

Original Research Article

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Phytoremediation of Lead by *Ceratophyllum demersum* Lab. Work

Nashmeel Ali Hassan^{1*} and Sahira H.H. Al-Khalidi²

¹Directorate General of Baghdad Education, Rasafa third, Iraq

²Educational Directorate, Ministry of Education, Diyala, Iraq

*Corresponding author

ABSTRACT

Keywords

C. demersum, Heavy metal, Phytoremediation

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This study was done to recognize the capacity of *C. demersum* for different concentrations of lead element in lab aqueous ecosystem. The concentrations of 10, 20 and 30 ppm were used in three replications for each concentration for 30 days. The results showed that the plant can remove 30 ppm of Pb. Significant differences were found in removing capacity by plant for Pb, in all concentrations 10, 20, 30 during experiment period. There was accumulation in the stem more than the leaf. The highest removal ratio for Pb in the stem was 10.25 ppm, 9.18 ppm in the leaf and the lowest removal ratio was 8.01ppm in the concentration 30 ppm for 30 days.

Introduction

Lead (Pb) is a naturally occurring element found in small amounts in the earth's crust, while it has some beneficial uses; Lead a toxic element is harmful to plants, lead moves into and throughout ecosystems. Atmospheric lead is deposited in vegetation, ground and water surfaces (Chen, 2011). The chemical and physical properties of lead and the biogeochemical processes within ecosystems will influence the movement of lead through ecosystems (Sasmas *et al.*, 2015). The metal can affect all components of the environment and can move through the ecosystem until it reaches equilibrium.

Lead can accumulate in the environment, but in certain chemical environments it will be

transformed in such a way to increase its solubility (e.g., the formations of lead sulphate in soils). The effects of lead on the ecosystem level are usually seen as a form of stress (Brain, 2002).

Plants on land tend to absorb lead from the soil and remain most of this in their roots. There is some evidence that plant foliage may also take up lead and it is possible that this lead is moved to other parts of the plant (Cador, 1996). The uptake of lead by the roots of the plant may be reduced calcium and phosphorus to the soil. Some species of plant have the capacity to accumulate high concentrations of lead (Carolyn, 1997).

Lead pollution coats the surface of the leaf and reduces the amount of light reaching it. This

results in stunting the growth or killing the plants by reducing the rate of photosynthesis, inhibiting respiration, encouraging an elongation of plant cells influencing root development and causing pre-mature aging

Van and Clijsters 2013 suggest that lead can affect population genetics (Phukan *et al.*, 2015). All these effects have been observed in isolated cells or in hydroponically grown plants in solutions of around 1-2 ppm of lead in soil moisture e.g., the lead levels experienced by ecosystems near smelters or roadsides (Mishra, 2008).

Lead is one of the most abundant toxic metals that pose a serious threat to human beings, animals and phytoplanktons. In human, it is absorbed directly into the blood stream and is stored in soft tissues, bones and teeth (95% in bones and teeth) (Mitchell, 1987).

Materials and Methods

Collecting and growing of *Ceratophyllum demersum*

Ceratophyllum demersum Plant samples were collected from Tigris River in Iraq (Figure 1). Plants were well washed and placed in two glass containers (40 *50 *80) cm filled with water from the same river. After a month period plants put to experimental containers (10 *20 *30) cm, their capacity 4L of water.

Care was taken to prevent the decrease in water level by adding the oxygenated water.

Physical and chemical measurements

Some physical and chemical measurements were done for river water directly as following:

Temperature was measured by water thermometer.

pH was measured by pH meter type Milwaukee, Romania

Electrical conductivity and salinity were measured by Conductivity meter type Milwaukee, Romania.

Total dissolved solids (TDS) were measured by TDS meter type Milwaukee, Romania.

Plant acclimatization

Plants were transferred to laboratory and put in glass container contain 30L of distilled water (Figure 1), the laboratory temperature was adjusted to $20 \pm 2 \text{ C}^\circ$.

10 the plant samples were putting in each container to avoid the crowing.

Preparation of heavy metals concentration

Heavy metals solutions were prepared by using 0.7996g $\text{Pb}(\text{NO}_3)_2$ (BDH, England) dissolved in 1litter of distil water to prepare 1 liter of concentrations 10, 20 and 30, mg\ L of Pb.

Heavy metals measurement

Leaves and stems left in the sun to dry. 1 gram of dry plants sample was digested by 16ml of mixture from HNO_3 (64%) (BDH, England) and H_2O_2 (30%) (BDH, England) in ratio 6: 2 and the mixture was put in the oven at 120 C° for two hours.

After cooling the digested samples, 10 ml of distilled water were added; the mixture was filtered through filter papers (0.45 μM , Whatman) and diluted to 50 ml (Senila *et al.*, 2011). Flame Atomic Absorption

Spectrophotometer type (VGP 2010 Buck, England) was used to measure the heavy metal concentrations in plant samples.

Results and Discussion

The results of statistical analysis and examine the least significant difference LSD At the probabilistic level $P < 0.05$ to a significant effect for incoming factors in the study Duration of experience and concentration in the level of soluble lead absorption in water of plant showed from the results there were significant difference between (time and concentration) in the absorption capacity of the plant for lead and the effect of time was clear in absorption index, we note increased lead adsorption in a plant as the experiment progresses showed the results of experiment no significant differences at the probabilistic level $P < 0.05$ in increase the absorption of lead element in first day compared to the period of absorption 30 days, refers that to the maximum efficiency of absorption to

pollutants present in water, including lead thirty days, showed the results of statistical analysis and examine the least significant difference LSD $P < 0.05$ to significant difference for concentration (10,20,30) ppm in the study in the a mount of absorption and accumulate lead element from *C. demersum* plant, and when comparing between the concentration (10, 20) ppm no significant different the least difference at the probabilistic level $P < 0.05$ as shown in the table 1.

The results are consistent with the study (Vahati and Khara, 2012) which he did Hydrocotyleranoncloids, *C. demersum* to they can concentrate to determine their ability to concentrate lead and Cadmium in their tissues, the results were stem of Cadmium higher ability to absorbed than their leaves (Fig. 1–6).

Table.1 Concentration of lead in root and stem and leaf of *Ceratophyllum demersum*

| Time of Experemental | Part of plant | ppm (Concentrations) | | | | LSD |
|----------------------|---------------|----------------------|---------|---------|---------|--------------|
| | | Control | 10 | 20 | 30 | |
| First day | Leaf | 0.30 | 0.35 | 1.36 | 2.89 | 0.562* |
| | Stem | 0.42 | 1.06 | 2.48 | 3.01 | 0.478* |
| | LSD | 0.25NS | 0.442* | 0.561* | 0.447NS | --- |
| Fifth day | Leaf | 0.08 | 1.36 | 3.07 | 5.23 | 0.803* |
| | Stem | 0.29 | 2.21 | 4.19 | 7.17 | 1.034* |
| | LSD | 0.094* | 0.352* | 0.469* | 0.994* | --- |
| Tenth day | Leaf | 0.27 | 2.08 | 5.42 | 6.77 | * 0.885 |
| | Stem | 0.31 | 3.10 | 6.39 | 8.36 | * 1.338 |
| | LSD | 0.193NS | *0.507 | * 0.675 | * 1.028 | --- |
| Fifteenth day | Leaf | 0.28 | 2.68 | 5.85 | 8.53 | * 1.096 |
| | Stem | 0.30 | 4.43 | 7.29 | 11.67 | * 1.463 |
| | LSD | 0.183NS | * 0.609 | * 0.778 | * 1.068 | --- |
| Thirteenth day | Leaf | 0.16 | 3.15 | 7.23 | 11.39 | * 2.054 |
| | Stem | 0.23 | 5.07 | 9.44 | 13.69 | * 2.456 |
| | LSD | 0.189NS | * 0.791 | * 0.769 | * 0.882 | --- |
| | | NS: Not significant | | | | * $P < 0.05$ |

Fig.1 Iraq map showing the Tigris River



Fig.2 Concentrations (ppm) of lead in plant tissues after first day of experiment period

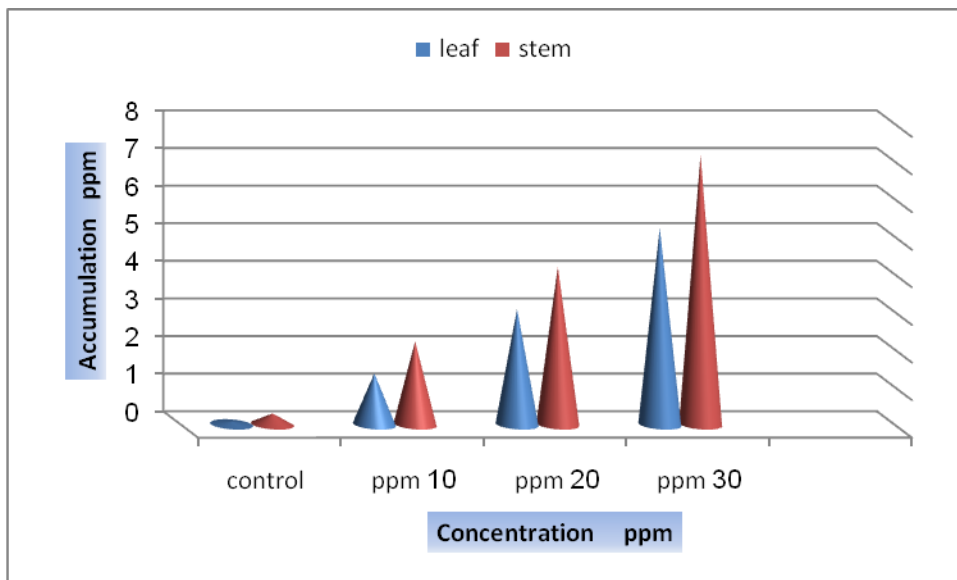


Fig.3 Concentrations (ppm) of lead in plant tissues, after 5 days of experiment period

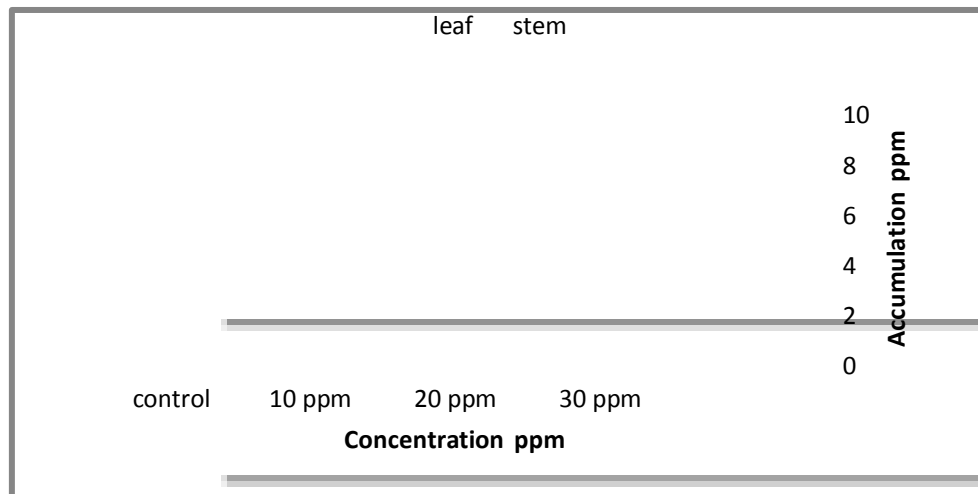


Fig.4 Concentrations (ppm) of lead in plant tissues, after 10 days of experiment period

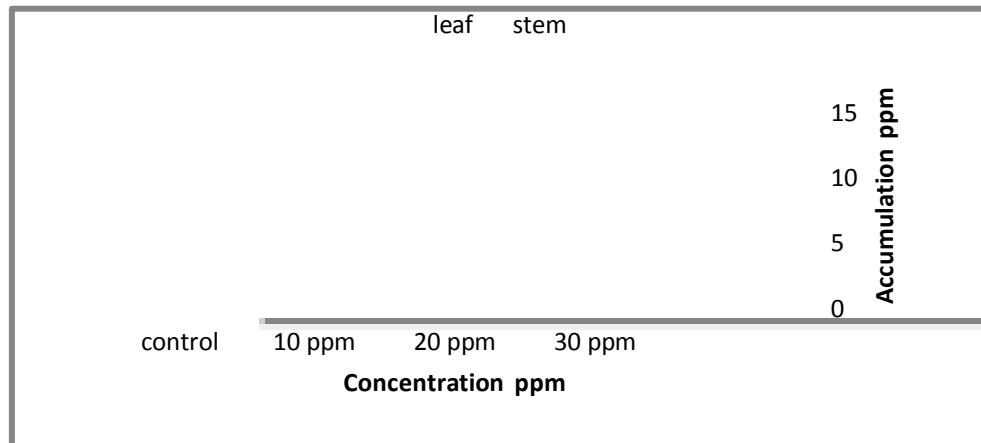


Fig.5 Concentrations (ppm) of lead in plant tissues, after 15 days of experiment period

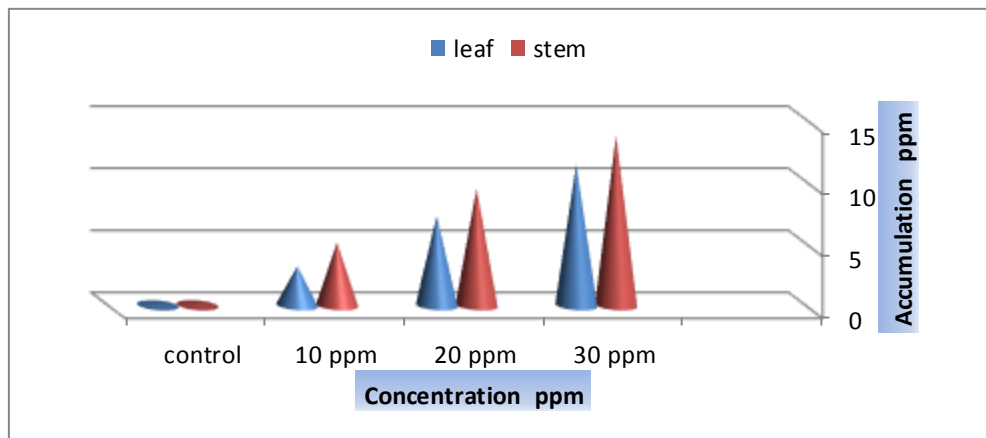
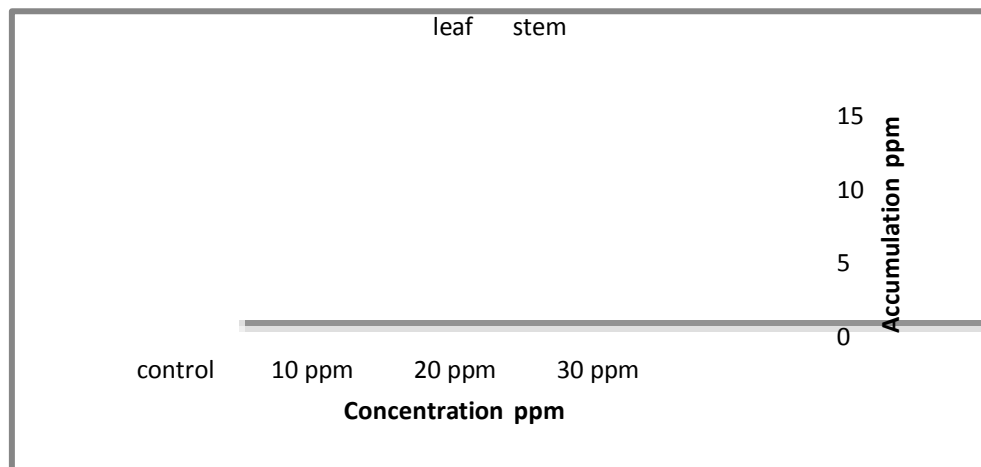


Fig.6 Concentration (ppm) of lead in in plant tissues, after 30 days of experiment period



The effect of the time of the experiment and the concentration of the plant element in the bioconcentration factor were observed. The highest values of the bioconcentration factor in the leaves of the sham plan were 2.85. At 20 days after 30 days and the lowest 0.12 concentration at 10 days after 10 days. In the legs, the concentration coefficient was higher than the leaves. The highest was 1.79 at the 30th concentration on the 30th day of the experiment and the lowest concentration was 0.08 at the concentration of 10 After 24 hours of experiment, the study showed a change in the ability of plants to tolerate the elements. The plant began to wither during the days of the experiment. The results also showed the high capacity of the sham plan plant to remove, especially when the concentration increased in the water medium to 30 ppm.

These results coincide with Syriyani *et al.*, (2014) during their laboratory experiment by exposing the shamplan plant to concentrations (10, 20, 30, 50) parts per million of cadmium, Cd and CO iron and Fe for five weeks. And also consistent with Kamel (2013). In the study of the susceptibility of six water plants and their ability to withstand six types of heavy elements Cd, Co, Cu, Ni, Pb, Zn, it was found that the biological concentration coefficient of the elements follows the following compatibility Pb> Cd> Cu> Ni> Co> Zn.

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