range	Mean	Range	Mean
pH (1:2.5)	7.0-9.2	7.08	7.1-9.4	7.99	7.0-9.1	8.01
EC (dSm^{-1})	0.11-0.37	0.21	0.12-0.37	0.23	0.12-0.46	0.22
$CaCO_3$ (g kg^{-1})	1.0-3.1	1.58	1.0-3.0	1.72	1.25-3.55	1.57
Organic carbon (g kg^{-1})	0.23-.055	0.42	0.36-0.58	0.48	0.25-0.53	0.43
Total Fe (%)	2.22-3.56	2.58	2.21-3.70	2.48	2.25-3.85	2.72
Exchangeable Fe (mg kg^{-1})	1.2-4.1	2.75	1.2-4.7	2.93	1.6-5.1	3.58
Available Fe (mg kg^{-1})	4.4-12.5	7.52	4.5-15.0	8.88	4.5-17.5	9.66
Total Mn (mg kg^{-1})	220-380	272.6	220-375	274.4	215-375	276.2
Exchangeable Mn (mg kg^{-1})	8.0-17.4	12.9	7.5-17.5	12.2	8.5-18.2	12.8
Available Mn (mg kg^{-1})	12.2-22.5	17.5	12.2-24.5	17.3	12.1-24.5	17.7

A perusal of the data (Table 1) indicated that all the soils under study were alkaline in reaction, the variation in pH being from 7.0 to 9.4. The range of variation within soils of Ashoha, Hilauli and Purwa blocks were from 7.0 -9.2, 7.1-9.4 and 7.0-9.1, respectively. The electrical conductivity of the soil water /suspension (1:2.5) ranged between 0.11 and 0.46 dSm^{-1}. The ranges of variation within the soils of Ashoha, Hilauli and Purwa blocks were from 0.11-0.37, 0.12-0.37 and 0.12-0.46 dSm^{-1}, respectively. In general, the amount of soluble salts in soils varied with location. The soil collected from Purwa block contained relatively higher concentration of salts as compared to soils of Hilauli and Ashoha blocks. The amount of organic carbon ranged from 0.23-0.55, 0.36-0.58 and 0.25-0.53 g kg^{-1} in soils of Ashoha, Hilauli and Purwa blocks 0.42, 0.48 and 0.43 g $kg^{-1,}$ respectively. The calcium carbonate in these soils ranged from 1.0 and 3.5 g kg^{-1}. The soils of Purwa block contained more calcium carbonate (mean 1.5 g kg^{-1}) than the soil of Ashoha block (mean 1.58 g kg^{-1}) than Hilauli block (mean 1.72 g kg^{-1}). The total iron

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content in the soils of Ashoha, Hilauli and Purwa blocks ranged between 2.22 and 3.56, 2.21 and 3.70 and 2.25 and 3.85 % with mean values of 2.58, 2.48 and 2.72 %, respectively. Purwa block soils contained relatively higher value (2.72 %) of total iron as compared Ashoha (2.58 %) and Hilauli blocks (2.48%). The amount of available iron in soils of Ashoha, Hilauli and Purwa blocks ranged between 4.4 and 17.5mg kg^{-1} (Table 1). Among these soils, the Ashaha block soils contained the lower amount of available iron, the variation being from 4.4 and 12.5 mg kg^{-1} with a mean value of 7.52 mg kg^{-1} , while soils of Purwa block showed relatively higher content (4.5 -17.5 mg kg^{-1} average 9.66. mg kg^{-1}). The amount of exchangeable iron in soils of Purwa tehsil varied from 1.2 - 5.1mg kg^{-1} .Thus, there was not much difference in the status of exchangeable iron in soils of different blocks of Purwa tehsil probably due to the reason that exchangeable iron content of the soil is directly proportional to the total iron content of the soil. Kumar *et al.* (2004), Alli and Lakhan (2013) reported similar results. Data on available Fe in soil samples indicated that 38% soil samples were deficient in DTPA-Fe content and 62 % of soil samples were sufficient (4.50 mg kg^{-1} as per critical limit (Katyal and Rattan, 2003). Total manganese content in the soils of Purwa tehsil ranged from 220 to 380 mg kg^{-1} (Table-1) with a mean value of 474.4 mg kg^{-1}. The amount of exchangeable manganese in these soils varied from 7.5 to 18.2 mg kg^{-1}. The highest average value for exchangeable manganese was observed in the soils of Ashoha block while the lowest in soils from Hilauli block. The amount of available manganese ranged from 12.2 to 22.5, 12.2 to 24.5 and 12.1 to 24.5 mg kg^{-1} in Ashoha, Hilauli and Purwa blocks, respectively, Chaudhary *et al.* (2012**)** also reported similar results in alluvial soils. On an average, soils of Purwa blocks were found to be relatively rich in available manganese as compound to soils of other blocks of the tehsil. The available Mn status of these soils ranged from 12.2 to 24.5 mg kg^{-1}. The status of these soils was found to be well above the critical limit of 3.5 mg kg^{-1} (Lindsay and Norvell 1978). None of the soils of Purwa tehsil of Unnao district was found to be deficient in available manganese.

Table 2: Coefficient correlation between soil properties and forms of iron and manganese

Soil characteristics	pH	EC	$CaCO_2$	Organic carbon
Total Fe	-0.389	0.094	-0.120	0.225
Exchangeable Fe	-0.007	0.048	-0.202*	0.294*
Available Fe	-0.005	0.820	-0.025	0.247*
Total Mn	-0.011	0.089	-0.002	0.164
Exchangeable Mn	-0.007	0.068	-0.021	0.066
Available Mn	-0.025	0.21	-0.265*	0.370*

**Significant at 5% level*

The Fe content of the soils was found significantly and negatively correlated with pH. Organic carbon content of the soils influenced total, exchangeable and available Fe content of soils significantly and positively (Table-2). Calcium carbonate content of soils showed significant and negative correlation with exchangeable iron only. Total and exchangeable manganese content did not show any significant correlation with physico-chemical properties of soils. Similar observation was also reported by Ali and Lakhan (2013). However, available Mn content was found to be significantly and negatively correlated with calcium carbonate and positively with organic carbon.

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