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Original Research Article

Analysis of heavy metals content in soil and *phragmites australis* in some areas of Salah-Din Governorates-Iraq

Ahmed Mohamed Taher[1] & *Ibrahim Omar Saeed[2]

[1,2] Department of Biology, Collage of Science, University of Tikrit, Salah Al-Din, Iraq.

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***Corresponding author:** Ibrahim Omar Saeed

Abstract

In this study analysis some heavy metals (Fe, and Cu) in soil and Phragmites australis plan in Fatha areas in Salah - Din Governorate- Iraq. The results indicated the mean concentration of heavy metals was high in the far soils from Phragmites australis, reaching (567.406) µg/g in Al-Fatah sites, compared to the nearby soils from Phragmites australis, reaching (547.0155) µg/g in the Al-Fatah sites. The mean concentration of heavy metals in the roots compared to the leaves was (447.4625) µg/g in the roots of the Phragmites australis for Al-Fatah sites, and it reached (266.5346) µg/g in the leaves of the Phragmites australis in Al-Fatah sites, The soil of Al-Fatha location was Clay Sandy soil, pH (7.8), EC (2900 µ Siemens/cm), CEC (8.58 ppm/100 g soil), and organic content (0.24%).

Keywords: Heavy metals, Pollution, phragmites australis

INTRODUCTION

One of the most important and most pressing environmental problems in human life is the problem of pollution with heavy metals as a result of human activities such as mining, smelting metals, oil extraction, refining operations, vehicle exhaust, energy production, gas and fertilizers, and the use of pesticides.... etc.

Heavy metals are chemical substances with a high density estimated at five times the density of water, and their molecular weight is between (63-200) and they are considered toxic substances even at low concentrations at times [3, 12].

These metals are found in nature in small concentrations and are measured in parts per million (ppm) or parts per billion (ppb), It is very important for humans and other living organisms, but in small concentrations and becomes toxic and dangerous when it exceeds natural concentrations, many of which are (Mg, Ni, Co, Cu, & Fe). It is essential in biological function because of its important role in the functions and systems of enzymes, but it becomes toxic in high concentrations, while other elements represented by (As, Hg, Pb, Cr) do not have basic biological functions and may be toxic even at low levels [1]. In our study, the concentration of Heavy metals (Fe, Cu, Ni, and Co) was estimated in soil and plants.

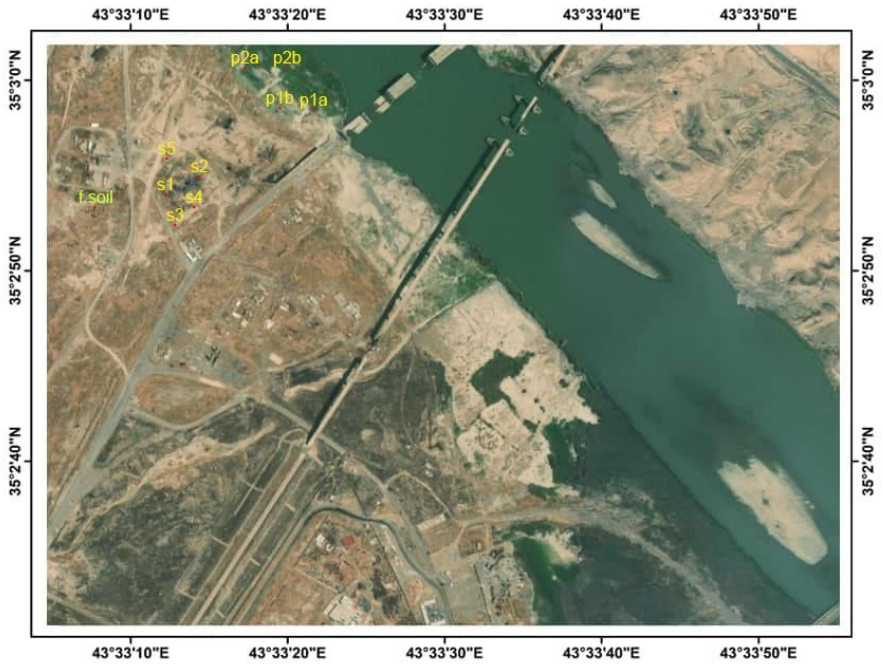
The heavy elements, especially when their concentration is high negative impact on agricultural lands and crops significantly and on food safety as well as human health[9].

In this regard, the disposal of heavy metals by phytoremediation is one of the best methods instead of physical and chemical methods, for the ease of this technique, its low material cost, and the low use of human resources, it took its role and from the nineties in treating areas contaminated with heavy elements, especially *Phragmites Australis*, which is considered one of the best plants. It is used in heavy metal processing and is widely used [10].

Materials and Methods
Collection of samples
Soil samples

Soil samples were randomly collected from different areas of Salah -Din governorate. Soil samples were taken from five areas contaminated with oil spills from al-Fatha area, Map (1) in Salah Al-Din Governorate, located about (63,2) km away from the city of Tikrit. Samples are put in sterile polyethylene bags and the required information (sample number,

date, weight) was recorded on them and transferred to the laboratory and kept in the refrigerator at a temperature of 4 °C until use.



Map (1) Al-Fatha location in Salah -Din Governorate

Plant samples

The plant samples were collected Al-Fatha, with two duplicates, and the root system was isolated from the shoot, where each group was weighed separately by a sensitive balance that was done at the site after which the plant samples were placed in paper bags to avoid moisture and the required information was recorded (Sample name, number, date and weight) and transferred to the laboratory. The samples were *Phragmites Australis* from the family of *Poaceae.*

Soil inspection

Soil chemical analyzes

PH measurement of a soil model

The pH was measured by the method of suspension (soil: solution), where the suspension was prepared by placing 10 g of soil in a 250 ml conical and adding 50 ml of distilled water to it (5: 1), after which the conical was closed and shaken for an hour and then the reading was done by the pH meter [2].

Measuring the EC conductivity of the soil model

The electrical conductivity of the soil was measured by the suspension method (5: 1), after preparing the suspension and after filtering, the EC of the filtrate is read by an electrical conveyor device at a rate of three readings and the average of those readings was taken to find the error rate, after calibrating the device with its standard solutions [5].

Chlorides Estimate

The chlorine was determined according to what was described by[11] by titrating the soil suspension (1: 1) with $AgNo_3$ silver nitrate solution after adding potassium chromate solution to it.

Calcium Carbonate estimate

Calcium carbonate was estimated in the soil model according to what was described by [4] by adding hydrochloric acid HCL to a standard N 1 and heating to a temperature of (50-60 °C) and estimating the residual of the hydrochloric after titration with NaOH solution N 1 and by using Phenolphthalein indicator.

Estimate organic matter

The soil organic matter content was estimated according to the Walkley-Black`s method in 1934 based on oxidation of the organic matter with a standard potassium dichromate N 1 in the presence of sulfuric acid, after which the excess potassium dichromate is calculated by titration with ammonia ferrous sulfate N 0.5.

Cation exchange capacitance: CEC

The cation exchange capacitance was measured according to what was described by[13, 15] by replacing all cations adsorbed on soil colloids with a sodium ion, then displacing this anion with an excess amount of ammonium ions and then measuring the sodium concentration in the solution obtained by displacement.

Calcium and magnesium: Ca & Mg

Calcium and magnesium in soil suspensions (1:1) were determined according to what was described by[11] by correcting with a solution of (Ethylene Diamine Tetra Acetate) (EDTA) 0.01 N standard and using Ammonium purpurate as an indicator when determining (Calcium and Erochrom black-T EBT) as an indicator for (Calcium + Magnesium) estimation.

Phosphorous:

The recoverable phosphorus was estimated using a modified sodium bicarbonate method[6, 7] as black coal was neglected. A single solution containing ammonium molybdate, ascorbic acid and a small amount of antimony was used to develop the color in the soil extract.

Nitrogen

Nitrogen was determined by colorimetric method using Nessler's reagent (Total nitrogen by Nessler's method).
After digesting the soil, all forms of nitrogen are transformed into NH_4^+, where Nessler's solution KOH + K_2 (HgI_4) reacts with the NH_4^+ ion, giving the yellow color, which is read in the wavelength of 425 nm. [8]

Physical analyzes

Determination of soil texture (soil texture):

20 g of soil samples previously collected from the study areas were weighed and after they were dried and sifted (using sieves with 2 mm holes) the samples were placed in a beaker of (600) ml capacity with the adding of (60 ml) of distilled water and then the samples were placed on the surface of the (Hot plate) for 40 minutes, then transfer the mixture to the mixer and add (25 ml) of distilled water and (10 ml) of the dispersed solution, which was prepared in advance from (dissolving 40 g of hexametaphosphate sodium and 10 g of sodium carbonate in one liter of (distilled water), the mixture was stirred by a mixer at a high speed for a period of 5 minutes, then the mixture was transferred and poured into a graduated glass cylinder with a capacity of one liter. The volume was completed with distilled water. The cylinder was placed with the mixture in a water bath at a temperature of (20 °C) and was taken The first reading, using a 25 ml pipette, after 30 minutes and 44 seconds has passed with a depth of 10 cm, and then it was placed inside a baker with a known weight and at a temperature of 110 °C for 45 minutes for the purpose of drying the next day we weigh the baker and that the weight difference represents weigh the clay and silt, and then take a second reading after 30 minutes and 15 seconds from a depth of 20 cm, as the previous step the difference in weight here represents only clay. As for the weight of silt, we obtain it by subtracting the weight of the clay from the sum of silt and clay, while we extract the weight of sand by subtracting the total weight of silt and clay from 100, and by knowing the proportions of soil components (clay, silt, and sand), the texture of the soil (soil texture) is determined by means of a triangle of texture, through which the type of soil can be known. [16]

Heavy Metals Experiments

Digestion of soil sample

Soil digestion was carried out in the Department of Soil and Water Resources, College of Agriculture, Tikrit University, according to what was stated in (Jackson, 1958), as it included a weight (0.4 g) of air-dried soil, and it was placed in a clean glass beaker with a capacity of (250 ml) and (12 ml) of the digestion solution was added. The component of (concentrated sulfuric acid, concentrated nitric acid and perchloric acid), in a ratio of (1: 1: 3), the beaker was covered with a watch glass to prevent the evaporation of concentrated acids. The samples were heated on the surface of a thermal plate at a temperature of 105 °C for an hour and a half or until it evaporates and we get dry soil by placing it on the (Electric heating plate),then 20 ml of nitric acid is added to the dry soil sample, after which we transfer the contents of the beaker to a volumetric flask of 100 ml capacity after filtering the liquid with filter paper to prevent clogging of the capillary tube of the Atomic Absorption Spectroscopy (A.A.S) device, and we perform the dilution process by adding distilled water to (50 ml).

Digestion of the plant sample

After collecting the plant sample, drying it in an oven at 70 °C for 48 hours and grinding it, the vegetable powder was digested by acid digestion or wet digestion according to[1], where (0.2 grams) of the powder of the plant sample to be digested (the shoots) and (the root system) Each part separately was placed inside a (Griffin beaker) with a volume of 200 ml and then, digestion was performed on it after adding sulfuric acid, nitric acid and perchloric acid in ratios 2:1:1 for a period ranging from (2-4) hours, Taking care to cover the beakers with the watch glass, Then the beaker and the watch glass are washed with distilled water (Dionized) and the samples are filtered, then the volume is completed to (50) ml of distilled water, as the sample becomes ready for analysis using A.A.S, and through the standard curve for each metals, the concentration of each metal can be found through its equation and expression About concentration in µg/g dry weight.

Determination of Heavy Metals

Determination of Heavy Metals in the Plant

After the process of digesting the plant samples and adjusting the volume of the solution according to the expected concentration in the samples to the volume (50 ml), the samples became ready for analysis using an A.A.S. device, where acetylene gas was used and the wavelengths of each metals were determined and the light beam from the lamp was used as the cathode in it is made of the metals whose concentration is to be measured, and it is highlighted by passing it over the flame and burning the mixture at a temperature of (2100-2800 °C) And during the combustion process, where free atoms reach to a stable state from which the atoms are absorbed with a certain wavelength, the bioconcentration factor (BCF) was estimated according to the method as in the following equation:

$$BCF = \frac{\text{Concentration Plant}}{\text{Concentration Soil}}$$

Determination of Heavy Metals in the Soil

The heavy metals of the soil samples were estimated at the Technical Institute in Mosul, according to what was mentioned in [4], as it included the digestion of the soil as in paragraph () and after dilution with distilled water, the absorbance of each of the heavy metals in the soil samples is estimated by A.A. S, of the type (Perkin Elmer) the currently used wavelength and current for each heavy metals were determined and the absorbance was converted into concentration units and by referring to the regression equations for the standard curves of the heavy metals under study, and the results were expressed in the microgram unit of the metal and per gram of dry weight of soil.

Statistical analysis

The data were analyzed statistically according to the complete random design method to show the confirmation of each type of bacteria and the concentrations and the combinations between them, as well as the trend analysis of the concentrations (as levels of a quantitative factor), the differences between the averages of the factors and the combinations between them, were compared in a Duncan manner the multi-range at the level of significance (0.01) and according to this test, the values followed by the similar letters indicate that there are no significant differences at the level of significance (0.01), all statistical procedures were carried out with the help of the ready-made statistical analysis system (SAS).[1]

RESULTS AND DISCUSSION

Table (1) illustrated the soil of AL-Fatha location was Clay Sandy soil, pH (7.8), EC (2900 µ Siemens/cm), CEC (8.58 ppm/100 g soil), and organic content (0.24%), phosphor (0.34%), nitrogen (1.68%), Calcium and magnesium reached (124, 9.722) mg/kg respectively, chlore (142) mg/kg, total organic and calcium carbonate was (0.24, 9.8) % respectively.

Table-1: Soil Samples Properties

NO.	Parameters	AL Fatha
1	pH	7.8
2	EC	2900 µ Siemens / cm
3	CEC	8.58 ppm/100 g soil
4	P%	0.34%
5	N%	1.68%
6	Ca^{++}	124 mg/kg

7	**Mg^{++}**	**9.722 mg/kg**
8	**Cl**	**142 mg/kg**
9	**Total organic**	**0.24%**
10	**$CaCo_3$**	**9.8%**
11	**Clay**	**11.95%**
12	**Silt**	**4.75%**
13	**Sand**	**83.3%**
14	**Soil Texture**	**Clay Sandy**

Table (2) and Figure (1) show the concentration of heavy metals ` in the far soils were higher than the nearby soil to the *Phragmites australis*, where they were in the far soils (**213.4870, 1897.5000**) for each of (Cu, Fe) respectively, due to the absence of plants in the far soils, while the plant density of *Phragmites australis* to a decrease in heavy elements In the nearby soil, where in the nearby soil they became (**189.2870, 1856.2500**) for each of (Cu, Fe) respectively, and the elements were concentrated in the roots of the cane plant more than its leaves, as the concentration of elements in the roots was (**261, 1366**) for each of (Cu, Fe) respectively, while it was in the leaves (**179, 760**) for each of (Cu, Fe) respectively.

Table-2: The Concentration of heavy metals in AL-Fatha region

location		Heavy metals	
		Cu	Fe
AL-Fatha	Leaf	179.275h	760.7633d
	Root	261.0000e	1366.0000c
	N. Soil	189.2870g	1856.2500b
	F. Soil	213.4870f	1897.5000a

- Values followed by the same letter for each factor and the interactions between them are not significantly different from each other.

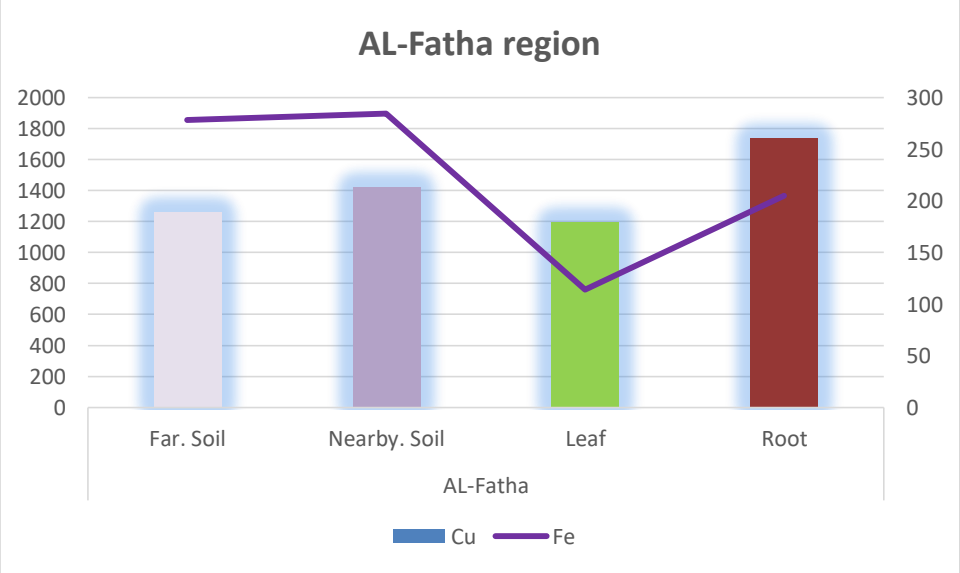


Figure-1: The Concentration of heavy metals in AL-Fatha region

Table (2) shows the bioconcentration factor of the elements in the plant parts, where it is clear that the (BCF) of copper is higher than the iron element, so the accumulation of copper (**2.325**) was recorded, while the iron (**1.145**) was due to the presence of a power station in the study area, which led to the pollution of the area More copper than iron

Location	Metals	Plant	Soil	BCF
Fatha	Fe	2126.763	1856.250	1.145
	Cu	440.275	189.287	2.325

Table (2) the bioconcentration factor of the elements in study site.

CONCLUSIONS AND RECOMMENDATIONS

The reed plant is one of the plants that cleanses a high accumulation of heavy elements, and the reason is due to the composition of the cells, especially in their roots and the existing pores, which led to this function in the most perfect way, and this is clear as the concentration of elements in the roots is more than in the leaves. Hydrogen neutral to basic and due to the presence of the electrical station, the concentration of the element copper was more than that of iron.

The study recommends paying attention to the vegetation cover and reducing the subtractions of the electric station.

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