



ISSN: 0974 - 0376

The Ecoscan : Special issue, Vol. VIII: 289-297: 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES
www.theecoscan.in

STATUS OF AVAILABLE MICRONUTRIENTS IN SOILS OF RAE BARELI, UTTAR PRADESH

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KEYWORDS

Micronutrient
Zinc
Iron
Manganese and copper

Proceedings of National Conference on
Harmony with Nature in Context of
Bioresources and Environmental Health
(HARMONY - 2015)
November 23 - 25, 2015, Aurangabad,
organized by
Department of Zoology,
Dr. Babasaheb Ambedkar Marathwada University
Aurangabad (Maharashtra) 431 004
in association with
National Environmentalists Association, India
www.neaindia.org



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ABSTRACT

An investigation was carried out to study the micronutrient status in soils of Rae Bareli districts in Uttar Pradesh and their relationship with different physicochemical properties of soils. The soil samples collected from different tehsils of Rae Bareli district in Uttar Pradesh, during April and May 2012-13. The available Zn, Fe, Cu and Mn were analyzed in the collected soil samples. The results indicated that all the tehsils showed the variation in pH being from 6.8 to 9.4, electrical conductivity ranged from 0.04 to 0.39 dSm⁻¹, organic carbon ranged from 0.11 to 0.77 per cent and calcium carbonate ranged from 1.0 to 3.0 g kg⁻¹. The mean values of available iron, manganese, zinc and copper content were 9.2, 15.35, 1.47 and 1.48 mg kg⁻¹, respectively. Negative non-significant correlation with pH and available Fe and Mn, negative significant between pH and Zn, positive non-significant between pH and Cu was found. Non-significant positive with EC and Fe, Mn and Cu but non-significant negative between EC and Zn. Positive significant with organic carbon and Fe, Mn and Zn. Negative significant with CaCO₃ and Mn and Zn, negative non-significant between CaCO₃ and Fe while positive non-significant correlation between CaCO₃ and Cu was recorded.

INTRODUCTION

Micronutrients deficiency in crops and livestock's may cause a serious crop production or animal health problems. Micronutrients serve as constituents of prosthetic groups in metalloprotein and as activator of enzyme reactions. It is reported that about 49, 12, 4 and 3 % soils of our country are deficient in available Zn, Fe, Mn and Cu respectively (Singh, 2004). Iron helps in the formation of chlorophyll. Iron is a structural component of porphyrin molecules like cytochromes, hematin, ferrichrome and leghemoglobin. Manganese helps in chlorophyll formation and influence auxin levels in plants and high concentration of Mn favour the breakdown of indole acetic acid (IAA). Copper forms various compounds with amino acids and proteins in the plant. Copper has some indirect effect on nodule formation. It also act as "electron carrier" in enzymes which bring about oxidation-reduction reactions in plant. Zinc influences the formation of some growth hormones in the plant. Zinc is helpful in reproduction of certain plants and is associated with water uptake and water relations in the plant. The major nutrients, deficiencies of zinc, copper, iron and manganese are frequent occurrence with major losses of crop productivity. Several studies by different workers have been since reported signifying the emphasis on delineation of areas of deficiencies on crop and location-specific basis. Tiwari *et al.* (1995) reported the distribution of DTPA-extractable Zn, Cu, Mn and Fe in Bundelkhand soils of U. P. Similar findings were reported by Dhane and Shukla (1995) in Maharashtra soils, and Sood *et al.* (2009) in Punjab soils. Sharma *et al.* (2000) studied the pedospheric attributes in distribution of available Zn, Cu, Mn and Fe in Indogangetic plains. It is, therefore, important to precisely assess the status of available micronutrients in U.P. soils. The present paper describes the status of available micronutrients in soils of Rae Bareli district in Uttar Pradesh.

MATERIALS AND METHODS

The present investigation was carried out in different Tahsil namely Dalmau, Maharajanj, Rae Bareli and Unchahar of Rae Bareli district. The district of Rae Bareli occupies a position in the map of Uttar Pradesh between the parallels of 25°49' and 26°36' North latitude and 80°41' and 81°34' East longitude. The district comprises a flat or gently undulating tract. The highest point being only an apex of watersheds of different drainage system. The district is located at sub - tropical region of the state. Soil samples (0-15 cm depth) were collected with the help of stainless-steel auger covering all the tehsil in the district Rae Bareli, Uttar Pradesh during April and May 2012-13. The soils were put in cotton bags, labelled properly and carried to the laboratory. The soil samples were air-dried and removed all material from the soil samples other than soil and were crushed with the mortar and pestle and sieved through 2 mm sieve. The powdered samples, thus obtained were stored in the stoppered wide mouth plastic boxes properly labelled subjected to chemical analysis. Organic carbon was determined by Walkley and Black method as outlined by Jackson (1973) and rapid titration method was followed for the estimation of

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calcium carbonate. The sand, silt, clay were determined by International pipette method. The available micronutrients (Zn, Cu, Fe and Mn) content in soils was extracted by diethylenetriamine pentaacetic acid (DTPA) soil to solution ratio 1 : 2, shaking time 2 h on environmental shaker by Lindsay and Norvell (1978). Estimation of these four micronutrient cations was done on the clear extract with an Atomic Absorption Spectrophotometer (AAS).

RESULTS AND DISCUSSION

All the soils under study were alkaline in reaction, the variation in pH being from 6.9 to 9.4 (Table 1), There were no wide variations in soil pH values of different tehsils of the district under reference. However, the soils of Maharajganj and Unchahar tehsil showed higher pH values than other tehsils of Rae Bareli district. The minimum average pH was recorded in soils of Dalmau tehsil of the district (Fig.1). The electrical conductivity of the soil water suspension (1:2.5) ranged between 0.04 and 0.39 dSm⁻¹. In general, the amount of soluble salts in soils varied with location. The soils collected from Uchahar tehsil contained relatively higher concentration of

salts as compared to soils of other tehsils of the district. The minimum concentration of salt was in soils of Maharajganj thesil. The amount of organic carbon ranged from 0.13-0.40, 0.19-0.77, 0.11-0.77 and 0.25-0.56 g kg⁻¹ with mean values of 0.20, 0.31, 0.24 and 0.44 g kg⁻¹ in soils of Dalmau, Rae Bareli, Maharajganj and Unchahar, respectively (Fig.2). The soils of Rae Bareli tehsil having greater content of organic carbon as compared to other tehsils of the district. The minimum average value of organic carbon is found in Dalmau tehsil of the district (Fig.3). In general, on an average the percentage of organic carbon deficiency (87%) was noticed in Dalmau tehsil soils followed by Maharajganj (80%), Unchahar (73%) and Rae Bareli (65%). The amount of calcium carbonate ranged from 1.0-2.5, 1.0-3.0, 1.0-2.6, and 1.0-2.9 with a mean values of 1.62, 1.69, 1.68 and 1.85 in the soils of Dalmau, Rae Bareli, Maharajganj and Unchahar tehsils respectively. The soils of Uchahar tehsil contained more amount of calcium carbonate (mean 1.85 g kg⁻¹) than the soils of other tehsils. The soil of Dalmau tehsil had relatively low average value of calcium carbonate (Fig.4). The soils of Rae Bareli tehsil having greater content of coarse and fine sand as compare to other tehsils of the district. The minimum average value of coarse and fine

Table 1: Physio-chemical characteristics and availability of micronutrients of various location soils of Rae Bareli district.

Properties	Dalmau Range	Mean	Rae Bareli Range	Mean	Mahrajganj Range	Mean	Unchahar Range	Mean
pH (1:20)	6.9-9.4	7.3	7.3-8.0	7.4	6.8-8.9	7.7	7.1-8.7	7.6
EC (dSm ⁻¹)	0.06-0.26	0.19	0.04-0.19	0.14	0.09-0.19	0.07	0.09-0.39	0.21
Organic carbon(%)	0.13-0.40	0.20	0.19-0.77	0.31	0.11-0.77	0.24	0.25-0.56	0.44
CaCO ₃ (g kg ⁻¹)	1.0-2.5	1.6	1.0-3.0	1.7	1.0-2.6	1.6	1.0-2.9	1.8
Coarse sand (%)	0.3-8.4	1.6	0.6-7.8	3.2	0.6-3.8	0.5	0.3-6.8	1.9
Fine sand(%)	2.0-86.9	56.4	60.9-81.5	70.9	12.3-54.4	36.5	14.2-72.3	39.3
Silt (%)	3.8- 43.5	21.1	8.0-16.6	11.1	4.0-53.6	29.0	6.7-52.6	23.4
Clay (%)	9.23- 43.3	18.1	7.1-12.8	14.6	10.5- 48.0	24.4	8.2-43.6	22.6
Iron (mg kg ⁻¹)	4.5-17.2	8.5	4.5-17.0	8.6	5.5-18.0	10.2	4.5-13.8	9.5
Mn (mg kg ⁻¹)	12.7-20.1	6.5	10.8-23.0	17.4	12.8-22.6	18.2	10.5-24.5	19.3
Zn (mg kg ⁻¹)	0.5-5.0	1.6	0.3-2.7	1.2	0.6-4.7	1.9	0.5-4.3	1.2
Cu (mg kg ⁻¹)	0.3-7.1	1.3	0.2-5.3	1.2	0.4-7.2	1.6	0.3-5.6	1.8
G.M	-	10.3	-	11.4	-	11	-	10.8

Table 2: Evaluation of Coefficient correlations between physico-chemical characteristics and available micronutrients of soils in Rae Bareli district

Soil properties V/S Avail. Macronutrients	Tehsil Dalmau	Rae Bareli	Mahrajganj	Unchahar
pH Vs Fe	-0.012	-0.016	-0.014	-0.017
pH Vs Mn	-0.026	-0.024	-0.028	-0.022
pH Vs Zn	-0.41*	-0.45*	-0.43*	-0.44*
pH Vs Cu	0.043	0.043	0.043	0.043
EC Vs Fe	0.087	0.089	0.085	0.086
EC Vs Mn	0.023	0.026	0.029	0.025
EC Vs Zn	-0.196	-0.192	-0.188	-0.193
EC Vs Cu	0.062	0.063	0.063	0.062
Organic carbon Vs Fe	0.248*	0.245*	0.246*	0.240*
Organic carbon Vs Mn	0.376*	0.372*	0.378*	0.375*
Organic carbon Vs Zn	0.652**	0.656**	0.654**	0.650**
Organic carbon Vs Cu	0.137	0.136	0.134	0.135
CaCO ₃ Vs Fe	-0.020	-0.021	-0.022	-0.023
CaCO ₃ Vs Mn	-0.260*	-0.262*	-0.265*	-0.264*
CaCO ₃ Vs Zn	-0.722**	-0.723**	-0.725**	-0.727**
CaCO ₃ Vs Cu	0.055	0.051	0.056	0.054

*Significant at 5% level **significant at 1% level

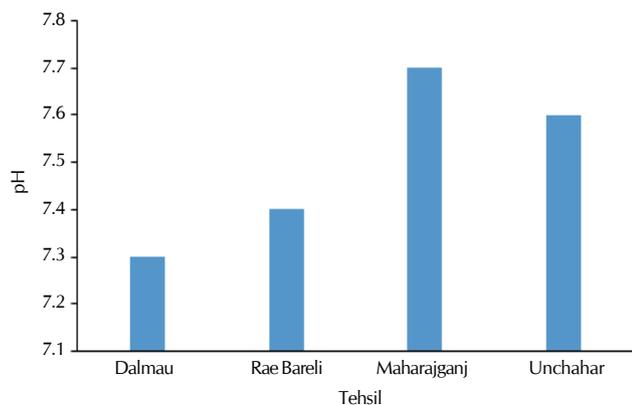


Figure 1: Status of pH in different tehsil of Rae Bareilly district

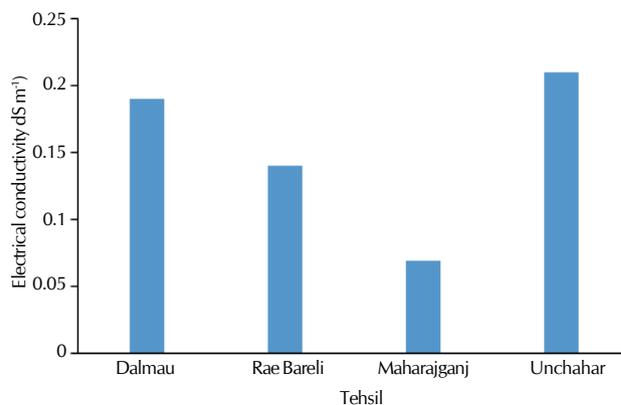


Figure 2: Status of Electrical conductivity in different tehsil of Rae Bareilly district

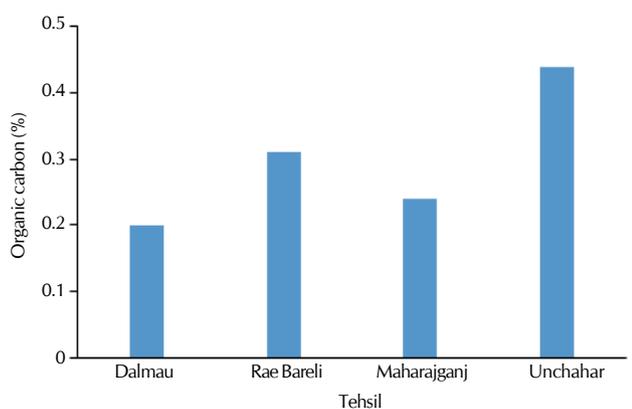


Figure 3: Status of Organic carbon in different tehsil of Rae Bareilly district.

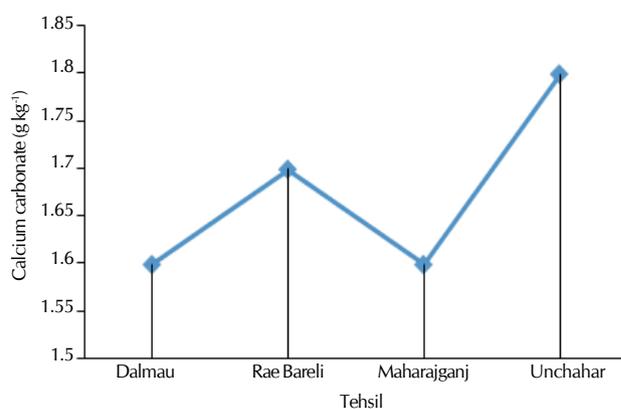


Figure 4: Status of Calcium carbonate in different tehsil of Rae Bareilly district

sand found in Maharajganj . Maharajganj tehsil soils contained relatively higher silt content (29.03 %) as compare to other tehsils of the district and Rae Bareilly having lower silt content, mean value 11.14. The amount of clay in the soils of Maharajganj is higher (24.36) and the minimum mean value 14.28 is found in soils of Rae Bareilly tehsil of the Rae Bareilly district. The available iron content in the soils of Dalmau, Rae Bareilly, Maharajganj and Unchahar tehsil ranged between 4.5 and 17.2, 4.5 and 17.0, 5.5 and 18.0 and 4.5 and 13.8 mg kg⁻¹ with mean values of 8.5, 8.63, 10.2 and 9.46 mg kg⁻¹, respectively. Maharajganj tehsil soils contained relatively higher mean value (10.2 mg kg⁻¹) of iron compared to soils of other tehsils. The minimum average values of iron were recorded in soils of Dalmau tehsil (Fig.5). (Divya *et al.*, 2012, Kumar *et al.*, 2014). The amount of available manganese in soils of Dalmau , Rae Bareilly, Maharajganj and Unchahar tehsil ranged between 12.7 and 20.1, 10.8 and 23.0, 12.8 and 22.6, and 10.5 and 24.5 mg kg⁻¹ (Table 1). Among these soils, Dalmau tehsil soils contained the lower amount, while soils of Unchahar showed relatively high content of available manganese, (Choudhary *et al.*, 2012, Singh *et al.*, 2015). The amount of available copper in soils of Rae Bareilly district varied from 0.20 to 7.17 mg kg⁻¹. The content of available copper in the soils of Dalmau , Rae Bareilly, Maharajganj and Unchahar tehsil varied from 0.32-7.10, 0.20-5.30 , 0.37-7.17 and 0.25-

5.62 mg kg⁻¹, respectively. The highest mean value of available copper 1.77 mg kg⁻¹ were recorded in Unchahar and the minimum mean value 1.24 mg kg⁻¹ in soils of the Rae Bareilly tehsil of the district (Fig.5). The amount of available zinc in soils of Rae Bareilly district varied from 0.30-5.00 with mean value of 1.50 mg kg⁻¹. Maharajganj tehsil soils contained relatively higher value (1.91 mg kg⁻¹) of zinc compare to soils of other tehsils of the district (Naik, 2014) (Fig.5). Singh (2008) also reported similar results. DTPA-Fe was negatively correlated with pH and CaCO₃ and significantly and positively with organic carbon probably due to higher degree of adsorption and chelation as reported by (Kumar, 2004). Available Mn showed significantly negative correlation with pH and CaCO₃ in soils of different tehsils, these findings corroborate the observations of Ali and Lakhan (2013). In general available iron, manganese, copper content in soil showed positive correlation with salt concentration except zinc in all soils. Increasing organic carbon content in soils enhanced the availability of these micronutrients as indicated by significant positive correlations. Increasing CaCO₃ content in soils decreased the availability of iron and manganese (Table-2). Yurembam *et al.* (2015), Kumar *et al.* (2006) also reported similar results. The results of the study indicate that higher potential of accumulating organic carbon in the soils of Rae Bareilly tehsil recorded than others.

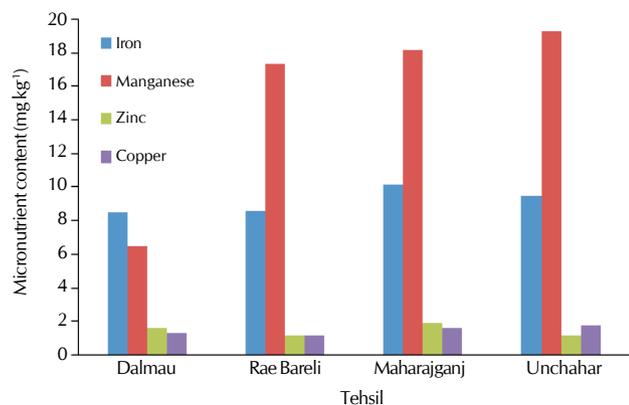


Figure 5: Status of available micronutrients in different tehsil of Rae Bareilly district.

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