American-Eurasian J. Agric. & Environ. Sci., 14 (12): 1382-1385, 2014
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2014.14.12.12948

Accumulation of Heavy Metals in Agricultural Soil Sample in Viswanatham, Sivakasi

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Abstract: Soil heavy metals are very useful indicator of improving environmental quality worldwide. The present study was conducted to investigate the levels of heavy metals present in agricultural soils. seven heavy metals were screened (Mn, Zn, Ni, Pb, Cu, Cr and Cd) such as manganese 15.5472 ppm Zinc-1.2411 ppm Nickel- 0.1371 ppm, lead-0.1370 ppm copper 0.0584 ppm, chromium- 0.0270 ppm and cadmium 0.0068 ppm by Atomic Absorption Spectroscopy. Generally, the distribution of these metals is influenced by the nature of parent materials, climate and their relative mobility depending on soil parameter, such as mineralogy, texture and classification of soil. Exposure to heavy metals is normally chronic due to food chain transfer and excess heavy metal accumulation in soils is toxic to humans and other animals.

Key words: Trace Metals · Atomic Absorption Spectroscopy · Heavy metals analysis · Contamination

INTRODUCTION

Living organisms require varying amounts of heavy metals. Iron, cobalt, copper, manganese, molybdenum and zinc are required by humans. All metals are toxic at higher concentrations [1]. Topsoil and dusts in urban areas are indicators of heavy metal contamination from atmospheric deposition. It has been noted that location close to roads are severally polluted by heavy metals such as Pb, Zn, Cu, Cd etc, from traffic [2, 3]. Among pollutants, heavy metals have been the subject of particular attention because of their long-standing toxicity when exceeding specific thresholds. Among the key issues in the environmental research on heavy metals is their mobility in the ecosystems and transfer in the food chains [4, 5]. The soil environment is a boundary point, diverse and dynamic and the fundamental characteristics of soil contamination are different from those of air and water, such as concealment and hysteresis, accumulation and irreversibility [6, 7]. Heavy metal content of soil is of major significance in relation to their fertility and nutrient status. Soil heavy metals have been a very useful indicator of environmental quality worldwide and been the subject of much attention because of their peculiar characteristics. These heavy metals in the terrestrial environment visibly constitute a significant risk to the quality of soils [8], plants [9], natural waters [10] and human health [11]. Generally the natural concentration of heavy metal in agricultural soils, derived from soil parent materials, is not sufficiently high to harm human health. However, anthropogenic sources such as mining, smelting, waste disposal, urban effluent, vehicle exhausts, sewage sludge and agrochemical can greatly increase heavy metal concentrations in agricultural soil [12-14].

In agricultural soils, the presence of metals is of increasing concern because they have the potential to be accumulated in less soluble forms, transferred into soil solution and subsequently deteriorate the groundwater and crop quality. The food crops constitute an important source of human oral exposure to metals [15, 16] and as a result careful monitoring of metal levels in agricultural soils is of great importance for protecting its quality and ensuring future sustainability [17]. Investigations of heavy metal contamination in urban soils is receiving a growing body of literature. The most common problem causing *cationic* metals (metallic elements whose forms in soil are positively charged cations e.g., Pb^{2+}) are mercury, cadmium, lead, nickel, copper, zinc, chromium and manganese. The most common anionic compounds (elements whose forms in soil are combined with oxygen

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and are negatively charged) Arsenic, molybdenum, selenium and boron Due to urbanization and land degradation, the area of agricultural land is continuously decreasing. Proficient use of available agricultural land resources is important to overcome the deficiency. Soil is a non-renewable dynamic resource and acts as an interface between agriculture and the environment. Maintaining soil quality is the vital factor to improve crop yield and productivity. Among the soil quality maintance heavy metals plays an imperative role to sustain its eminence properties [18,19].

MATERIALS AND METHODS

Soil sample was taken from agricultural area by using sterile zip cover. Heavy metals were analyzed by using 20 g of soil was mixed in 100 ml of distilled water and overnight incubated by orbital shaker. The mixed sample contain 0.5 ml was used to measured seven heavy metals (Mn, Zn, Ni, Pb, Cu, Cr and Cd,) by Atomic Absorption Spectroscopy (AAS)[20].

Study Area: Viswanatham is a Village in Sivakasi Taluk in Virudhunagar District in Tamil Nadu State. Viswanatham is 2.4 km far from its Taluk Main Town Sivakasi. Viswanatham is located 20.1 km distance from its District Main City Virudhunagar. Viswanatham is located at the latitude of 9.429 and the longitude of 77.807. The given latitude and longitude location of Viswanatham are decimal based coordinates. The area of investigation in agricultural soil sample was taken from viswanatham.

RESULT

The result of lead, chromium, nickel, zinc, copper, Manganese and Cadmium content in agricultural soil samples were present in table 2.

The concentration of heavy metal accumulation in viswanatham agricultural sample chromium - 0.0270 ppm, Nickel- 0.1371 ppm, lead-0.1370 ppm, Zinc-1.2411 ppm, copper 0.0584 ppm, manganese 15.5472 ppm, cadmium 0.0068 ppm (Table 1).

DISCUSSION

The knowledge of chemical mobility of heavy metals in soils is fundamental to understand their toxicity, bioavailability and geochemical behavior. Accumulation and persistence of heavy metals in surface soil layers, their bioavailability and potential toxicity were the main reasons for conducted research. The major sources for Mn, Pb and Ni enrichment in soils of study area. Highest contents above mentioned metals were determined in the upper soil layer of agricultural soil. Results on the influences of heavy metals to soil microorganism along the deposition gradient illustrate their negative response to heavy metal pollution. Studies on the relationship between soil biota and pollution levels have raised the question regarding the importance of natural soil abiotic properties, stressing the importance of background data of environment conditions. In their study concluded that even very low levels of heavy metals in soils may influence plant growth and reproduction.

Table 1: Heavy metal analysed by following parameters

S.No	Heavy metals	Parameters AAS Analysis
1	Lead	Flame type: Air-C2H2
		Fuel gas flow rate: 2.0 L/Min
		Support gas flow rate: 15.0 L/Min
2	Chromium	Flame type: Air-C2H2
		Fuel gas flow rate: 2.8 L/Min
		Support gas flow rate: 15.0 L/Min
3	Nickel	Flame type: Air-C2H2
		Fuel gas flow rate: 2.0 L/Min
		Support gas flow rate: 15.0 L/Min
4	Zinc	Flame type: Air-C2H2
		Fuel gas flow rate: 2.0 L/Min
		Support gas flow rate: 15.0 L/Min
5	Copper	Flame type: Air-C2H2
		Fuel gas flow rate: 2.0 L/Min
		Support gas flow rate: 15.0 L/Min
6	Manganese	Flame type: Air-C2H2
		Fuel gas flow rate: 2.0 L/Min
		Support gas flow rate: 15.0 L/Min
7	Cadmium	Flame type: Air-C2H2
		Fuel gas flow rate: 1.8 L/Min
		Support gas flow rate: 15.0 L/Min

Table 2: Lead, Chromium, Nickel, zinc, Copper, Manganese, Cadmium content in Agricultural soil sample

Heavy metals	Wavelength (nm)	Concentration (ppm)
Chromium	357.9	0.0270
Nickel	232.0	0.1371
Lead	283.3	0.1370
Zinc	213.9	1.2411
Copper	324.6	0.0584
Manganese	279.3	15.5472
Cadmium	228.8	0.0068

Since the study site serves as a grazing field, high doses of accumulated toxic metals in edible plants are not only harmful to animals when used as animal feed but also to humans. Plants growing in metal polluted locations exhibit altered metabolism, growth reduction, lower biomass production and metal accumulation. Various physiological biochemical processes in plants are affected by metals. [21,22]. In present study focus on agricultural soil heavy metal accumulation indication of environmental quality and maximum amount of heavy metal was recorded in manganese (15.5472 ppm) and followed by Zinc(1.2411 ppm) Nickel-(0.1371 ppm), lead (0.1370 ppm), copper(0.0584 ppm), chromium- (0.0270 ppm) and cadmium (0.0068 ppm). Heavy metals constitute a very heterogenous group of elements widely varied in their chemical properties and biological functions. They are persistant in nature, therefore get accumulated in soil and plants. Dietary intake of many heavy metals through consumption of plants and drinking water has long term detrimental effect on human health[23,24].The transmission of water borne disease has been a matter of concern for many years [25, 26]

CONCLUSION

The knowledge of chemical mobility of heavy metals in soils is fundamental to understand their toxicity, bioavailability and geochemical behavior. Accumulation and persistence of heavy metals in surface soil layers, their bioavailability and potential toxicity were the main reasons for conducted research.The major sources for Mn, Pb and Ni enrichment in soils of study area.

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