

Original Research Article

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## Phytoremediation of Lead by *Hydrilla verticellata* Lab. Work

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### ABSTRACT

#### Keywords

*H.verticellata*,  
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#### Article Info

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This study was done to recognize the capacity of *H.verticellata* 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 ppm during experiment period. There were accumulation in the root more than the stem and leaf.it was root > leaf > stem respectively. The highest removal ratio for Pb in the root was 10.25ppm, 9.18ppm in the leaf and the lowest removal ratio was 8.01ppm in the concentration 30ppm 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 an equilibrium. Lead can accumulates in the environment, but in certain chemical

environments it will be transferred 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 & Clijsters (2013). Some studies 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 *Hydrilla verticellata***

*Hydrilla verticellata* Plant samples were collected from Tigris River in Iraq. 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:

- 1-Temperature was measured by water thermometer.
- 2-pH was measured by pH meter type MILWAUKEE, ROMANIA
- 3- Electrical conductivity and salinity were measured by Conductivity meter type MILWAUKEE, ROMANIA.
- 4-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  $20 \pm 2$  C°. 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 Pb (NO<sub>3</sub>)<sub>2</sub> (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, stems and roots left in the sun to dry. 1 gram of dry plants sample was digested by 16 ml of mixture from HNO<sub>3</sub> (64%) (BDH, England) and H<sub>2</sub>O<sub>2</sub> (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 (0.45µM, 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

Results showed that the exposing of *H. verticillata* plant to different concentrations of lead element of the form (1) an increase in the accumulation of the element in the root rate of the passage of days and increase user concentrations, as results showed in the table (1) a significant increase in the roots, especially in concentrations 30 ppm element content while significant differences were not recorded in the concentration 10 ppm and the averages recorded on first day (3.59, 2.21, 1.08) ppm Figure (2) and in the fifth day were (5.19, 4.61, 2.18) ppm to Figure (3) in the tenth day ( 6.85, 4.71, 3.22) ppm Figure (4) and in the fifteenth day were (7.95, 6.69, 4.61) ppm for Figure (5) while in the thirteenth day from the age of the experience were (10.25, 7.36, 4.36) concentrations used (10, ,20, 30) ppm, respectively (Figure 6), the higher accumulation of lead in the roots of *H. verticillata* plant is consistent with a study (javed, 2011), who studied the accumulation of Cadmium and Chromium in *H.*

*verticellata* plant and concluded in his study that the *H. verticellata* able to accumulate metals in the roots more than other parts of the plant As for the papers, the results showed that *H. verticellata* plant accumulates lead concentration lower than the averages in the roots was recorded on the first day (2.20, 1.18, 0.63 ppm on the fifth day (4.17, 3.42, 1.32) ppm on the tenth day it was (5.35, 4.25, 2.43)ppm the concentrations in the fifteenth day (6.67, 5.30, 2.43) ppm on the day Thirtieth day were (9.18, 6.17, 2.73) ppm concentrations used (10, 20, 30)ppm, respectively.

The lower concentrations recorded in this study is the accumulation of lead in the stems of the plant *H. verticellata* which was less than the roots and leaves as recorded on the first day (1.23, 1.06, 0.24) ppm on the fifth day (3.03, 1.26, 1.04) ppm on the tenth day (4.01, 3.13, 1.04) ppm on the tenth day the results were (4.01, 3.13, 1.04) ppm and total concentrations of lead in the fifteenth day of the life experience (5.28, 4.22, 1.02)ppm and on Thirtieth day was (8.01, 5.25, 2.02) ppm concentrations used (10, 20, 30) ppm respectively.

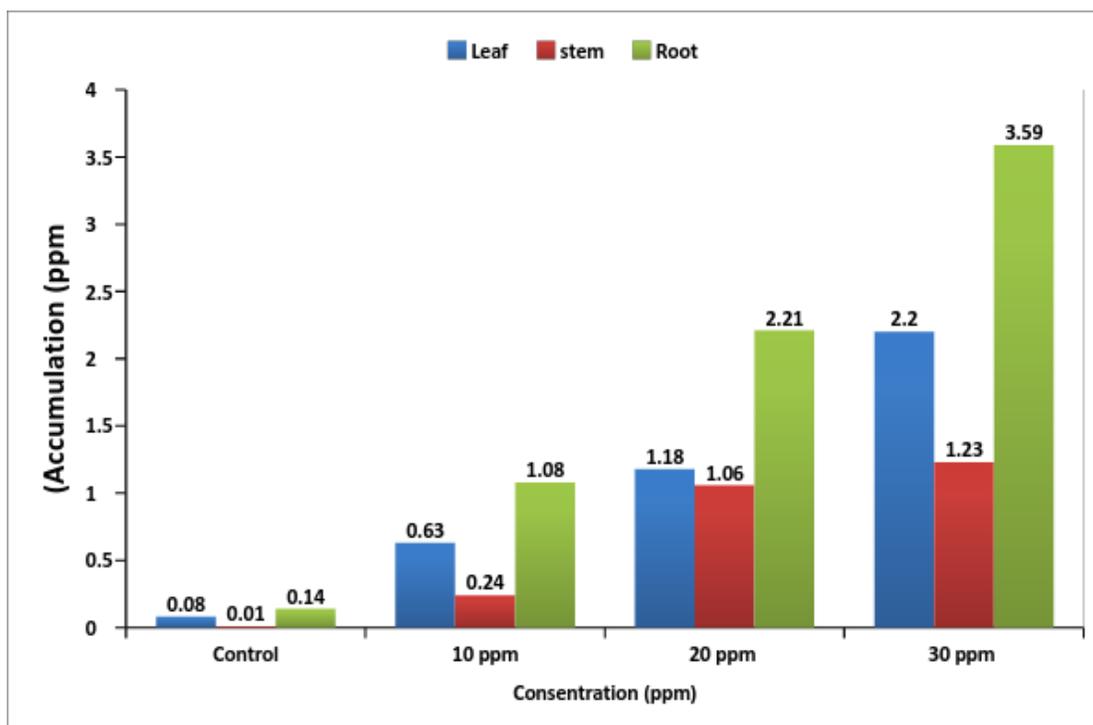


**Figure.1** *H. verticillata* plant in acclimatization

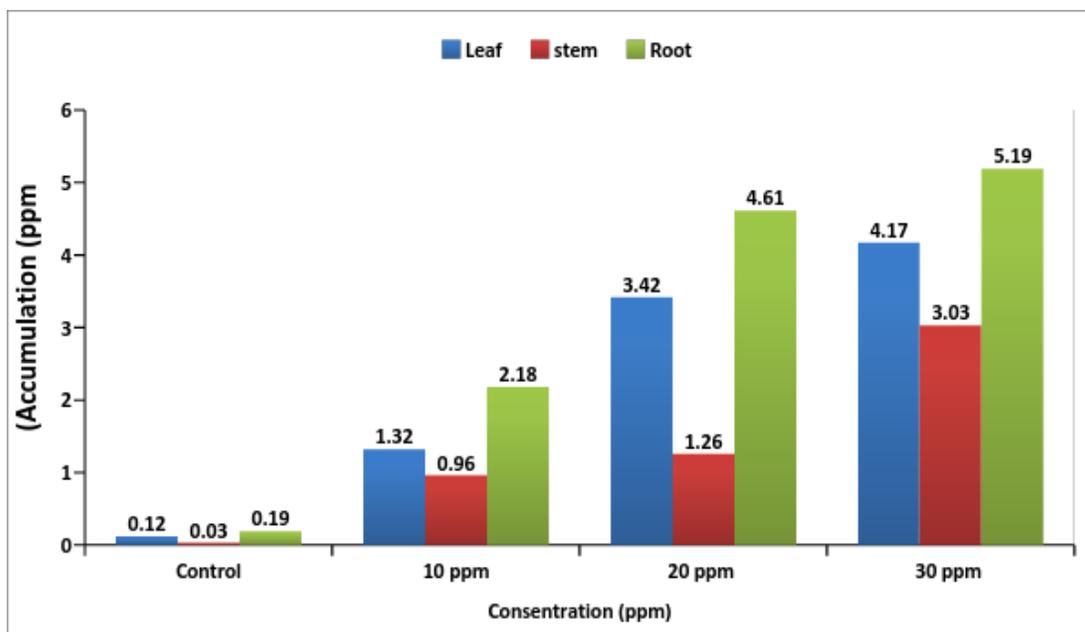
**Table.1** Concentration of Lead in root and stem and leaf Of *Hydrilla verticellata*

LSD	Concentrations (ppm)				Part of plant	Time of Experimental
	30	20	10	Control		
0.556 *	2.20	1.18	0.63	0.08	Leaf	First day
0.468 *	1.23	1.06	0.24	0.01	Stem	
0.804 *	3.59	2.21	1.08	0.14	Root	
---	0.651 *	0.779 *	0.712 *	0.133 NS	LSD	
0.761 *	4.17	3.42	1.32	0.12	Leaf	Fifth day
0.682 *	3.03	1.26	0.96	0.03	Stem	
0.887 *	5.19	4.61	2.18	0.19	Root	
---	1.08 *	0.871 *	0.667 *	0.17 NS	LSD	
0.904 *	5.35	4.25	2.43	0.14	Leaf	Tenth day
0.662 *	4.01	3.13	1.04	0.04	Stem	
0.879 *	6.85	5.71	3.22	0.20	Root	
---	156 *	1.12 *	1.05 *	0.17 NS	LSD	
1.033 *	6.67	5.30	2.43	0.19	Leaf	Fifteenth day
0.871 *	5.28	4.22	1.02	0.09	Stem	
1.094 *	7.95	6.69	4.61	0.25	Root	
---	1.24 *	1.008 *	1.24 *	0.19 NS	LSD	
1.557 *	9.18	6.17	2.73	0.18	Leaf	Thirteenth day
1.742 *	8.01	5.25	2.02	0.10	Stem	
1.894 *	10.25	7.36	4.36	0.22	Root	
---	1.33 *	1.15 *	1.06 *	0.16 NS	LSD	

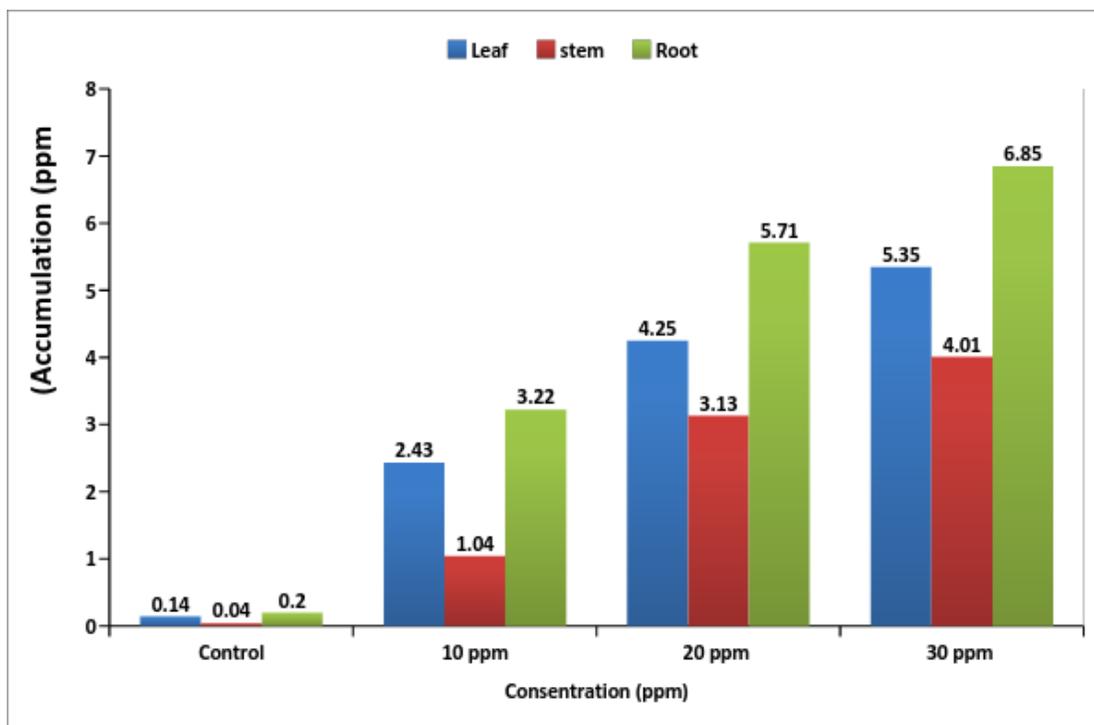
NS:Not significant \* P<0.05



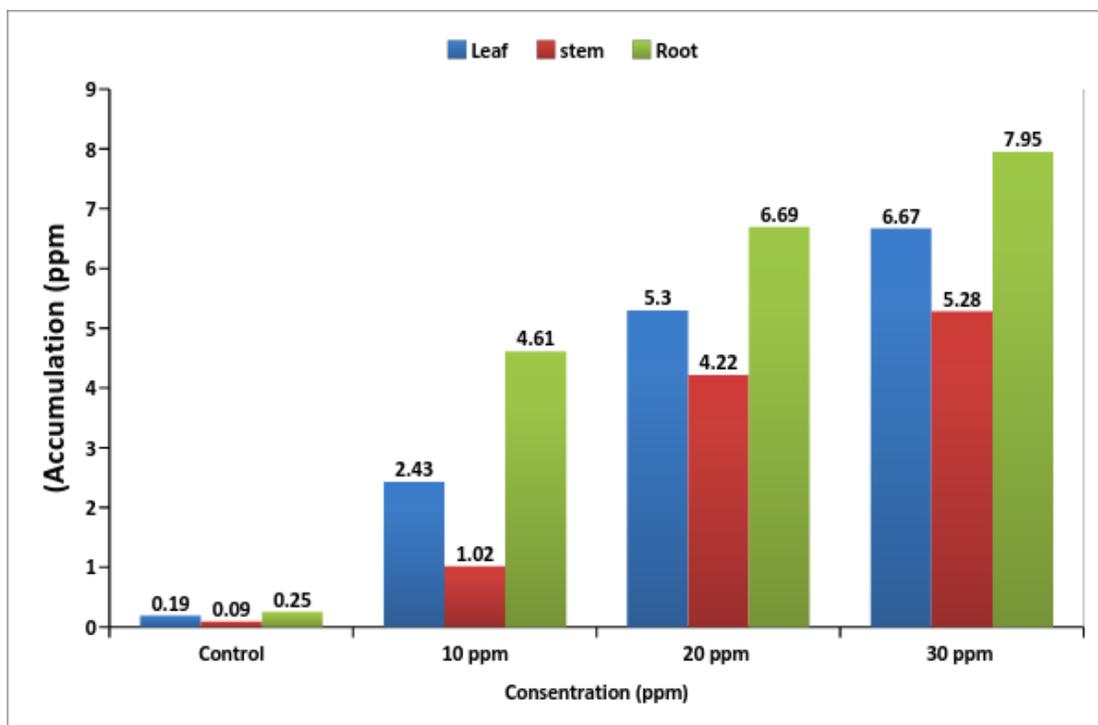
**Figure.2** Concentrations (ppm) of lead in plant tissues after first day of Experiment period



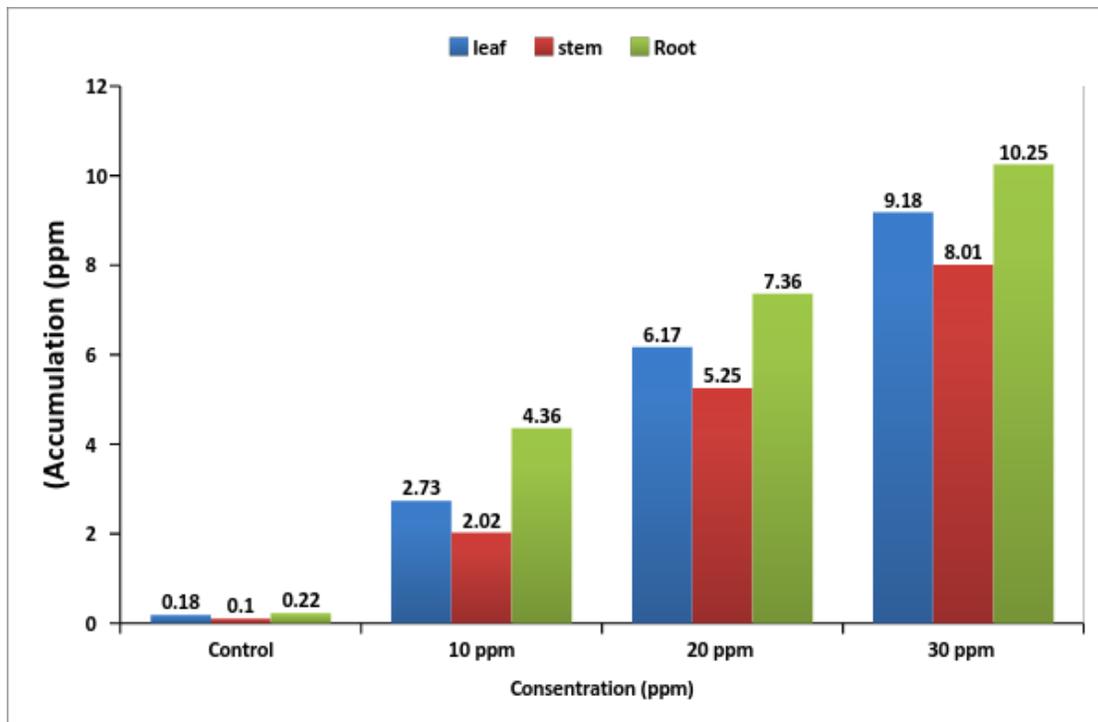
**Figure.3** Concentrations (ppm)of lead in plant tissues, after 5 days of Experiment period



**Figure.4** Concentrations (ppm)of lead in plant tissues, after 10 days of Experiment period



**Figure.5** Concentrations(ppm) of lead in plant tissues, after 15 days of Experiment period



**Figure.6** concentration (ppm) of lead in in plant tissues, after 30 days of Experiment period

Characterized *H. verticellata* plant with its anatomical characteristics as observed during the duration of the experiment are numerous aerial roots in addition to owning securities with a wide surface area, leading to the accumulation of more of the elements and thus increased efficiency absorbance of the plant which has increased the amount of accumulation in the tissues (Guo-Xin, *et al.*, 2005). Sulhakar and his group (2010) carry aquatic plants for different concentrations of heavy elements and continued growth is the result of the possibility of a balance in the level of each of the antioxidant enzyme and molecular such as peroxidase and proline and total phenols and other as well as the possibility of increasing the secretion of the outputs of cellular metabolism such as Alsstin and glutamine, and when the plant exposed to high concentrations of Cadmium increases plant production Cysteine that surrounds the seed of Cadmium, and metal coated Singh elucidate (2012) that the plants *H.verticellata* when absorbed heavy elements to form plant compounds maintained by the inside gaps exist in the plant tissue cells, or through (Methallothioneins) which is found in plant and animal cell proteins play an important role in removing toxic elements through the link in cell (1999, Rauser) and turn them into forms an inert can prevent the accumulation of these elements in the target sites (salt crystals are harmless) and stored in the non-sensitive sites Calfjuat (peverly, 1988) or converts to other forms of non-toxic could have distributed and used again in the processes metabolic (Memon, *et al.*, 2000). The accumulation of mechanical elements within the plant body is that these toxic elements linked to the walls of the cells in roots or leaves, which prevents from travelling through the plant succulents or expel a private to non-sensitive sites in the cell as it is stored in the gaps (Memon, *et al.*, 2001).

## References

- Brain, O.E. 2002. Sources of Lead. J of Lead Advisory Service Vol 1 No 1:pp53-58.
- Çador, Isabel Ca., Vale, Carlos, Catarino, Fernando. 1996. "Accumulation of Zn, Pb, Cu, Cr and Ni in Sediments Between Roots of the Tagus Estuary Salt Marshes, Portugal"., 42 (3): 393-403.[Abstract]
- Carolyn, K. 1997. Lead Contamination in our Environment, Yale-New Haven Institute Vol 18: p15-18.
- Chen, k., W. Yu, X. Ma, K. yao, Q. Jiang. 2011. The association between drinking water source and colorectal cancer incidence in Jiashan County of China: a prospective cohort study. *Eur. J. Public. Health*, 15: 652 – 656.
- Guo-Xin, S.H.I., Kai-He, D.U., Kai-Bin, X.I.E., Xiuo-Yu, D., Guo-Xiang, C. 2005. Ultrastructural study Chemical and Biological Environment. Springer-Verlag, Berlin.
- Memon, A.R., Aktoprakligil, D., Ozdemir, A., Vertii, A. 2001. Heavy metal accumulation and detoxification mechanisms in plants. *Turk. J. Bot.*, 25: 111-121.
- Mishra, S.S., Sivastava, R.D. 2008. Ttipathy. "concurrent removal and accumulation of heavy metals by three aquatic macrophytes". *Biores. Technol.*, vol. 99: 7091-7097.
- Mitchell, W.L. 1987. Lead toxicity and reproduction, *J. Occop. Med.*, London, Vol 18:pp15-18.
- Peverly, J.H. 1988. Cadmium movement and accumulation in a sediment-water-plant system. Reprinted from trace substance in environmental Health – XXII (1988) a symposium , D.D. Hemphill, Ed university of Missouri, Columbia .
- Phukan, P., Phukan, R., S.N. Phukan. Heavy

- metal uptake capacity of *Hydrilla verticillata*: A commonly available *Aquatic Plant Int.*
- Res. *J. Environ. Sci.*, ISSN. 2319–1414 Vol. 4(3), 35-40, March (2015).
- Rascio, N., Navari-Izzo, F. 2011. Heavy metal hyperaccumulating plants: how and why do they do it? And what makes them so interesting. *Plant Sci.*, vol. 180, no. 2, pp. 169–181.
- Rausser, W.E. 1999. Structure and function of metal chelators produced by plants, The case for organic acids, amino acids, phy tin and metallothioneins. *Cell Biochem. Biophys.*, 31: 19-48.
- Sasmaz, M., Topal, E.I.A., Obek, E., Sasmaz, A. 2015. The potential of *Lemna gibba* L. and *Lemna minor* L. to remove Cu, Pb, Zn, and As in gallery water in a mining area in Keban, Turkey. *J. Environ. Manag.*, 163: 246–253.
- Senila, M., Levei, E., Miclean, M., Senila, L., Stefanescu, L., Marginean, S., Ozunu, A., Roman, C. 2011. Influence of pollution level on heavy metals mobility in soil from NW Romania, *Environ. Eng. Manag. J.*, 10: 59-64.
- Singh, A., Kumar, C.S., Agarwal, A. 2012. Physiological study of combined heavy metal stress on *Hydrilla verticillata* (L.f.) Royle. *Int. J. Environ. Sci.*, 2(4): 2234E2242.
- Van, A.F., Clijsters, H. 2013. Effects of metal on enzyme activity in plants. *Plant Cell Environ.*, 13: 195-206.

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