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Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 13
Issue: 05

Res. Jr. of Agril. Sci. (2022) 13: 1364–1365

CARAS

Res. Jr. of Agril. Sci. (Sep-Oct 2022)
13(5): 1364–1365

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

www.rjas.org

Short Communication

Analysis of Heavy Metals Content in Agricultural Soil of Bathinda District, Punjab (India)

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Received: 21 Jun 2022 | Revised accepted: 19 Aug 2022 | Published online: 07 Sep 2022

***Key words*:** Heavy metals, Inductively coupled plasma-mass spectroscopy, Agricultural soil, Permissible limit

In term of agriculture, soil is a dynamic natural body and it is present on the surface of earth. It is a complex mixture of mineral, organic and inorganic compounds that interact continuously and provide mechanical support to the growing plants and crops. It includes sixteen elements such as C (Carbon), Ca (Calcium), B (Boron), Cl (Chlorine), H (Hydrogen), Cu (Copper), Mo (Molybdenum), Fe (Iron), N (Nitrogen), K (Potassium), P (Phosphorus), Zn (Zinc), S (Sulphur). Soil transports the water, nutrient and air to all parts of plants. Inappropriate and excessive use of fertilizers, Pesticides as well as contamination due to the affluent and wastage of industrial wastage contaminate the soil quality [1]. Scientists resulted that most human activities also act as the main cause of contamination of the soil ecosystem [2-4]. Heavy metals accumulation inside the soil not only put impacts on plants and vegetables but also it enhances the death rate. An excessive content of heavy metals cause several health issues like dysfunction of kidneys, vomiting, cramps, headache, fever and mutation in DNA [5-6]. According to the soil science society of America, 1997 depicts the quality of soil is a mixture of the biological, chemical and physical characteristics that helps the soil to perform its functions. The numbers of reactions are based on the chemical properties and physical properties of soil. All these properties play an important role in agricultural practices. Heavy metals are omnipresent due to their non-biodegradable and persistent nature and potential to accumulate in different parts of the body, soil and water. All around the world, the issue of soil contamination due to heavy metals, creates a problem regarding bioaccumulation in the ecosystem. Among all the heavy metals, Pb, Cu, Cd, Zn, Ni, Fe and Cr are the main contaminants. Fossil fuel, Fertilizers, forest fires, pesticides and other anthropogenic activities are the main sources that enhance the content of heavy metals in the ecosystem. it also put an impact on the aquatic ecosystem as well as on soil. It decreases the yield of crops and growth of plants. Mostly plants and trees absorb contaminants from soil and pass them into the food chain. Mercury, Arsenic, lead, cadmium, zinc, manganese, chromium are toxic. Heavy metals are mainly harmful to humans as well as to all living beings on the earth. The content of Lead (Pb) and cadmium (Cd) are more toxic as compared to other elements. All over the World, many research accomplished to estimate the concentration of heavy metals in ecosystem, agricultural soil, water, in plants. In the industrial area contamination of soil is found more severe [7] as compared to the non-industrial area. Sludge of sewage is the main reason for the enhancement of cadmium concentration which put an impact on plant growth and nutrient uptake by plants as well as, inhibits the synthesis of chlorophyll in plants. Most of the data related to contamination and the impact of heavy metals are given by many countries such as China, New Zealand, Nigeria and Italy. Excessive content of heavy metals in the soil of agriculture affects the quality of food as well as its production. The Impact of heavy metals depends upon the type of soil as well as the presence of ions in the soil. Manure, sludge of sewage, fertilizers, pesticides and many other agrochemicals affect the uptake and bioavailability of heavy metals in the agricultural soil. To some extent zinc, copper, iron, manganese and nickel are essential elements but toxic at a high level. Present study was undertaken to analyze heavy metal content in the collected soil samples from the Bathinda district of Punjab.

The present study was conducted in the Bathinda district (Malwa region) of Punjab. Bathinda district is located in the southern part of Punjab state in the heart of the Malwa region. It is located between 29-33’ and 30-36’ North latitude and between 74-38’ and 75-46’ East longitudes. Bathinda district is one among Punjab state, India. Bathinda district occupies an area of approximately 3385 square kilometres. As per 2021 census of India, Bathinda has a population of 1,477,978. The average annual rainfall and temperature of the Bathinda district are between 20 to 40mm and 1-49 c, respectively. The height from Sea level is in the range of 200-202m. The climate of the area is hot in summer and cool in the winter season. Main crops grown in this area are wheat, sugarcane and paddy crops.

Agricultural soil samples were collected from the selected site of the villages of Bathinda district during October, 2020 and March, 2021. Soil samples were collected from the depth 0-20 cm. at room temperature, all the collected soil

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samples were kept to dry for forty-eight hours. Agricultural soil samples were collected in clean plastic bags. Content of Heavy metal was measured by using ICP-MS in the laboratory of Sophisticated Analytical instrumentation Facility (SAIF), PU University Chandigarh.

Analysis of heavy metals in soil samples by ICP-MS (Inductively Coupled Plasma- Mass Spectrometer)

0.30gm sample of soil was digested with 6.5 ml of 75% HNO_3 and 1 ml of 28% Hydrogen peroxide. In pre- cleaned Teflon vessels, sample mixture was taken and kept it open overnight at room temperature and digested by MDS (Microwave Digestion system) (CEM Corporation, USA). The operating program for MDS (Microwave Digestion system) for each digestion set up was optimized at a power of 800 (watts) and at a 180°C temperature, hold time (25) minutes, cool down (25) minutes. After digestion, digests were transferred to 50 ml. volumetric flasks and brought up to mark with the milli- Q water and then sample was analyzed by Inductive coupled plasma- mass spectrometer (ICP-MS).

Content of heavy metals viz. zinc, cadmium, copper, nickel, lead and chromium were analyzed in selected soil samples. The content of heavy metals was observed in the range of zinc (71.7 mg/kg- 311mg/kg), Nickel (15.6 mg/kg to 19.6 mg/kg), Copper (8.4 mg/kg-32.1mg/kg), Chromium (0.21mg/kg-1.08 mg/kg) and Lead (1.5mg/kg-15.3mg/kg). The content of cadmium was 0.001 mg/kg which was detected less than the MPL (Maximum Permissible Level) (0.6mg/kg). One East soil sample was found to contain Zinc concentration higher than the MPL (Maximum Permissible Level). High concentration of Zinc content in soil is due to the prolonged use of fertilizers and pesticides in Agricultural field. High concentration of zinc impacts the plants such as stunting of shoot, curling and rolling of young leaves, death of leaf tips and chlorosis, premature necrosis etc. High content of zinc can persist in the soil for an extended period of time and it affects seed germination, root system development and plant vigor etc. [8].

The concentration of chromium was found to be below in the detection limit. Copper content was found to be less than the MPL value (100mg/kg). Nickel concentration was found less than MPL (60mg/kg). All the soil samples contained less concentration of lead than maximum permissible level (350mg/kg).

Table 1 Soil samples collected during October, 2020 and soil samples collected during March, 2021. Content of heavy metals in agricultural soil of Bathinda district

Content of heavy metals	North zone		Centre zone		South zone		East zone		West zone	
	NS_1	NS_2	CS_1	CS_2	SS_1	SS_2	ES_1	ES_2	WS_1	WS_2
Chromium	0.56	N.D.	0.26	1.08	N.D.	N.D.	0.21	0.44	N.D.	N.D.
Zinc	71.7	194	277	147	74.7	230	305	311	275	215
Nickel	15.6	19.6	8.9	11.9	25.2	12.1	6.73	9.5	15.7	17.4
Copper	23.6	18.3	32.1	14.6	19.4	10.6	8.7	22	8.4	8.7
Cadmium	0.01	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Lead	1.5	2.4	15.3	8.9	3.4	2.5	3.6	8.7	12.2	9.8

SUMMARY

The present study was conducted to analyze heavy metals content in the agricultural soil of the Bathinda (Punjab). Due to the modern farming practices, issue of soil contamination due to heavy metals, creates a problem in the ecosystem. Fossil fuel, fertilizers and pesticides are the main sources to enhance the content of heavy metals in the ecosystem. According to the above result, heavy metals viz. Pb, Cu, Cd, Zn, Ni and Cr were detected in the collected agricultural soil samples. Among all the samples, concentration of Zinc was higher than the detection limit. Higher concentrations of heavy metals cause cancer, brain damage, dysfunction of kidney, blockages of nerves, headache, irritation of the eye, skin allergy, reproductive disorders etc. it also put an impact on agricultural soil. It decreases the yield and growth of plants. Mostly plants and trees absorb contaminants from soil and pass them into the food chain. Hence, these types of researches and studies are useful to determine the concentration of metals as well as estimate the heavy metal contamination in agricultural soil, so it is right time to shift from fertilizer farming to organic farming to improve the soil quality as well as quality of crops too.

Acknowledgements

The author is thankful to the authorities of Desh Bhagat University, Gobindgarh (Punjab) for providing permission to carry out research work.

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