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CHEMICAL ANALYSIS OF SOIL NUTRIENTS (MICRO NUTRIENTS & MACRO NUTRIENTS) IN NON-CULTIVATED SOILS OF LUCKNOW DISTRICT

SARIKA BAJPAI

CIPET IPT, Lucknow, Uttar Pradesh, India

Address of Corresponding Author: Dr Sarika Bajpai, Assistant professor (Chemistry), CIPET IPT, Lucknow, Uttar Pradesh, India; Email ID - E-mail: dr.sarikabajpai@gmail.com

ABSTRACT

The study undertaken during the year 2017 – 2018 (July to April) deals with thorough chemical investigation of soil samples collected from different study sites in varying seasons located in Lucknow district, Uttar Pradesh, India. Samples were estimated in a regular interval of 3 months (July, Oct, Jan & April) for seasonal variations. The deficiency of micro nutrient boron and macro nutrients total N, Ca & Mg was discovered in many of our soils in recent years. Extremely high concentration of Fe (60 to 200 ppm) and Mn (72 to 99 ppm) were reported almost in all seasons. pH showed highly alkaline (7.2 to 10.3) nature of soil. Organic carbon ranged from 0.4 to 14%, total nitrogen ranged from 0.05 to 1.2%, Phosphorus & Potassium ranged from 0.1 to 0.8% & 1.6 to 4.8% respectively. Calcium & Magnesium deficiency was found throughout the year.

Key words : *Soils; Macronutrient; Micronutrient; AAS (Atomic Absorption Spectrophotometer); Kjeldahl method; Olsen method; pH*

INTRODUCTION

Soil, as the mother earth, has all the functions of the 'Tridev' of the Hindu mythology. It is at once the 'Brahma', the 'Vishnu' and the 'Maheshwar'; The creator, preserver and destroyer. Soil is the soul of infinite life. The essence of life in the soil is in its crop producing capacity i.e. the soil productivity. Soil fertility is that component of productivity which primarily deals with nutrient supplying capacity of the soil to the plant [6] . The excessive use of chemical fertilizers have wasted thousands of hectares of land in India. Continuous cropping without fertilizer caused declines in soil organic carbon and microbial biomass size and activity compared to farmyard manure alone or in combination with inorganic fertilizer [4]. Application of Bio fertilizers increases the crop production [10] . Increase in fertilizer rates on non cultivated soils the productivity of rice-wheat cropping system also increases the yield approximately 50% over the recommended dose [16]

Soil pH is a key parameter for crop productivity. Soil pH affects the soils physical, chemical and biological properties and thus plant growth. The macro nutrients (N, P. K) and micro nutrients (Fe, Zn, Cu) are essential for healthy plant growth [3] .For better yield of crop, the status of soil constituents, chemistry of availability of water, nutrient supply to the crop and climatic conditions are most important [7] . Soil of Lucknow District, Uttar Pradesh is highly alkaline in non cultivated regions. Soil fertility has one common goal. Balance fertilization is must to improve soil health and its productivity on highly polluted sites, by application of some bio fertilizers the concentration of heavy metals can be minimized. Heavy metals in the environment are a common plant stress factor, which can be harmful to plants as well as indirectly to humans due to their placement in the tropic chain, since plant accumulate them [2] . The amount of macro and micro nutrients available to plants roots is the main factor limiting the yield of crop. The macro nutrients (N, P, K & C_{ORG}) are needed in large amounts and Micro nutrients (Fe, Zn, Cu, Mn & B) are needed in smaller amounts [5] .

Some heavy metals are necessary for the plant's development e.g. Fe, Cu, Zn, Mn and Mo, but their excess can be toxic for plants. Beyond that there are also other heavy metals (Cd, Hg, Pb) which are not associated with plant development and can cause damage to them [15] .

The presence of heavy metals in the environment can have a natural (volcanic emission) or industrial (smelters, coal mines) origin. Industrial areas are usually highly contaminated where the pollutants can also spread throughout the vicinity (e.g. due to dust emission) consequently influencing cultivated crops therefore arable land should be excluded from agricultural production [17].

Materials and Methods

The Investigation was conducted in various sites of Lucknow district, Uttar Pradesh, India including each 8 blocks, in different seasons. The soil samples were collected from all 8 blocks in regular interval of 3 months during July 2017 to April 2018. Samples were taken from cultivated area of 4 sampling sites of each blocks. Samples were brought to laboratory in polythene bags for analysis and spread out on thick brown paper. Coarse, concretion, stones and pieces of roots, leaves and other un-decomposed organic residues were removed. Large lumps of moist soil were broken by hand. Soil samples were air dried for 24 hours, then samples crushed gently in pestle and mortar and sieved through 2 mm sieve [1] . This size has been adopted as an international standard because the soil passing this mesh contains almost the whole of the nutritionally important fraction in the soil. pH of soil samples were determined by pH meter. The higher range of pH in soils is due to high concentration of alkaline salts, particularly carbonates and bicarbonates of sodium. Estimation of other macronutrients carried out by given methods:

1) Organic carbon (Walkley & Black method) [18]
2) Total Nitrogen (Kjeldahl method) [1]
3) Phosphorus (Olsen method) [9]
4) Potassium (Flame photometric method) [1]
5) Calcium (EDTA Titration method) [1]
6) Magnesium (EDTA Titration method) [1]

For estimation of micro nutrients the soil samples were washed with 0.1 N HCl followed by washing with double distilled water. 0.5 gm. Sample taken into a 100 ml Kjeldahl flask, added 1 ml of 60% $HClO_4$,5 ml HNO_3 and 0.5 ml H_2SO_4 , swirled gently and digested slowly at moderate heat, increasing later, digested for 10 – 15 min. after appearance of white fumes. It was set aside to cool, diluted and applied modifications for Zn, Fe, Cu, Mn & B. The solution was transferred into 50 ml volumetric flask and diluted. Blank sample was analyzed with the help of atomic absorption spectrophotometer.

RESULTS

The results of pH , Zn, Fe, Cu, Mn and B are indicated in Table 1. Variation of concentration of micro nutrients including pH also showed with the help of bar diagram, these are represented in Fig 01 and Fig 02. During the study, it has been observed that pH values are in alkaline range. Concentration of Zn varied from 0.1 to 19.3 ppm. Fe content ranged from 8.3 to 200 ppm (extremely high). During the period of study, it has been observed that Cu contents showed variation from 0.1 to 13 ppm. Mn contents in non cultivated soils varied from 6.1 to 99 ppm. Boron contents during the present investigation in non cultivated sites ranged from 0.5 to 4.5 ppm.

The concentration of organic carbon, total nitrogen, phosphorus, potassium, calcium and magnesium are indicated in Table 2. Variation of concentration of macro nutrients was represented with the help of bar diagram in Fig. 03 and Fig. was 04. Organic carbon contents fluctuated strongly. It showed maximum value in July and minimum in October. Total nitrogen showed deficiency in almost all seasons. Phosphorus ranged from 0.1 to 0.8 % .Potassium showed excess in all seasons, ranged from 1.6 to 4.8%. Deficiency of Ca & Mg was observed in all seasons. The standard and ideal concentration of macro nutrients present in healthy soils, as for organic carbon, total nitrogen, phosphorus, potassium, calcium and magnesium were 0.2 to 10%, 2 to 5%, 0.01 to 0.2%, 0.02 to 2%, 0.1 to 2% & 0.05 to 3% respectively [1].

Table -1
Seasonal variation of pH & Micro nutrients in non cultivated soil samples at selected study sites of Lucknow district during July 2017 to April 2018

S.No	Parameters	July 2017	October 2017	January 2018	April 2018
1	pH	7.5 ± 10.2	7.6 ± 10.3	7.2 ± 9.6	7.2 ± 10.0
2	Zn	0.1	± 19.3	0.6 ± 8.2	0.5 ± 7.0 0.8 ± 8.0
3	Fe	9.0 ± 200.0	8.3 ± 60.0	14.0 ± 120.5	13.4 ± 132.0
4	Cu	0.1	± 13.0	0.5 ± 3.2	0.6 ± 4.20.3 ± 6.5
5	Mn	6.1 ± 77.0	7.0 ± 99.0	30.1 ± 72.0	16.0 ± 64.2
6	B	0.5 ± 2.1	0.5 ± 2.0	0.8 ± 4.2	0.6 ± 4.5

Table - 2
Seasonal variation of Macro nutrients in non cultivated soil samples at selected study sites of Lucknow district during July 2017 to April 2018

S.No.	Parameters	July 2017	October 2017	January 2018	April 2018
1	Organic C	0.4 ± 14.2	0.9 ± 12.0	2.7 ± 14.0	1.0 ± 13.5
2	Total N	0.05 ± 1.2	0.08 ± 1.0	0.2 ± 1.2	0.09 ± 1.2
3	P	0.1± 0.8	0.1± 0.3	0.1± 0.3	0.1± 0.3
4	K	1.6 ± 3.3	2.6 ± 4.7	2.3 ± 4.8	2.0 ± 4.8
5	Ca	0.07 ± 0.6	0.08 ± 0.7	0.04 ± 0.4	0.2 ± 0.7
6	Mg	0.01± 0.5	0.2± 1.8	0.2± 0.5	0.6 ± 1

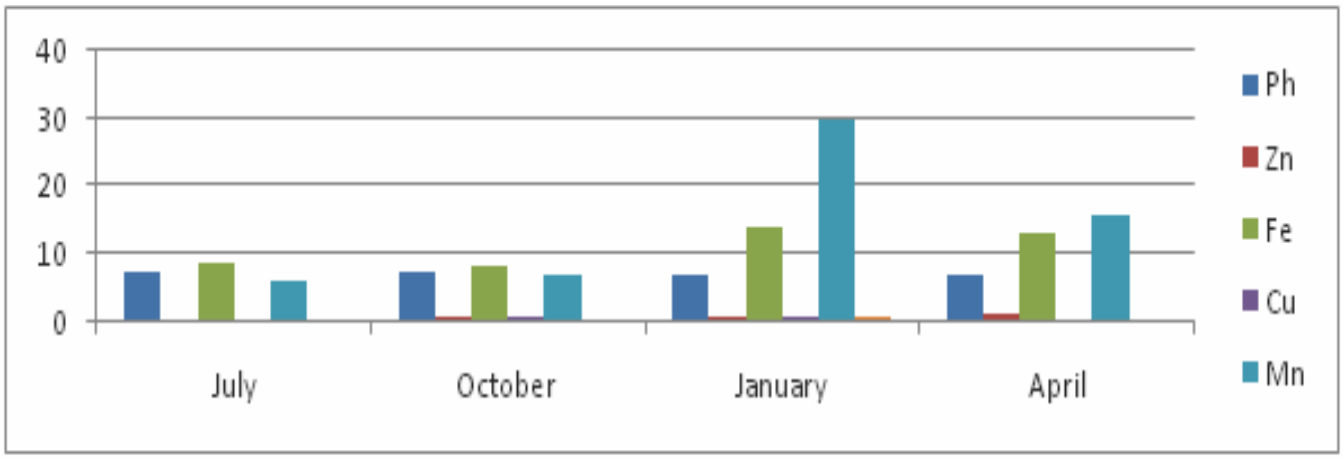

Fig. 01
Seasonal variation of Minimum values of pH & Micro nutrients in non cultivated soil samples at selected study sites of Lucknow district during July 2017 to April 2018.

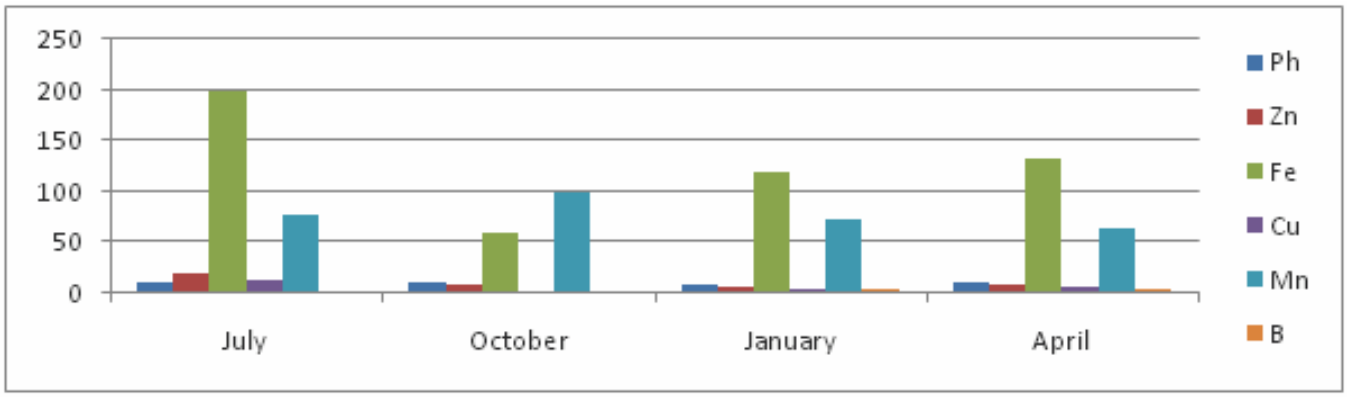

Fig. 02
Seasonal variation of Maximum values of pH & Micro nutrients in non cultivated soil samples at selected study sites of Lucknow district during July 2017 to April 2018.

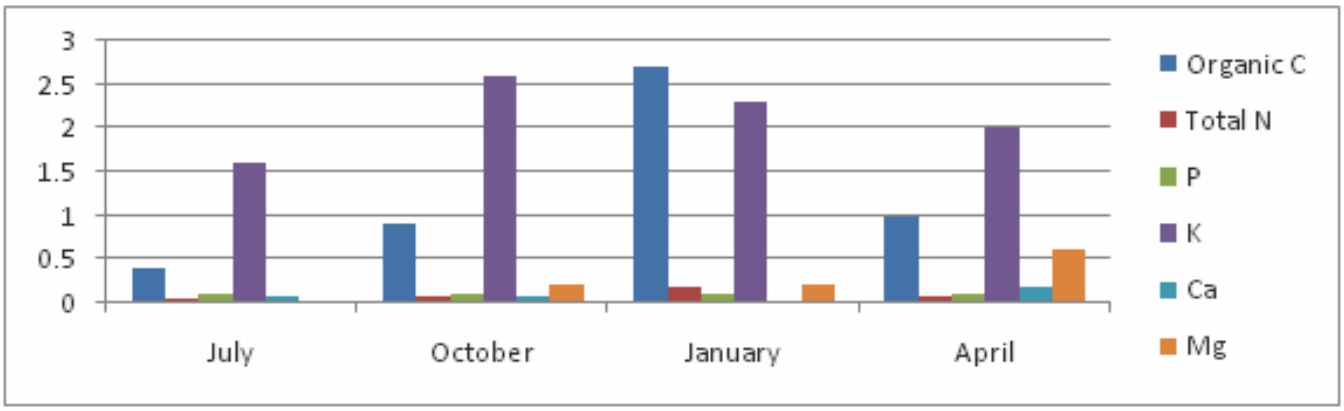

Fig. 03
Seasonal variation of Minimum values of Macro nutrients in non cultivated soil samples at selected study sites of Lucknow district during July 2017 to April 2018.

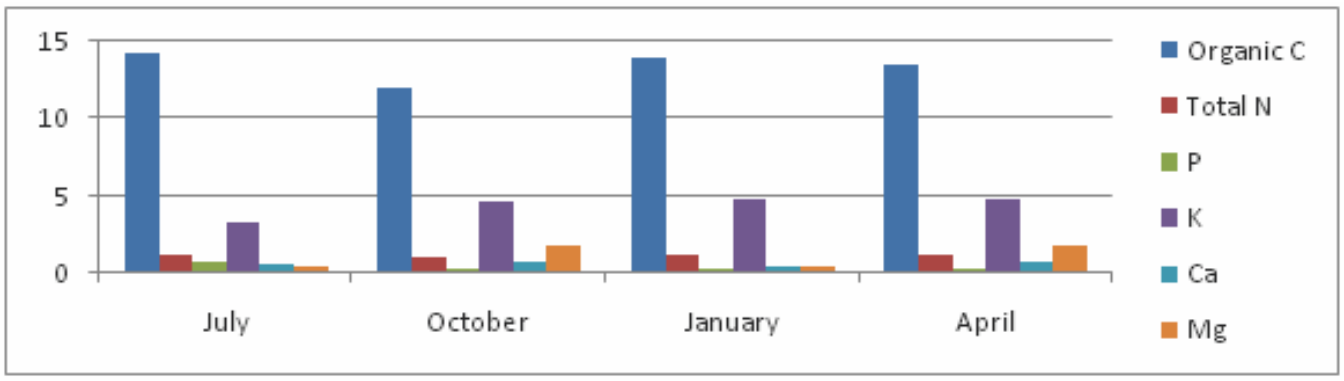

Fig. 04
Seasonal variation of Maximum values of Macro nutrients in non cultivated soil samples at selected study sites of Lucknow district during July 2017 to April 2018.

DISCUSSION

The values of physicochemical parameters obtained were represented in table 01. The soil was alkaline (7.2 to 10.3) throughout the year. Maximum value of Zn (19.3 ppm) was noted in July. Available Fe content of soil varied from 8.3 to 200 ppm. Excess of Fe was noted in almost all the seasons. Value of Cu varied from 0.1 to 13 ppm, deficiency of Cu pointed in July & April. Mn status of different soils varied from 6.1 to 99 ppm, excess of Mn was observed in all seasons. The concentration of boron varied from 0.5 to 4.5 ppm. Extractable Zn, Fe, Cu, Mn & B less than 1.2, 8.0, 0.4, 4.0 & 0.5 ppm respectively were considered deficient. [1]

Zinc, a dominant metal in many organic waste materials, is an essential plant micronutrient and is also potentially toxic to plants and humans at high concentration, depending on pH & organic carbon and in non cultivated soils excess of Zn reported due to sewage effluents and other sources [12] . Concentration of Zn could be controlled with the help of addition of cadmium. Absorption of Zn decreased when cadmium was present in soil samples [11]. High value of Fe throughout the year may be due to disposal of waste of factories containing insoluble Fe complexes like $FeSO_4$, Fe – EDTA, Pyrites, Biotites & Fe – EDDHA. Excess of Cu might be due to fixation of insoluble copper complexes. Excess of Mn reported in all seasons might be due to fixation of MnO_2, $MnSO_4$ & Mn_2O_3 % Pyrolusites. Boron showed sufficient concentration except Jan (4.2 ppm) & April (4.5 ppm) which may be due to fixation of borates of Ca & Mg .

Excess of organic carbon was reported almost in all seasons and its concentration varied from (1.0 to 14.2%). In non-cultivated soils excess of organic carbon might be due to cattle manure, human excreta, urination and other sources. The concentration of N could be increased by addition of urea and nitrates of Na, K & Ca in soils. Range of Phosphorus varied from 0.1 to o.8%. Deficiency of Nitrogen is universal, low phosphorus status is in 50% & medium in 48% soils. About 48% soils are low to medium in available K & its deficiency is rapidly increasing under intensive cropping and unbalanced fertilizer use [8]. The concentration of P increases, as pH increases, the concentration of K is high due to fixation of soluble K salt at high temperature. Alkaline soil found available N in low category and K in medium [14]. The salt affected soils were low in available N & P and medium in K [13]. The range of K in our investigation varied from 1.6 to 4.8%. The concentration of Ca & Mg ranged from 0.04 to 0.7 and 0.01 to 1.8 respectively. Deficiency of Ca & Mg was reported in all seasons. Main cause of their deficiency is presence of phosphates of Ca & Mg and Organo Mg complexes, which are insoluble in water, thus present at soil surface only and leached in rainy season.

CONCLUSION

From this study, it is quite evident that Soil of Lucknow district , Uttar Pradesh , India showed alkaline nature. In non cultivated soils, excess of Zinc was reported due to sewage effluents and other sources. High value of Iron was reported throughout the year. Copper also showed excess in majority of our sites, the excess presence might be due to fixation of insoluble Cu – complexes by chemical fertilizers. Excess of Mn was reported in all seasons except October. Boron showed sufficient concentration except in October, here excess of Boron was reported. Organic carbon showed positive correlation with total nitrogen. Excess of carbon due to stabilization of mineral carbon in soil and excess cropping also helpful in fixation of carbon as organic matter in soils. Concentration of phosphorus increases as pH increases. Potassium concentration is high in April due to fixation of soluble potassium salts at high temperature. Deficiency of Ca & Mg in soils of Lucknow district was observed throughout the year. Heavy metals are toxic for many plants and humans also, thus its toxic effects should be decreased by applying microbial or Bio-Fertilizers in place of chemical fertilizers. The adequate nutrients and maintenance of proper moisture regime is advocated for better crop production in non cultivated soils of Lucknow district. For proper balancing of these micro and macro nutrients, addition of suitable salts in proper ratio should be applied to minimize leaching of macro nutrients into ground water.

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