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WATER HYACINTH (*EICHHORNIA CRASSIPES*) : AN EFFICIENT PLANT IN REMOVING POLLUTION AND TREATMENT OF HEAVY METAL IN WASTEWATER BEFORE FLOW IN THE IRAQ RIVERS

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Abstract

The experiment was conducted during the growing season 2017 at Diyala (Iraq). The aim of study is remove heavy elements and reduce pollution in water using water hyacinth plant. The experiment applied in (CRD) with two factors:1-the types of water, 2-the time periods of sampling. Each week as water samples were taken before entering basin planted with water hyacinth plants and then taking other samples after the presence of water with plants after two days. Showed results high efficiency of water hyacinth in the absorption of heavy elements. Where the plant absorbed from the heavy elements when water entering the plant growth area during the summer months amounts of NO_3, PO_4, Cu, Zn, Pb and Cd reached 0.79, 3.4, 0.9, 1.6, 0.053, 0.015 mg/L, respectively. Although, there is variation in the rates of the elements present in the water during the time periods of July to September, the plant higher absorption amounts of the heavy elements of Cu, Cd in the month of Sept., while absorption the highest level of NO_3, PO_4 and Zn in the month of July.

Key words : Water hyacinth, Heavy elements, Remove Pollution, Absorption.

Introduction

Water pollution is one of the most important problems facing the world because of the progress of civilization or contain soil on some of the heavy elements Iraq, for the first time in its long history, is facing a dire water crisis that depends on the decrease in the quantities and degradation in the qualities of the water that enters its borders via Tigris and Euphrates rivers (AL Bomola, 2011). The toxic elements, including heavy metal are still a source of concern for workers in the field of the environment because they relate to human health (Feng *et al*., 2008), several studies were conducted to measure the salinity, nitrate, phosphorus and some heavy elements in the Tigris and Euphrates rivers, where they found the element of lead and cadmium, zinc and phosphate, nitrate and increased salinity high proportions of the limits permitted by the river and also found the concentration of lead and nickel in the Tigris river has exceeded the Iraqi determinants of drinking water (UNEP, 2003; Rahi and Halihan, 2009). The water hyacinth plants that grow and multiply in a wide range of different environmental conditions and the best growth is observed in water = pH7, which contain large quantities of nutrients such as nitrates and phosphorus, so absorbed by these elements are leading to an increase the biomass and number of stolon, especially when the proportion of nitrogen and phosphorus: 1:7 (Heard and Winterton, 2000), grown in a salinity of 9.2 g/l and 13.7 g/l resulted in necrosis (De Casabianca and Laugier, 1995). In general because of the absorption heavy elements in varying degrees started states used in water treatment or water purification cities especially water containing manganese, zinc and lead, copper, nickel, chrome and cadmium in large quantities and that the absorption capacity depends on the volume biomass, growth and propagation of biomass (Zhu *et al*., 1999; Julien *et al*., 2001; Hill and Coetzee, 2008). The aim of the search to identify the capacity of the efficiency of the water hyacinth on absorbed heavy elements in sewage and the cities before discharging it to a river in salinity, nitrate, phosphorus and some heavy elements to reduce water pollution of rivers.

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Materials and Methods

The study was carried out in the Faculty of Agriculture, Universities of Diyala during the growing season of the 2017 water hyacinth plant the experience included on two factors, the type of the water and the time periods for sampling. Used plastic basin in area (71 × 40 cm depth 29 cm) where the soil depth of 10 cm and then filled with water then put the water hyacinth plants homogenously and after a 60 day of agriculture, the ratio of heavy elements was measured in the water inside before watering the water hyacinth plants. After two days, a sample of the remaining water was taken in the basin and the ratio of heavy elements was measured. This process was repeated and at fixed time intervals of seven days between sample and another and the water used in the irrigation process comes from the drainage, where it inside the University of Mosul, this drainage combining water from agricultural and residential lands and industrial water and rainwater, and the concentrations of zinc, copper, cadmium, phosphate, nitrate and lead were estimated by the Atomic Absorption Spectrometer and by the standard curve of each elements, the concentration of metals can be determined by applying the equation expressed the unit (mg/L). Experiments method Randomized complete designed (CRD), using a computer according to a program (SAS) and using Duncan test multi-term compared to the averages according to Al-Rawi and Abdul-Aziz (1980) differentiate averages that are different from each other different for it about the marker letter different in the level 5%.

Results and Discussion

NO_3

The amount of nitrate is different according to the period of time, with the highest nitrate rate in 7, 21,28 July. While, it was observed the lowest rate of nitrate was on 15 September, which is significantly different from the rest of the time periods, and that the reason for this difference may be due to the difference in the amount of nitrates in the water entering the plant. In general, these amounts do not constitute a danger in the water pollution because the plant susceptibility to absorb nitrogen at a rate of 28 mg/L (Sato and Kondo, 1981). As noted there is the impact of the plant in the water inside and outside of the plant is significant differences, where the plant ability to absorb more than 50% of the nitrates in the water entering it because of its need of this element in large amount if compared with phosphorus element by 7 : 1 (Heard and Winterton, 2000). Nitrogen increases the biomass and the number of plant that the one plant produce. Of the interferences between the time period of water entering and exiting the plant, it was noted that the highest absorption rate of nitrates by the plant (the difference between water and interference) was in the first week of 0.79 mg/L and the third week of 0.71mg/L and less absorption in 15 Sept., amounting to 0.29mg/L The reason is not the ability of the plant, but to the low amount of nitrates in the water entering it. We conclude that the plant has the ability to absorb nitrate from water the limits of 30-60% as the plant does not have the ability to absorb all the nitrates found in water, even if in small amount. Also, the difference in absorption rate of nitrates depends on the growth rate of the plant and the environmental conditions that encourage it to reproduce. In general, the plant has a greater ability to exploit the elements within the surroundings of better growth compared with other water plants (Coetzee *et al*., 2005).

PO_3

The quantities of phosphorus differ significantly with time periods for sampling of sewage, the phosphorus rate was high in the first week at first reading 7, 14 July and 18 August as it reached 6.4, 6.5 mg/L, respectively, it was also noted a decreased in the amount of the Phosphorus in 15 September this depends mainly on the quantity of phosphorus in the water, Sengupta (2006) found that approximately 85% of the sources of pollution in the river caused by the pollution of civilization and sources of domestic sewage untreated. water hyacinth plant has the ability to absorb the phosphorus element of sewage, absorbed the 3,79 mg/l equivalent to 38.7% of the phosphorus in the water and note that the best suitable amount for phosphorus to growth the plant is 7 mg/L ideally (Sato and Kondo, 1981). Xie and Yu (2003) found that the roots of the plant water hyacinth be long and flexible, dense when the phosphorus at low and get the contrary if increase the level of that element. The compatibility between the dates of sampling during the period of this weeks with the kind of the water within the plant growth and out, it is clear that the highest amount of phosphorus element in 7, 14 July, amounting to 6.4 mg/L plant has absorbed the limits of 3.4 mg/L, but there is more phosphorus element absorbed on 18 August, amounting to 2.7 mg/L, which indicates that the rate of absorbed not depend on the amount of the phosphorus element in the watercourse, but depends on the rate of growth, activity and its need for phosphorus. Indicated (Heard and Winterton 2000; Ripley *et al*., 2006) that the concentration of the nitrogen and phosphorus element has a positive correlation with the growth of the water hyacinth plant, especially when the ratio of nitrogen to phosphorus is 1: 7.

Cu

There is significant differences in the amount of copper in different sampling dates during growing in summer and amounted to 0, 14 mg/L in 14, 21 July, respectively while he was less than the amount of copper observed on 1September, and amounted to 0,06 mg/L. The reason for this difference is not only due to the amount of copper present in the water channel, but also due to the difference in the absorption rate as the lower the amount of copper at different time period the greater the absorption rate, and the length water channel before reaching the river has an impact increase or decrease the amount of copper in the water reaching the plant growth area. The presence of some heavy metals in the Tigris River such as Cu, Cr, Ni, Pb and Co source of, natural (rocks and soils) in addition to the water of the industrial areas (Varol and Şen, 2012). Figure shows that the water hyacinth plant has the ability to absorb large amounts of copper, so, in some countries the use of this plant in purification of the wastewater of the cities due to absorbed a number of heavy elements such as Cu in large quantities it depend on the density of the plant in the water bodies and climatic conditions appropriate (Zhu *et al*., 1999; Hill and Coetzee, 2008). It's either compatibility between the different time periods and the susceptibility of the plant to absorb this element has reached the highest rate of absorption by the plant in the 14, 21, 28 July and 15 Sept., while a decrease the absorption rate in the month of August has been the reason for the difference in the rate of absorbed component Cu to activity growth in July compared to the month of August, as the limit temperature of the ability of plants to absorb some of the heavy elements (Wolverton and McDonald, 1978), that the speed of a doubling of this plant in Wastewater its be faster compared to aquatic plants other, if produced 26 -72 $g/m^2/day$ when the presence in wastewater of cities (Wolverton and McDonald, 1978).

Zn

There is significant differences in the amount of zinc at different sampling date of the in water channel, the water hyacinth plant it absorb a large amount for element Zn in 4 August while in 7 July and 1 September was the lowest amount, this may be due to variation in the amount of zinc entering in area. Plant growth (Hill and Coetzee, 2008) have indicated that they can be used to treat or purify urban wastewater. There was a significant difference in the amount of zinc between the date of sampling and the quality of water entering and leaving the plant growth area. The plant absorbed 1.6 mg/L at 4 August, while the absorption decreased in 7 July and reached 0.7 mg/L. Also decreased at 1 September and reached 39%. The difference in absorption is due to either the ability of the plant and its absorption efficiency during its growing season. This depends on the biomass of the plant (the increase in mass means increased absorption) or may be due to the images in which the zinc is present during the time periods may not be suitable for absorption by the plant, we can infer from this that the plant is not able to absorb all the amount in the water, but its capacity may be proportional to the size of the mass and growth rate and to the amount of the benefit of this element in its growth.

Pb

Thedifferences in the amount of lead according to the time periods where the highest amount of lead in 7,14 July and 11 August, while it decreased in 11 August and 8 Sept. The reason for this fluctuation may be due to the difference in the quality of the waste water or the exhaust of the cars and leaks into the rivers where the amount of lead varies according to the locations in addition to seasonal differences (Tomazelli *et al*., 2007). However, the existing rates doesn't make any pollution because it a littel amount in the water canal, because of the scale of the natural presence of lead limits (1 – 10 mg/L) (Kar *et al*., 2008). The effect of the water hyacinth plant in the absorption of lead element he is absorb 0.038 mg/L of the amount of lead in the water entering the area of growth of that plant, as an average for the summer season and this ratio is good of treat waters and this result agree with Hill and Coetzee (2008), who mention that the plant has the capacity to absorb heavy metals, including lead, in large quantities leg roots are more efficient in the absorption process compared to the leafs. The interference between the time periods and the effect of the plant in the absorption of the lead element has indicated the results to the existence of differences significant, where the highest amount was plant absorb 7, 21 July and 1 Sept., but because of the different amount lead, the note that the absorption is reached 0.053, 0.049 and 0.050 mg/L respectively, while in other dates, the of absorption best reached in 1 Sept. and absorption decreases to 0.022 mg/L in 28 July, this gives a significant increase in the rate of the effect the readings because of the low absorption of this element by the plant. In general, the rate of absorption was from 40 - 64%[16]. found the element of lead by normal amount from 20 to 400 micrograms/liter. However, chemical and geochemical factors are needed to determine the concentration of elements from time to time (Feng *et al*., 2008).

Cd

The effect of the readings during the summer season varies in the water channel of the cadmium element. The

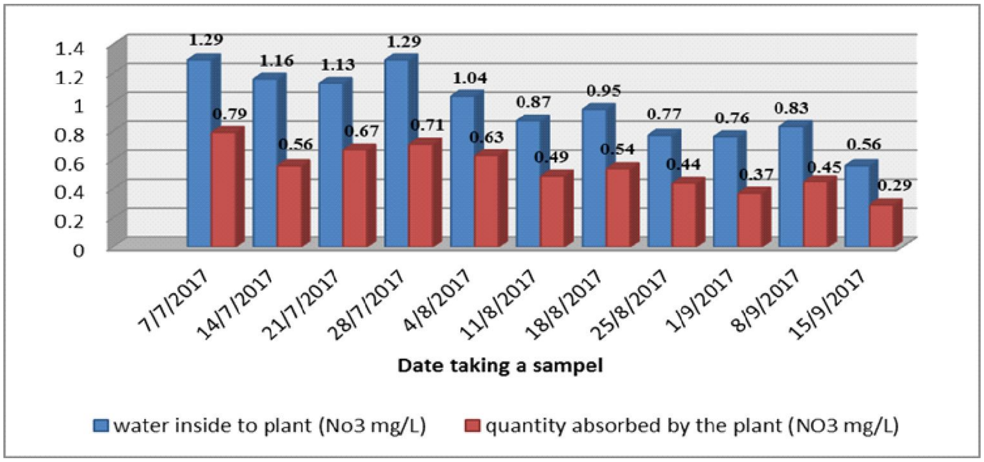

Fig. 1 : Effect of different time periods in the absorption of NO_3 from the wastewater by water hyacinth plant.

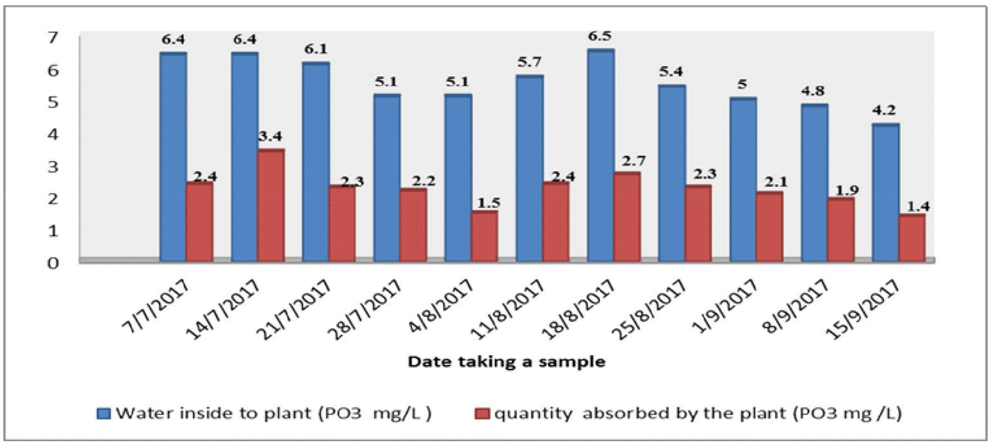

Fig. 2 : Effect of different time periods in the absorption of PO_3 from the wastewater by water hyacinth plant.

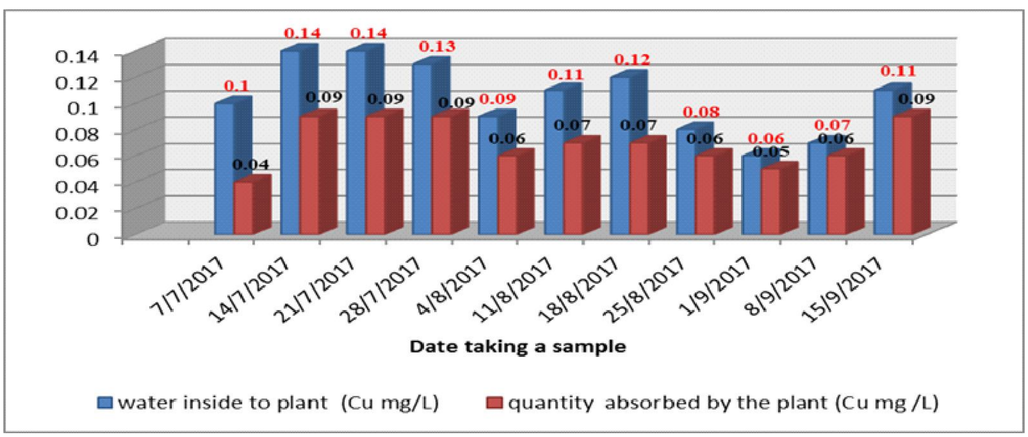

Fig. 3 : Effect of different time periods in the absorption of Cu from the wastewater by water hyacinth plant.

highest level of this element was in 14/7, which is 0.027 mg/L due to the low absorption of the plant, compared to the low rates in September due to the rate of absorption of the water hyacinth plant to varying degrees. In the quantities of the element present in the water entering the plant growth area, this result is agree with Tomazelli *et al*. (2003) when it was stated that the cadmium element is exist in different sites different periods of time, and in general contain drinking water at 1 μg/L and may reach in some industrialized countries to 5 micrograms/L in the soil reaches 0.53 Ppm (Bowen *et al*., 1969; Järup, 2003). Effect of the water hyacinth plant on the quality of water out of the growth area led to a reduction in the amount of cadmium, which means that the plant has absorbed 0.14 mg/L cadmium after go out water the plants and this is a large proportion of the absorption of the plant heavy

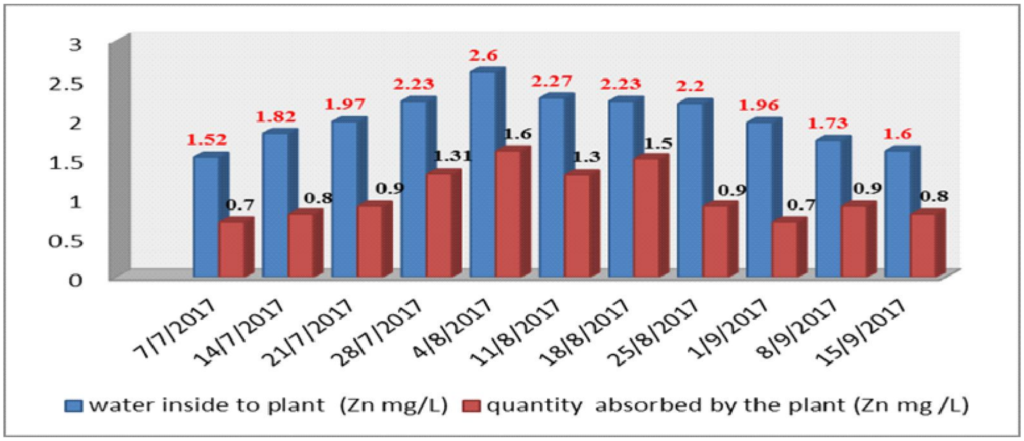

Fig. 4 : Effect of different time periods in the absorption of Zn from the wastewater by water hyacinth plant.

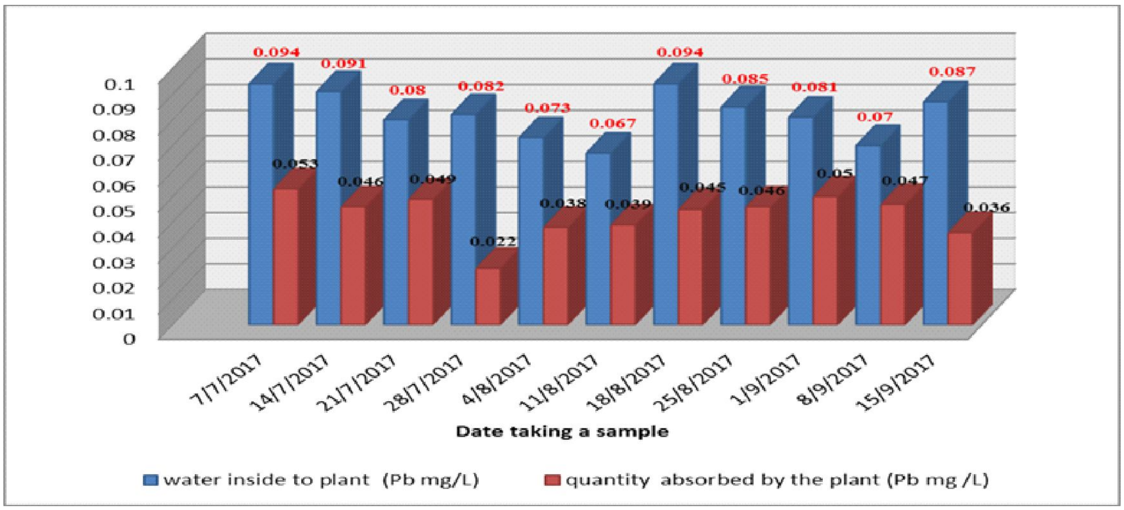

Fig. 5 : Effect of different time periods in the absorption of Pb from the wastewater by water hyacinth plant.

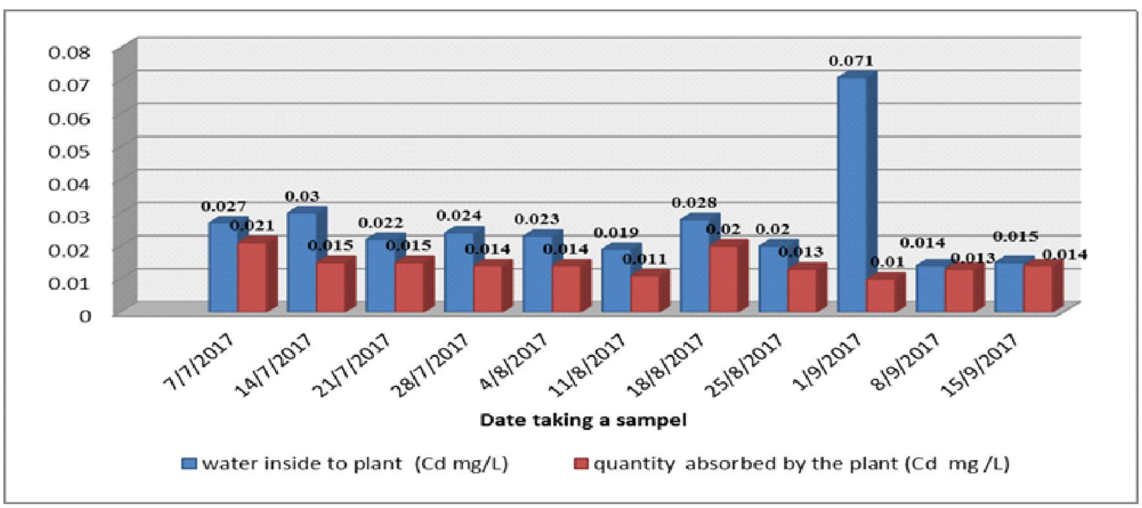

Fig. 6 : Effect of different time periods in the absorption of Cd from the wastewater by water hyacinth plant.

elements and we infer from that result that the plant is useful in the treatment Water before discharge to the river and this result is agree with the results of Hill and Coetzee (2008), in the efficiency water hyacinth plant in the absorption of cadmium element of water. The differences in the sampling time showed differences in amount of cadmium on water entering the plant growth area. These differences resulted in a difference in the absorption rates of that element, which reached 0.014 mg/L at 15 Sept., while the amount of the Cd in water was 0.015 mg/L, while the absorbed quantities were less by the plant 0,015 mg/L on 14 July and the amount of cadmium in the water was significantly higher at 0, 3 mg/L, while half the quantity for that element is present in the water of the channel.in 8 Sept., the amount of Cd element in water of 0.014 mg/L, but the absorption rate was 0.013 mg/L. These results indicate that the lower the amount of cadmium in the watercourse, the higher the absorption rate by the plant.

Conclusion

This results showed that the amount of heavy elements adsorbed increased with increasing growing plant conditions and environment for the growth. The result also indicated absorbed in summer months, remove the plant higher amounts of the element of copper, lead and cadmium in the month of September.it was shown that *E. crassipes* can be successfully used for high removal heavy elements from sewage and consequently offers a potential Purification and cycle water in agriculture.

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