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By

Rashmi Upadhyay and Yogesh Kumar Sharma

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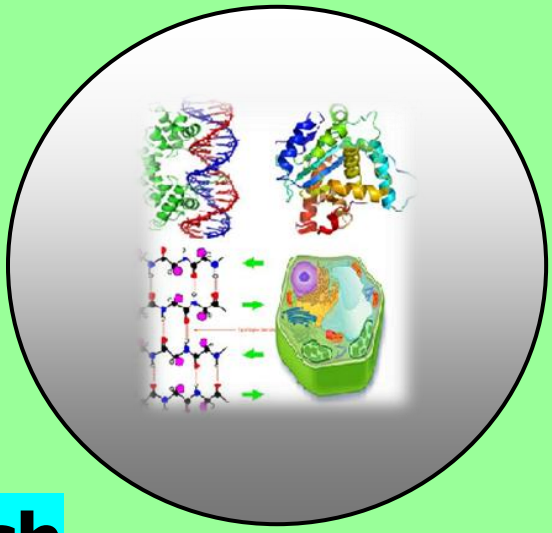

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R. Upadhyay Prof. Y.K. Sharma
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RESEARCH PAPER

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Soil Characteristics and their Nutritional Status in Lucknow District

Rashmi Upadhyay and Yogesh Kumar Sharma

Department of Botany, Lucknow University, Lucknow-226007, U.P., India

ABSTRACT

Soil samples were collected and analysed for physio-chemical properties like pH, Electrical conductivity (EC) and organic matter of different locations in Lucknow district. The pH of different regions was neutral which is suitable for any plantation to grow. EC (< 1.0 dSm^{-1}) and in most of the locations organic matter was found at optimum levels that is up to 0.75%. Available micronutrient contents in soil samples were also analysed. Deficient levels of zinc were found at all the locations subjected to minimum level at Devricala (0.028 mg kg^{-1}). Iron was highest (23.14 mg kg^{-1}) at Mahipatpur and lowest at Tilsua (2.995 mg kg^{-1}). Maximum and minimum level of Copper was found at Tilsua (0.352 mg kg^{-1}) and Bhavanipur (0.200 mg kg^{-1}) respectively. Manganese was found maximum at Khalilabad (6.345 mg kg^{-1}) and minimum at Gosainganj (1.396 mg kg^{-1}).
Key words: Soil, pH, EC, Organic matter, Available micronutrient contents (Zn, Fe, Cu, Mn).

INTRODUCTION

The backbone of Indian economy is the agriculture and it is the main occupation of the majority in rural places of India. About 65 percent of Indian population depends on agriculture. The most important natural resource for basic agricultural production is soil. Soils differ greatly in their physical and chemical properties. Since these properties control the response of soil to management practices, it is essential to have information about characteristics of each soil. The National Academy of Agricultural Sciences (Kanwar & Katyal, 1997) estimated that India may need approximately 301 million tonnes food grains by 2025. There is also an urgent need of continuously enhancing the productivity of soil to produce additional food grains for day by day increasing population. So, for higher production soil needs inputs of fertilizers and organic manures. Its efficiency depends on

right quantity to be applied at right time. Therefore, for maintaining soil health and sustainable agricultural production, on replenishment of macro- and micronutrients an addition of soil amendments is a must in the soil to obtain good crop yields.

Growing crops continuously remove both macro and micro nutrients which deplete the fertility of soil (Bahadur and Singh, 2008). Since the crops are utilizing micro elements year after year and generations after generations without adding traces of them, therefore, it becomes imperative to determine their existing status in the soil so that a balanced nutritional programme may be chalked out. Though micronutrients are required in traces yet its role is significant in crop production. Among these zinc, iron, copper and manganese are relatively more important. Zinc is one of the essential plant nutrients that functions in diverse metabolic, regulatory and developmental processes (Marschner, 1993). Manganese regulates growth and yield of plant like photosynthesis (water splitting reaction), oxidation reduction processes and many enzymatic reactions (Welch et al., 1991). Iron participates in various cellular processes such as respiration, chlorophyll biosynthesis and photosynthetic electron transport (Marschner, 1995). Copper promotes normal growth and helps in metabolism of plants (Sharma and Agarwal, 2005; Singh et al., 2007).

In most of the soils of Uttar Pradesh besides the major nutrients, deficiencies of sulphur, zinc, copper, iron, manganese and boron are of frequent occurrence with major loss of crop productivity. These days deficiencies of essential plant nutrients are increasing due to excessive use of fertilizers (Tiwari et al., 2014). Since then several workers have reported the soil status signifying the emphasis on delineation of areas of nutrient deficiencies on crop and specific location basis. Tiwari *et al.* (1995) reported the distribution of DTPA-extractable Zn, Cu, Mn and Fe in Bundelkhand soils of U. P. Similar studies were done by Dhane and Shukla (1995) in Maharashtra soils, and Sood *et al.* (2009) in Punjab soils. Sharma *et al.* (2000) studied the distribution of available Zn, Cu, Mn and Fe in Indogangetic plains. Such studies prior the crop is sown, provides a sound basis for determining the nutrients requirements for the desired crop production. It is, therefore, important to precisely assess the status of available Zinc, Iron, Copper and Manganese in U.P. soils. The present studies were done to find out the status of available Zinc, Iron, Copper and Manganese in different blocks of Lucknow district of Uttar Pradesh.

MATERIAL AND METHODS

Soil Sample Collection

Soil samples were collected from ten different locations of Lucknow district. Soil samples from two depths at every location were collected with the help of auger, and stored in polythene bags. Collected soil samples were air dried in shade, crushed gently with a pestle mortar and then pass through 2.0 mm sieve to obtain a uniform representative sample. Samples were properly labelled with tag and stored in polythene bags for analysis. The soil samples were processed and stored in the lab at suitable room temperature, and analysed for pH, Electrical Conductivity, Organic Matter (%), and available micronutrients (Zn, Fe, Cu, Mn) by using standard methods as per details given below:

a) **Soil Reaction (pH)** was determined by using 1:2.5 soils: water suspension with the calibrated pH meter (Hanna instruments H198129) by following the method given by Jackson (1973).

b) Soil Salinity (Electrical Conductivity) was determined by using 1:2.5 soil: water suspension with the calibrated conductivity meter (Hanna instruments H198129) by following the method given by Jackson (1973).

c) Organic matter (Walkley and Black, 1934) : 0.5 gm soil was taken into 250 ml conical flask.10 ml of 1N potassium dichromate was added with swirling motion after that 20ml of conc. H_2SO_4 was added containing a pinch of silver sulphate. Stand the suspension for 30 minute. 70 ml of GDW and 10 ml 85% phosphoric acid was added. Solution was titrated with 0.5 N PAS solution to bright green color after addition of 1ml DPA indicator.

d) Available Micronutrient cations (Zn, Fe, Cu & Mn) were determined by following Lindsay and Norvell (1978) method using Atomic Absorption Spectrophotometer (Electronics corporation of India limited AAS4141) cationic micronutrients (Fe, Mn , Cu and Zn) in soil samples were extracted with a Diethylene triamine pentaacetate (DTPA) solution (0.005 M) DTPA + 0.01 M $CaCl_2$+ 0.1 M triethanolamine, pH 7.3.

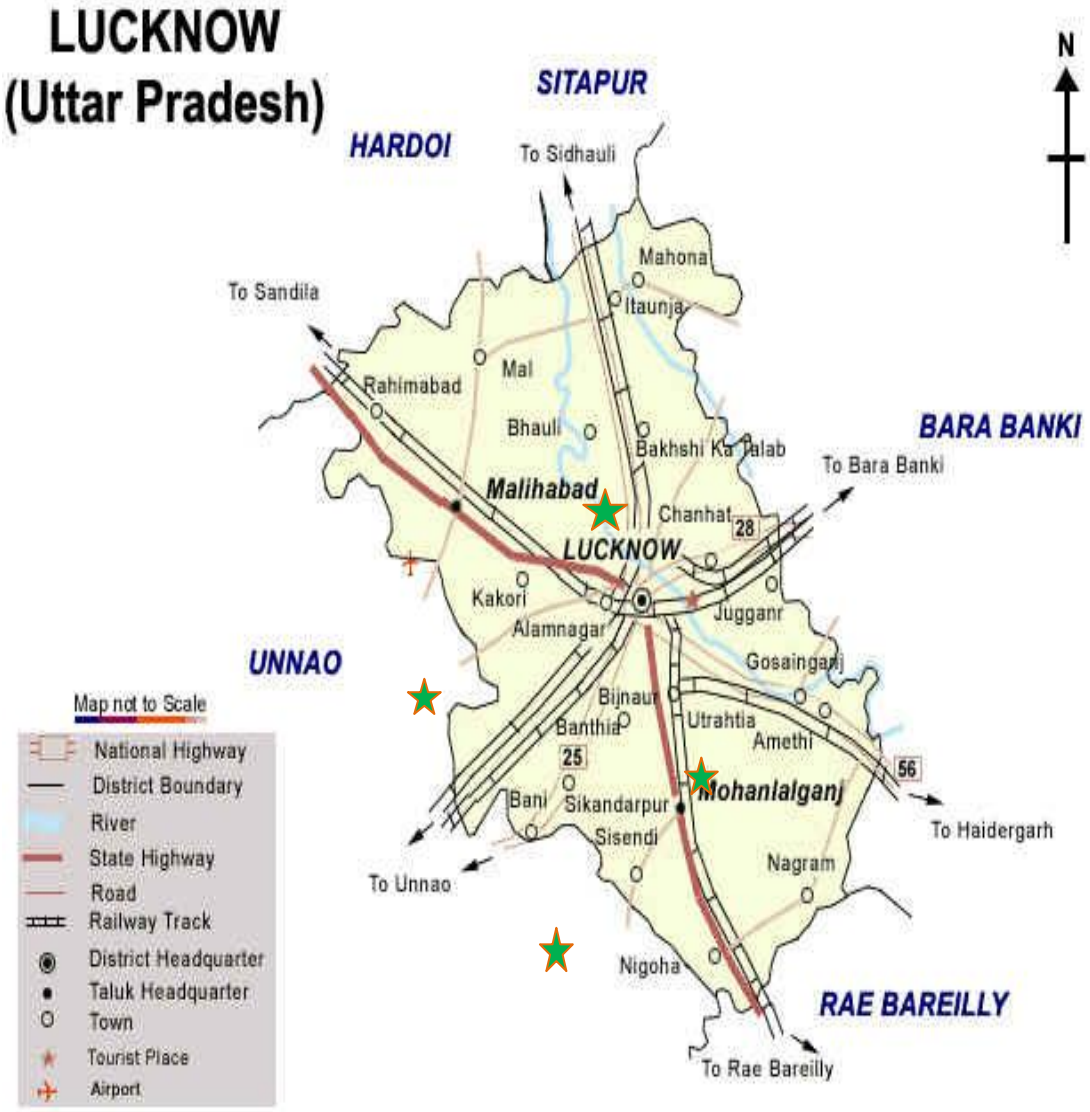

Figure 1. District map of Lucknow.

(http://www.google.co.in/search?q=lucknow+district+map) star showed soil sampled area

Table 1. pH and Electrical conductivity (dSm^{-1}) in soil profile at different locations of Lucknow.

S. No.	Location	Depth (cm)	pH	EC
1	Hazipur	0-15	6.77	0.66
		15-30	6.73	1.27
2	Devricala	0-15	6.83	0.86
		15-30	7.07	1.09
3	Bhavanipur	0-15	7.28	0.89
		15-30	7.21	0.75
4	Mahipatpur	0-15	7.21	0.86
		15-30	7.34	0.79
5	jugor	0-15	6.99	0.82
		15-30	7.21	0.92
6	khalilabad	0-15	7.05	0.57
		15-30	7.11	0.73
7	Gosainganj	0-15	7.03	0.75
		15-30	7.18	0.81
8	Sikandarpur	0-15	7.12	0.85
		15-30	7.13	0.91
9	Nai Basti	0-15	7.24	0.48
		15-30	7.43	0.45
10	Tilsua	0-15	7.34	0.18
		15-30	7.38	0.22

Table 2. Organic matter contents contents (g kg^{-1}) at different locations of Lucknow.

S. No.	Location	Depth(cm)	Organic matter
1	Hazipur	0-15	0.267
		15-30	0.261
2	Devricala	0-15	0.202
		15-30	0.205
3	Bhavanipur	0-15	0.419
		15-30	0.335
4	Mahipatpur	0-15	0.515
		15-30	0.503
5	jugor	0-15	0.335
		15-30	0.312
6	khalilabad	0-15	0.402
		15-30	0.335
7	Gosainganj	0-15	0.438
		15-30	0.435
8	Sikandarpur	0-15	0.268
		15-30	0.251
9	Nai Basti	0-15	0.704
		15-30	0.736
10	Tilsua	0-15	0.371
		15-30	0.304

Table 3. DTPA-extractable Zinc, Iron, Copper and Manganese content (mg kg^{-1}) in soil at different locations of Lucknow.

S. No.	Location	Depth (cm)	Zn	Fe	Cu	Mn
1	Hazipur	0-15	0.099	4.891	0.208	3.581
		15-30	0.074	2.381	0.218	4.477
2	Devricala	0-15	0.028	11.78	0.333	2.437
		15-30	0.029	8.154	0.315	3.680
3	Bhavanipur	0-15	0.115	3.748	0.200	3.343
		15-30	0.053	3.539	0.205	6.148
4	Mahipatpur	0-15	0.092	23.14	0.351	2.470
		15-30	0.056	16.21	0.267	5.350
5	jugor	0-15	0.069	4.321	0.187	3.343
		15-30	0.053	2.381	0.154	6.148
6	khalilabad	0-15	0.118	2.381	0.227	6.345
		15-30	0.078	2.176	0.245	8.841
7	Gosainganj	0-15	0.046	2.036	0.272	1.396
		15-30	0.036	1.431	0.288	2.705
8	Sikandarpur	0-15	0.080	16.79	0.333	4.014
		15-30	0.078	12.21	0.343	4.877
9	Nai Basti	0-15	0.121	4.373	0.247	2.437
		15-30	0.103	3.205	0.285	3.343
10	Tilsua	0-15	0.039	2.995	0.352	3.468
		15-30	0.033	2.061	0.369	4.267

RESULT AND DISCUSSION

Characteristics of soil

Soil reaction (pH)

Soil samples collected from surface and subsurface of different locations from Lucknow district were mostly found neutral with approximate pH 7.0 in reaction (Table 1). Kumar and co-workers in 2013 also reported the similar results. They observed that in Muzaffarnagar district that the soil reaction was moderately neutral. The pH value for surface soil (0 to 15 cm) and subsurface soil (15 to 30 cm) of different locations ranged from 6.77 to 7.34 and 6.73 to 7.38 respectively. According to classification of soil reaction suggested by Brady (1985), most of the samples were found to be neutral. In general pH of the soil was found to be increased with increase in depth.

Electrical conductivity (EC)

The electrical conductivity of the soils varied from to 0.18 to 0.89 and 0.22 to 1.27(dSm^{-1}) at surface and subsurface of soil (Table 1). On the basis of the limits suggested by Muhar et al.(1963) for judging salt problem of soils, most of the samples (99%) were found normal (EC < 1.0 dSm^{-1}) and only few samples were found in the category of soluble salt content critical for germination (EC 1 to 2 dSm^{-1}). The salt contents were found to be increased with soil depth. This high content of salts might be due to irrigation with saline water.

Organic matter content (OM)

The organic matter content of the soils varied from 0.202 to 0.724 and 0.205 to 0.736 g kg^{-1} soil at surface and subsurface level respectively (Table 2). Lower organic matter in the area might be due to prevailing high temperature and good aeration in the soil which increases the rate of oxidation of organic matter content. The maximum OM was found at Naibasti (0.724 g kg^{-1}) and minimum was found at Devricala (0.202 g kg^{-1}) at surface level.

Available cationic micronutrients

Zinc (Zn)

The available Zn estimated by DTPA in the surface and subsurface soil of different locations was found to be in deficient range as per criteria given by Lindsay and Norvell (1978). The minimum and maximum value of available Zn in surface soil and sub surface soil ranged from 0.028 to 0.121 and 0.029 to 0.103 mg kg^{-1} soil respectively (Table 3). The maximum DTPA extractable available Zn 0.121 and 0.103 mg/kg soil was found in Naibasti location and minimum 0.028 and 0.029 mg kg^{-1} soil in Devricala location for surface and subsurface soil.

Iron (Fe)

The DTPA- extractable available Fe in the surface and subsurface soil of different locations were found to be sufficient to high. The DTPA extractable iron in surface (0 to 15 cm) as well as subsurface (15 to 30 cm) varied from 2.036 to 23.14 and 2.061 to 16.21 mg kg^{-1} soil respectively (Table 3). The highest values of available Fe for surface as well as subsurface soils were found at Mahipatpur and lowest values of available Fe for surface as well as subsurface soils were found at Tilsua locations. According to the critical limit 4.5 mg/kg soil as purposed by Lindsay and Norvell (1978) all the surface soil sample and sub surface samples were sufficient in available Fe (Table 12). The amount of available Fe decreased with an increasing soil depth.

Copper (Cu)

DTPA-extractable available copper in the surface and subsurface soil of different locations were found to be sufficient. The DTPA-extractable Cu (mg kg^{-1} soil) in surface (0 to 15) and sub surface (15 to 30 cm) soils varied from 0.208 to 0.352 and 0.200 to 0.369 mg/kg soil, respectively (Table 3). The maximum available Cu 0.352 and 0.369 mg kg^{-1} soil for surface soil (0 to 15 cm) and subsurface was found in Tilsua location and minimum 0.200 and 0.205 mg kg^{-1} soil in Bhavanipur location. Considering the critical limit 0.20 mg/kg soil as suggested by Lindsay and Norvell (1978) all the soil samples of different locations were found to be sufficient in available Cu. An increasing trend in available Cu content with increasing depth was noticed in all different locations.

Manganese (Mn)

The DTPA extractable available Mn in the surface and subsurface soil in different locations is sufficient since all levels were well above the critical limit (1.0 mg/kg) as proposed by Lindsay and Norvell (1978). The maximum available Mn content 6.345 mg kg^{-1} soil was found in Khalilabad location and minimum available 1.396 mg kg^{-1} soil in Gosainganj for surface soil (0 to 15 cm). Maximum extractable Mn content 8.841 mg kg^{-1} in subsurface was found in soil of Khalilabad location and minimum 1.396 mg kg^{-1} in Gosainganj.

Based on survey studies**,** there is occurrence of zinc deficiency problem in the region due to low solubility of zinc in soils. Organic matter of soil plays an important role in solubility of zinc (Marschner 1993; Obrador et al., 2003).

There has been found a similar relationship between DTPA-extractable Zn and soil organic matter, the lower the soil organic matter, minimum the DTPA-extractable Zn concentration in soil (Cakmak, 2008). The minimum level of soil organic matter and DTPA- extractable Zn is found at Devricala. These results indicate that the availability of readily soluble Zn in soil might be low due to reduced level of organic matter. So, for reclamation of Zn deficiency $ZnSO_4$ is widely used due to its low cost and high solubility (Cakmak , 2008).

CONCLUSION

Physico-chemical characteristics and nutrient status of soil in Lucknow district of Uttar Pradesh indicated that soil of study area were neutral in reaction and non saline in nature. Study area was dominated by wheat, rice, blackgram, greengram, vegetables and fodder crops. Nutrient status regarding the available cationic micro nutrient in surface (0 to 15 cm) and subsurface (15 to 30 cm) depth of soil indicate that soils are zinc deficient in general and sufficient in available Fe, Cu and Mn in the surface and subsurface layer of the profiles.

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Corresponding author: Ms. Rashmi Upadhyay, Department of Botany, Lucknow University, Lucknow-226007, U.P., India
Email: rashmilk11@gmail.com