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A Comparative Study of the Ability of the *Cyperus Rotundus* to Accumulate Heavy Metal in Southern of Iraq

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Annotation: This experiment was conducted to evaluate concentration level of heavy metal pollutants ability of Cyperus rotundus to eliminate heavy metal from soli in different areas with in the southern region of Iraq, so, the study was conducted in three zones, zone 1 Grmma, zone 2 Shuiba, zone 3 Hartha. The study concluded that three areas were most polluted with lead, the highest concentration was in the Shuiba zone was noted in soil 7. 48±0. 21, and 6. 91±0. 81 in roots and4. 49±0. 33 in shoot. The lowest concentration of lead was found in Grmma zone1 in soil, roots and shoot. also concluded from this study the lowest concentration evaluate in of heavy metal is cadmium element was found with highest concentration in zone2 Shuiba 5. 64±0. 03, 4. 88±0. 08, 3. 99±0. 03 in soil. Roots and shoot respectively but the lowest concentration of heavy metal fined in soil and tissue of Cyperus rotundus in Grmma zone 1. The study also concluded that the Cyprus rotundas plant is efficient in removing pollutants from the soil and potential of this plant as phytodirector of pollution of soils in any areas. The TF, BAC and BCF were evaluate amount of heavy metals pollution in three zones were studied showed the three zones are pollute but by in different concentration.

Keywords: Heavy metals, TF, BAC, BCF, southern Iraq.

INTRODUCTION

The world is witnessing a large and rapid expansion that results in an environment activities or natural soil transformations, Also, the use of fertilizers, waste disposal, mining and pollution from cars exhausts or factory waste. All of this had led to the release they are of significant quantities of toxic compound into nature (Sachini *et al.* , 2023), and this leads to the entry of these toxic compounds in food chain causing a truly major trouble that result diseases in humans with animals such as methods for removing these pollutants are quite expensive and may not yield very satisfactory results(Jahan, *et al.* , 2021)therefore, attention has turned to the use of environmentally friendly technologies to deal with these toxic compounds, such technologies used to remove pollutants are physical and chemical techniques such as chemical precipitation membrane filtration and adsorption, (Hasan *et al.* , 2019) there are also other methods such as coagulation, ion photolysis and oxidation using ozone and H^+ and $_2O_2$ in order to remove these pollutants in some locations, these techniques are very expensive.

Phytoremediation is portray as a process came out by plants in the cleaning up and stabilize of contaminate in soils and water (Sultana *et al.* , 2018) phytoremediation has been used as one of the most sought after techniques for treating soil pollutants, in recent times phytoremediation techniques have been used to rumph pollutants from water and soil (Yan *et al.* , 2020), it is known that some plants can tolerate a amounts of pollutants inter their organs without harming their growth, these plants are called plant tolerant that are tolerant to metal pollutants and have fast-growing roots are selected (Harguinteguy *et al.* , 2014) they are preferred among plant species for use in treating pollutants for a long time due to the continuation of crop rotations for several years, thus helping to reduce metals to low levels (Zaynab *et al.* , 2022). Phytoremediation is a natural process by which plants play a role in ridding the environment of pollutants, phytoremediation is a general term that relies on the use of plants to treat contaminate sits (Sharma *et al.* , 2020)have description the, the phytoremediation is an effective and cost-effective method that relies on the nature of plants to absorb toxic elements and compounds from the environment and accumulate them in their tissues whether they are heavy metals, radioactive elements, or organic compounds (Wei *et al.* , 2021)

Cyperus rotundus, it belongs to the cyperaceae family or Sedge family of monocotyledonous family plants, that include many species and genera (Nafea and Šera, 2020), members of this family are found in all regions of the world, especially temperate and humid regions and sub-polar environments such as jungles (Aminirad & Sonboli, 2012). Individuals of this species are economically important as they are considered a source of food, feul and other medical benefits, some of them are used in the manufacture of textiles, perfumes and building materials, they are also used as biological indicator in wet environments (Simpson & Inglis, 2001). Cypraceae are annual or perennial plants that there in humid environments, species in this family range in height from 5cm-3m, there stems are triangular and the leaves at the top of the stems are crown –shaped, another benefit of this plant is that it used as food for insect larvae, the seeds and tubers are used as food for birds and mammals and are also used on popular medicine(Gratao *et al.* , 2005). *Cyperus rotundus* is a plant used in bioremediation and is known n for its tolerance to large amounts of heavy metals, especially since it contributes to the rehabilitation of a aquatic and terrestrial environments therefore, the study was conducted to evaluate the effectiveness of *Cyperus rotundus* in its use as a bioremediation and its tolerance to heavy metals.

MATERIALS AND METHODS

Sampling and zones all experiments were conducted in the department of biology department, college of science, university of Basra and chemical analyses were conducted in the chemistry department of the Marine Science center. Three zones were selected for study zone:1 control in Grmma zone by global positioning system (GPS) 47 º 45 º 46 º E and 30 º 34 º 46 º N zone 2:

contaminate zone (Al-Shaiba) 47 º 41 º 59 º E and 30 º 22 º 59 º N, zone 3: (Hartha) zone 47 º 45 º 58 º E and 30º 39 º 44 º N.

The following letters were given to the three zones as follows:

Z1= Grmma Z2= Shuiba Z3= Hartha

Cyperus rotundus plant samples were collected from the three zones in October 2023 and then transferred to the laboratory, to cleaning any remaining soil, the samples were carefully cleaned by tap water and then distilled water three times, then they were dried, to chemically analyze the samples to measure the accumulation of heavy metals in the roots, shoot and leaves of *Cyprus rotundus* plant, the samples were digested using concentrated nitric acid HNO_3, then the resulting solution was filtered and the solution was exposed to an. atomic. spectrophotometer (Phoenix-986, CITY, England).

Detect of. heavy elements in plant were detriment by comparison with slandered curve of concentration (Kabata-Pendias and Pendias, 2011), samples of soils dried in oven at 150 C ^{0} for 10 h, then digested with acid. Teflon microwave vessels hydrofluoric acid 3ml with 5ml HNO_3 were digested at 200C ^{0} (Binning and Baird, 2001). By using atomic. spectrophotometer (Phoenix-986, CITY, England) (Pb, Ni and Cd) were determined, with wave length Pb 217 nm, Cd -228. 8 nm and Ni 232 nm and limited of detection for each element: Pb, Ni and Cd were 0. 01 ppm.

Phytoextraction process:

Calculate of three parameters to compere translocation and accumulation of heavy metals from the root to shoot including as follow:

BCF= Bio concentration factor. Concentration Metals root / Concentration Metals soil. means the percentage of mineral concentration in roots to soil.

TF= Translocation factor. Concentration Metals shoot / Concentration Metals root. means proportion of the heavy metals in the shoot to its roots

BAC= Biological Accumulation Coefficient. Concentration Metals shoot / Concentration Metals soil. means a ratio of the heavy metals in the shoots to the soil. (Li *et al.* , 2007).

Statistical analysis

Analyzed of all data of this study were performed by PSSS 21 version. The mean differences of heavy metal concentration were detected by one-way analysis of variance ANOVA using tukey test at significant level $p<0.\ 05$.

RESULTS AND DISCUSSION

Nowadays, plant treatment techniques are used with high efficiency, guaranteed and inexpensive ways to elements pollutants from the external space, especially heavy metals, thus, plants are used to remove toxic elements from the environment, especially heavy metals, thus, plants are used to remove polluting elements from the soil, sediment and water (Garba *et al.* , 2018). According to this technique, which uses plants that have the ability to collect polluting elements from the soil in a way that does not harm their growth, it is called hyperaccumulator plants, plants with ability to absorb, transport and accumulate polluting elements in their tissues called tolerant plant, there are many plants species that have this ability to transport and accumulate heavy metals, such as cd, zn, pb, Ar…etc. and radionuclides from soil (Cho-Ruk *et al.* , 2006).

Pb concentration:

By observing table (1) we are note the distribution of pb quantityof in the soil and in the various tissues of the *Cyperus rotundus* plant within the studied areas we find that the pb concentration in the soil recorded a highest concentration in zone2, which was 7. 84± 0. 21, the lowest concentration was observed in zone1 which was 4. 17± 0. 02.

As for the *Cyperus rotundus* plant, it was noted that the highest concentration was found in caution 6. 91±0. 81 compared to zone2, and the lowest concentration was observed in zone1, which was 5. 29±0. 30. As for shoot, it was noted that the highest concentration was observed in zone3, which was 4. 54±0. 78, it was noted that there was no significant difference in the pb concentration in zone2, which was 4. 49±0. 33 compared to the lowest concentration observed in zone1 3. 97±0. 08.

We note from the results by experiment analysis of pb in the soil and tissues of the *Cyperus rotundus* plant that the highest concentration was noted in the soil and roots compared to the concentration of pb in the shoot, there are high amount were in zone2, which indicates the high pollution of this zone with heavy metals, we note that the process of absorption and transport of pb was rapid by the roots and its transfer to the shoot, this indicates that pb has been transported through several pathways into the roots, including ion transport channels, through the cell wall, pb absorption is non-selective and depends on a pump H-ATPase, in order to maintain the membrane potential in the cells of the root system (Wang *et al.* , 2007) so, there are known that inhibition absorption of pb occur by calcium, and competition between these two ions is linked to calcium channels (Kim *et al.* , 2002). There are studies that have showed that pb is transferred and accumulated in the root system of these plants, such as the study on *Viccia faba* and *Pisum sativum* (Gichner *et al.* , 2008), *Zea mays*(Rossato *et al.* , 2009), *Jincus rigidus* (Shatha *et al.* , 2020), these studies agreed with this experiment on Cyprus rotundas plant, that high concentrations of pb didn't clearly effect the level of growth in *Cyperus rotendus* plant can tolerate the toxicity of heavy metales within the stuid the noted recorders in this study. .

Table 1. Showed concentration of Pb (mg/kg.) of soil, root, shoot of *C. rotundus* with it BCF, BAC, TF.

Pb con.	Soil	Root	Shoot	BCF	BAC	TF
Z1	4. 17±0. 02	5. 29±0. 30	3. 97±0. 05	1. 26±0. 08	0. 95±0. 20	0. 75±0. 04
Z2	7. 84±0. 21	6. 91±0. 81	4. 49±0. 33	0. 88±0. 001	0. 57±0. 02	0. 64±0. 09
Z3	6. 61±0. 03	6. 22±0. 41	4. 54±0. 78	0. 94±0. 09	0. 08±0. 06	0. 72±0. 09

These data are mean and ±. standard deviation. SD at p< 0. 05. Z1= Grmma, Z2=Shaiba, Z3= Hartha.

Ni concentration:

which clarified the analysis of soil and plant tissues of *Cyperus rotendus*, it was noted that high concentrations of Ni in the soil within the studied areas were found, it was found that zone2 had the highest concentration in the soil and tissues of the *Cyperus rotendus* plant, as it recorded a concentration of 7. 24±0. 03 and the lowest concentration was recorded in the soil of zone1, which was 1. 20±0. 021.

As for the root, it was noted that the more amount was recorded in zone2 and was 8. 43±0. 24, while the lowest Ni symbol was recorded in zone1 and was 1. 45±0. 04. It was also noted that the Ni concentration in the shoot was high concentration in zone2 and was recorded at 9. 92±0. 04, and without a significant differences within zone3, as it was 7. 44±0. 04 compared to the lowest concentration recorded in zone1, which was 3. 59±0. 05, we note from the study that the concentration of Ni was found a high rate in the root and shoot zone, which indicates the a accumulation and effective transport of Ni in the tissues of the *C. . rotendus* plant, there are also studies that have shown that Ni accumulates in the root and is quickly transferred to the shoot, such as the study (Broadhurst. *et al.* , 2004 ;. Bani *et al.* , 2007) they noted through their studies that the process of Ni absorption and transfer to the shoot was very easy through the cell wall and membranes of the roots and then the shoot and its accumulation in the leaf gap (Kumar A, Kumar *et al.* , 2013)It was noted through the study the PH of the soil plays a role in the absorption of Ni, as well as the process of ionic exchange between Ni and other elements similar in molecular weight, many researchers have mentioned that large accumulation of Ni in plant causes a reduction in the number of leaves and flower, a reduction in biomass and the appearance of spotting on the leaves it also affects the process of photosynthesis and respiration, the study found that signs of toxicity did not appear on the *C. rotendus* within the concentrations recorded in this study.

Table 2. Showed concentration of Ni (mg/kg.) of soil, root, shoot of C. rotundus with it BCF, BAC, TF.

Ni con.	Soil	Root	Shoot	BCF	TF	BAC
Z1	1. 20±0. 021	1. 45±0. 04	3. 59±0. 05	1. 28±0. 33	2. 47±0. 11	2. 99±0. 01
Z2	7. 24±0. 03	8. 43±0. 24	9. 92±0. 04	1. 16±0. 43	1. 17±0. 66	1. 27±0. 03
Z3	6. 42±0. 05	6. 98±0. 25	7. 44±0. 03	1. 08±0. 72	1. 06±0. 59	1. 15±0. 08

These data are mean and ±. standard deviation. SD at p< 0. 05. Z1= Grmma, Z2=Shaiba, Z3= Hartha.

Cd concentration:

It was noted through chemical analysis of cd in the soil, roots and shoots of the *Cyperus rotendus* plant noted a highest concentration of cd was observed in the soil of zone1 and 2. 92 while it was noted.

It was noted through this study that the concentration of cd in the roots was 4. 88, which is the highest of cd concentration observed in zone2, compared to the lowest concentration observed in zone1, which was 2. 98±0. 04. As for the shoot, it noted that the high concentration of cd was recorded in zone2, which was 3. 99±0. 03 compared to zone1, which recorded a concentration of 2. 89±0. 07.

It was noted through studies that the roots are the most exposed of plant tissue to toxic elements present in the soil and that most plants tolerant to heavy metal toxicity are able to isolate these toxic elements in the vacuoles of the root cell and then transport them to the shoot (Miyadate *et al.* , 2011). It was noted through the study that there is ease in transporting cd from the roots to the shoot in *C. rotundus* plant. Likewise, many studies were noted that showed the ease of the plant parts, such as study on *Lycopersicon Tetraena qataranse*, (Usman *et al.* , 2019), the process of transporting cd to the rest of the plant parts occurs through the wood elements in the vascular bandles, which occurs in the plant parts through the process of drawing water during the transpiration process from the leaves (Yan *et al.* , 2020)through this study, it was noted that cd is easily transported due to the increased transpiration process in this plant, especially since temperatures are high in most months of the year due to the location of these regions in terms of elimate, Many studies have shown that increased cd concentration lead to disturbances in plant growth, including a general reduction in plant growth, a reduction in the amount of chlorophyll and carotenoid, and a decrease in protein synthesis in the plant, In this study, no signs of acute toxicity were observed in the *C. rotundus*, so this plant can be included among the plants that tolerate heavy metal stress within the recorded concentrations.

Table 3. Showed concentration of Ni (mg/kg.) of soil, root, shoot of C. rotundus with it BCF, BAC, TF.

Cd	Soil	Root	Shoot	BCF	TF	BAC
Z1	2. 99±0. 02	2. 98±0. 04	2. 89±0. 07	0. 99±0. 90	0. 96±0. 97	0. 96±0. 60
Z2	5. 64±0. 03	4. 88±0. 08	3. 99±0. 03	0. 86±0. 52	0. 81±0. 76	0. 79±0. 09
Z3	4. 49±0. 09	4. 43±0. 04	3. 59±0. 05	0. 98±0. 66	0. 81±0. 03	0. 79±0. 09

These data are mean and ±. standard deviation. SD at p< 0. 05. Z1= Grmma, Z2=Shaiba, Z3= Hartha.

BAC, TF, BCF Values

By observing the values of BAC, BCF, BCF, we notice the ability of the *Cyperus rotundus* plant to remove pollutants from the soil and transport them through the root and shoot, this plant also contribute by role in the process of stabilizing the soil in the areas where it is planted by C. rotundas, the process of stabilizing the soil helps prevent the spread of pollutants to other areas and thus can help prevent the increase of polluting elements in the human food chain (Tangahu *et al*. , 2011).

Conclusion

Phytoremediation is a successful technique for removing pollutants from soil. In this study the *Cyperus rotendus* plant has proven highly efficient and successful in its use as a phytoremediator to remove soil contamination, this treatment inducing and leaching the aforementioned toxic elements from the soil and water which found in the soil, thus reducing pollutants from the food chain, through this study, it was noted *Cyperus rotendus* plant can be used as an indicator of soil pollution in different regions, it was also found that the shuiba area is the most polluted, followed by the Hartha area and then Grmma area due to its distance from industrial company, however in general the study proved that the soil of the southern region carries different heavy metal pollution.

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