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AN INVESTIGATION OF HEAVY METAL CONTAMINATION IN SOIL AROUND BATHI LAKE, DAVANGERE

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Abstract - *There is a growing public concern over the potential accumulation of heavy metals in agricultural soils owing to rapid urban and industrial development and increasing reliance on agrochemicals in the last several decades. Excessive accumulation of heavy metals in agricultural soils may not only result in environmental contamination, but elevated heavy metal uptake by crops may also affect food quality and safety. The present paper deals with accumulation of Heavy metals and in soil around the Bathi Lake of Davangere city, Karnataka. The physic-chemical parameters of soil like pH, electrical conductivity, soil moisture, chloride, calcium, magnesium, organic carbon, Nitrogen, Potassium, Phosphorus were analyzed by standard methods and every one of these parameters analyzed are within the desirable limit. Four heavy metals Cr, Fe, Zn and Pb were analyzed using Atomic Absorption Spectroscopy. Heavy metals analyzed are within the standard limits and does not influence the plants.*

Key Words: Sampling, AAS, Heavy Metals.

1. INTRODUCTION

Soil may be defined as a thin layer of earth's crust which serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to, and influenced by genetic and environmental factors – parent material, climate, organisms and topography all acting over a period of time. Soil also plays a vital role in controlling global climate change because it acts as the main source and sink for greenhouse gases. Soil differs from the parent material in the morphological, physical, chemical and biological properties. Also, soils differ among themselves in some or all the properties, depending on the differences in the genetic and environmental factors. The components of soils are mineral material, organic matter, water and air, the proportions of which vary and which together form a system for plant growth; hence the need to study the soils in perspective. Soil testing is considered a useful tool for making fertilizer recommendation for various crop and crop sequences.

Soil fertility is simply defined as the ability of the soil to supply nutrients for plant growth. The soil is a store house of plant nutrients.. Physical properties of the soil include water holding capacity, aeration, plasticity, texture, structure, density and colour etc. Chemical properties refer to the mineralogical composition and the content of Calcium, Magnesium, Potassium, Nitrogen, Phosphorus and organic matter content.

Heavy metals occur naturally in the ecosystem with large variations in concentrations. In modern times, anthropogenic sources of heavy metals, i.e. pollutions from the activities of humans, have introduced some of these heavy metals into the ecosystem. The presence of heavy metals in the environment is of great ecological significance due to their toxicity at certain concentrations, translocation through food chains and non biodegradability which is responsible for their accumulation in the biosphere. Heavy metals like iron, tin, copper, manganese and vanadium occur naturally in the environment and could serve as plant nutrients depending on their concentrations. Mercury, lead, cadmium, silver, chromium and many others that are indirectly distributed as a result of human activities could be very toxic even at low concentrations. These metals are non-biodegradable and can undergo global ecological circles.

Heavy metals can accumulate in the soils to toxic levels as a result of untreated waste waters and fertilizer. The extent of soil pollution by heavy metals is very alarming because of their toxicity which lead to adverse effects on human and ecosystem health. Chronic exposure to heavy metals leads to serious kidney malfunction, anaemia, hematological and brain damage. Therefore, it is aimed at evaluating the level of metallic element concentrations in soil.

2. MATERIALS AND METHODOLOGY

The soil samples were collected in the month of December to May around the Bathi lake of Davangere having latitude of 14° 14' to 14° 31' towards north and longitude of 75° 30' to 76° 30' towards east. The soil samples were collected in the depth of 25-30cm from the surface of land in polythene bags. The sampling method used is

composite sampling and total four numbers of samples were collected from four sides of the site. The samples were kept in Oven and dried at 105^{0}C for 24hours. The samples are sieved using 2mm sieve. The pH was measured by pH meter. The potassium determination was carried out by Flame photometer in the Environmental laboratory, BIET College, Davangere.

Methods used for estimation of various nutrients and parameters are shown in Table-1.

Table-1: Methods used for Estimation of Nutrients and Parameters

SL.No	Parameters	Method
1.	Moisture	Gravimetric Method
2.	pH	pH Meter
3.	Electrical Conductivity	Conductivity Meter
4.	Specific Gravity	Gravimetric Method
5.	Bulk Density	Core Method
6.	Organic Carbon	Titration Method
7.	Available Nitrogen	Titration Method
8.	Available Phosphorous	Titration Method
9.	Available Potassium	Flame Photometry
10.	Chlorides	Titration Method
11.	Calcium	EDTA Titration
12.	Magnesium	EDTA Titration
13.	Sodium	Flame Photometry
14.	Soil Texture	Hydrometer Method
15.	Heavy Metals	DTPA Method

Source: U.E Chaudhari et.al(2012)

2.1 Heavy Metals

In soil samples Heavy metals were analyzed using Atomic Absorption Spectroscopy. Around 1gm of soil sample was processed in Nitric acid and Perchloric acid in 1:10 proportion and was heated in oven at 80^{o}C until white vapor was vanished. Then the digested sample was filtered using Whatman filter paper and the filtrate was made up to 10ml. Then this solution is placed in AAS and analyzed. Prior to the analysis AAS was calibrated using standard solutions of each metal. The trace metals analyzed in soil samples were Cr, Pb, Zn and Fe.

3. RESULTS AND DISCUSSION

The mean six months test results of soil samples are tabulated below.

Table-2: Results of Various Parameters Analyzed

Sl. No	Parameters	North Side	South Side	West Side	East Side
1.	Moisture, %	1.10	1.20	1.14	1.23
2.	pH	7.28	7.58	7.40	7.69
3.	Electrical Conductivity, µs/cm	0.29	0.36	0.31	0.5
4.	Specific Gravity	2.13	2.55	2.39	2.59
5.	Bulk Density, g/cm^3	1.52	1.60	1.49	1.63
6.	Organic Carbon, %	0.59	0.87	0.74	0.94
7.	Available Nitrogen, Kg/ha	337.59	393.50	379.68	409.03
8.	Available Phosphorous, Kg/ha	36.63	38.42	37.36	42.3
9.	Available Potassium, Kg/ha	172.3	197.42	175.6	201.8
10.	Chlorides, ml/100g	29.13	34.32	31.92	35.77
11.	Calcium, ml/100g	13.67	19.6	15.1	27.45
12.	Magnesium, ml/100g	6.67	6.92	6.58	7.93
13.	Sodium, Kg/ha	40.5	43.8	41.8	46.1
14.	Soil Texture	Sandy Clay Loam			
15.	Chromium, mg/kg	6.73	10.4	6.36	11.41
16.	Zinc, mg/kg	-	-	-	16.47
17.	Lead, mg/kg	9.03	-	-	8.13
18.	Iron, mg/kg	-	16.1	-	34.47

According to the results tabulated in the table 2 following discussions are made by comparing them with standard limits. Moisture content of soil samples varies from 1.10-1.23%. It has sufficient moisture content required for the plants. The soil pH value is a measure of soil acidity or alkalinity and directly affects nutrient availability. In the present study the pH of soil samples are 7.28 and 7.69 which are alkaline in nature.

Electrical conductivity is one of the important parameter of the soil sample because it shows the salinity of the soil and Organic carbon varies from 0.59-0.94%. Chloride content of samples varies from 29.13-35.77ml/100g. Calcium content of sample varies from 13.67-27.45ml/100g and Magnesium content in soil varies from 6.67-7.93ml/100g. Soil texture is determined by using

hydrometer method and the soil type is Sandy Clay Loam Soil.

Nitrogen is essential to nearly every aspect of plant growth. In this study Available Nitrogen varies from 337.59-409.03Kg/ha. Phosphorous provides plants with means of using the energy harnessed by photosynthesis to drive its metabolism. The phosphorous content of sample varies from 36.63-42.3Kg/ha and Available Potassium varies from 172.3-201.8Kg/ha. All the parameters are more in Sample 2 & 4 compared to Sample 1 & 3. The variations of Nitrogen, Phosphorous and Potassium are represented in graph.

In the present study the Chromium substance was seen in soil because of the excess use of fertilizers and pesticides which are key for the plant development. It varies from 6.73 to 11.41mg/kg from the month of March to May and these values are below the limits hence it does not affect plants and other micro organisms. The variation of Zinc content at each month varies from 16.2 to 16.7mg/kg in sample 4 and it is more in the month of April and May due to application of manure to increase the crops.

Lead content was observed only in sample 1 and sample 4 which is collected from the road side and it ranges from 8.13 to 9.03mg/kg. Sample 1 has more lead content compared to sample 4 due to the automobile exhaust and vehicular activity. Iron content in soil was observed in sample 2 and 4 and it is within the limit, it's sufficient for the plants growth. Iron content ranges from 16.1 to 34.7mg/kg from the month of March to May.

4. CONCLUSIONS

In the present study all the physic-chemical parameters of soil samples analyzed for 6 months are within in the standard limits. The study area has Sandy clay loam soil and is most suitable for growing paddy which is rich in organic content, nutrients and so on. Soil pH is neutral and the organic carbon is sufficient for plants growth.

There is gradual increase in Nitrogen, Potassium and Phosphorous in sample 2 and sample 4 in each month from December to May due to application of fertilizers and pesticides to increase the crop yield. Hence the soil is rich in NPK which is essential for the plants growth.

Heavy metal content is more but below the desirable limit in all the four samples in the month of April and May due to rainfall, fertilizers and pesticides applied on the land to increase the crops. It was observed that heavy metals does not affect the agricultural products and micro organisms as they are below the standard levels.Lead is observed in sample 1 and sample 4 due to the automobile exhaust and transportation and is below the standard limits.

The organic manures have to be use for the improvement of fertility of soil instead of chemical fertilizers.

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