

Short Communications

<https://doi.org/10.20546/ijcmas.2017.612.225>

Status of Available Zinc and their Relationship with Soil Properties in Soils of Rae Bareli District of Uttar Pradesh, India

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ABSTRACT

Keywords

Soil properties,
Zinc deficiency,
Balanced
fertilization.

Article Info

Accepted:
15 October 2017
Available Online:
10 December 2017

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. 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 available zinc content was between 0.3 to 4.3 mg kg⁻¹. DTPA-Zn was significantly negative correlated with pH but non-significantly negative correlation show between Zn and salt concentration. Increasing organic carbon content in soils enhanced the availability of zinc as indicated by significant positive correlation. Increasing CaCO₃ content in soils decreased the availability of zinc.

Introduction

Due to the increased productivity of the crops, the native soils began depleting of their nutrient reserves and the crops started responding to micronutrient fertilizers. Various studies indicated that the factor productivity of various crops declined in spite of balanced fertilization (nitrogen, phosphorus, potassium).

Zinc deficiency was also observed in wheat crop on sandy soils of Punjab in 1970 and

then in most of the intensively cultivated areas of India. The application of zinc sulphate to many high yielding crops has become common practice. To meet the requirements of the always growing population of India for food, fiber and fuel, the natural nutrient reserve has to be extensively exploited, thus leading to more deficiency of nutrients. The highest zinc deficiency is found in soils of Madhya Pradesh followed closely by Haryana and the

least in the Union Territory of Pondicherry. Application of zinc-containing fertilizer is needed to exploit the potentials of various crops. It has also been observed that the extractable zinc content of the soils increases with the application of zinc sulphate: the area of zinc deficiency was reduced with the application of zinc sulphate in the intensively cultivated areas of Haryana and Punjab states.

Wide variations in the proportion of zinc-deficient soils have been observed within states, which are due to the variations in soil texture, pH and organic matter content of the soils. It is thus imperative to work out the proper quantity and frequency of zinc sulphate application dependent on the characteristics of the soil as well as the cropping system.

Zinc is an important micronutrient, plant response to Zn deficiency occurs in terms of decrease in membrane integrity, susceptibility to heat stress, decreased synthesis of carbohydrates, cytochromes nucleotide auxin and chlorophyll. Further, Zn-containing enzymes are also inhibited, which include alcohol dehydrogenase, carbonic anhydrase, Copper-zinc superoxide dismutase, alkaline phosphatase, phosphopiperase, carboxy peptidase and RNA polymerase Marschner, (1993). Depending on the zinc level, zinc deficiency status of soil can be classified, that is less than 0.6 mg kg^{-1} is definite zinc deficiency and more than 0.6 mg kg^{-1} is sufficient Zn. The poor availability of zinc caused by waterlogging can be due to a relatively high pH, zinc being present as the insoluble sulphide (ZnS) and elevated concentrations of ferrous, bicarbonate, and phosphate ions, Doberman and Fairhurst (2000).

The present investigation was carried out in different Tahsil namely Dalmau, Maharajganj, 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 $25^{\circ}49'$ and $26^{\circ}36'$ North latitude and $80^{\circ}41'$ and $81^{\circ}34'$ 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 soil in the district Rae Bareli, Uttar Pradesh. 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 calcium carbonate. The sand, silt, clay were determined by International pipette method. The available zinc content in soils was extracted by diethylene triamine penta acetic acid (DTPA) soil to solution ratio 1: 2, shaking time 2 h on environmental shaker by Lindsay and Norvell (1978). Estimation of zinc was done on the clear extract with an Atomic Absorption Spectrophotometer (AAS).

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. 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 Mahrajganj 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. 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. 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. The soils of Rae Bareli tehsil having greater content of coarse and fine sand as compare to other tehsils of the district.

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

Properties	Dalmau		Rae Bareli		Mahrajganj		Unchahar	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
pH	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
Zinc(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

Table.2 Evaluation of Coefficient correlations between physico-chemical characteristics and available zinc of soils in Rae Bareli District

Soil properties V/S Avail. Macronutrients	Tehsil			
	Dalmau	Rae Bareli	Mahrajganj	Unchahar
pH VS Zn	-0.41*	-0.45*	-0.43*	-0.44*
EC VS Zn	-0.196	-0.192	-0.188	-0.193
Organic carbon VS Zn	0.652**	0.656**	0.654**	0.650**
CaCO ₃ VS Zn	-0.722**	-0.723**	-0.725**	-0.727**

*Significant at 5% level, **Significant at 1% level.

The minimum average value of coarse and fine sand found in Mahrajganj. Mahrajganj tehsil soils contained relatively higher silt content (29.03 %) as compare to other tehsils

of the district and Rae Bareli having lower silt content (mean value 11.14). The amount of clay in the soils of Mahrajganj 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 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, similar result found by Naik (2014).

DTPA-Zn was significantly negative correlated with pH but non-significantly negative correlation show between Zn and salt concentration. Increasing organic carbon content in soils enhanced the availability of zinc as indicated by significant positive correlations probably due to higher degree of adsorption and chelation as reported by Kumar *et al.*, (2006). Increasing CaCO₃ content in soils decreased the availability of zinc (Table 2).

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How to cite this article:

Gyanendra Kumar, Ashiwani Singh and Ravindra Kumar. 2017. Status of Available Zinc and Their Relationship with Soil Properties in Soils of Rae Bareilly District of Uttar Pradesh, India. *Int.J.Curr.Microbiol.App.Sci.* 6(12): 1968-1971. doi: <https://doi.org/10.20546/ijcmas.2017.612.225>