Anatomical Changes in the Tissues of Phragmites Communis Accumulated with Cadmium in the Rivers and Drains of Diyala Governorate

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Abstract: The problem of pollution of water environments with heavy elements is a major environmental challenge in Iraq in general, including Diyala Governorate. Where the governorate witnessed in recent years a great pollution in rivers and homes due to industrial, agricultural and home waste that contains varying proportions of heavy elements, including cadmium, which is considered one of the most dangerous environmental pollutants due to its high heaven and stability in the environment, where the importance of this research arises to know the effect of cadmium accumulation on the anatomical structure of the wild cane plant (phragmites australis) The developing in rivers and homes, where five sites were studied in Diyala Governorate (Khanaqin, Baquba, Al -Khalis, Al - Al-Muqdadiya, and Balad Ruz). The results of the research indicated that there are no concentrations of cadmium in the water, while we found a clear accumulation of it in the soil, especially in the locations of the yields that recorded much higher concentrations (up to 0.15 mg/kg) compared to the river water soil. In the plant's leg, cadmium concentrations were not detected, indicating that the wilderness has an effective mechanism to stabilize the heavy elements in its roots and limit its transmission to the air parts. The anatomical changes in the tissues of the plants in the waters of the clients also showed compared to other river water. There were a decrease in the thickness of the vascular package by rates ranging between 7.44% and 34.01%, and a larger shrinkage in Qatar, the wood container, with rates of 69.35% in some locations. Because of the environmental stress resulting from the presence of cadmium.

1 INTRODUCTION

The problem of pollution of water environments with heavy elements in Iraq in general and Diyala Governorate in particular is one of the most dangerous contemporary environmental challenges. In recent years, rivers and hostels have become a major future for industrial, agricultural and home waste containing varying proportions of heavy elements, which are considered one of the most dangerous environmental pollutants due to their high toxicity and stability in the environment. This situation requires urgent measures to protect water resources [1]. The continuous accumulation of pollutants in river deposits greatly affects the environmental balance and leads to the accumulation of toxins in the food chain and among the heavy elements [2], cassudm is highlighted as a dangerous pollution as a result of its toxic effect on environmental systems, as it can affect the chemical balance in the water, which increases its risk on living organisms , [3] the [Phragmites australis] .L most important plants used in phytoremediation technology. It also shows high efficiency in the absorption and concentration of specific heavy minerals such as cadmium, which nominates it for polluted water treatment programs [5]. Recent studies indicate that the floating wet land systems planted with wild cane plants have a high efficiency in removing cadmium from running rain water and polluted water, with the ability of the plant to withstand high concentrations of this element without great impact on growth and development, which enhances practical applications for this plant in sustainable environmental treatment techniques[6]. Wild cane is also characterized by a different accumulation of toxic elements in its various organs (roots, stems, leaves), which makes it an effective biological indicator to monitor the levels of pollution in the aquatic environmental systems. This contrast in the distribution of heavy elements between the plant tissues reflects the various mechanisms to absorb, transfer and store these elements within the plant, and provides a deeper understanding of the physiological and anatomical plants towards environmental stress caused by pollution with heavy minerals [7]. Despite these features, the high accumulation of cadmium in the plant tissues may lead to notable anatomical changes, such as increasing the thickness of cellular walls, changes in vascular tissues, a decrease in the physiological efficiency of the plant [8]. The roots have a high ability to absorb these minerals from the surrounding environment, which causes clear changes in their anatomical structure, [9]. The cadmium accumulation inside the wood contains increases its thickness of its walls and reduces its countries, which negatively affects the efficiency of water and nutrient transport [10]. The pollution also leads to clear anatomical signs that are the deposition of silica and the foresters and deformities in the sects. Green, which leads to a decrease in the production of chlorophyll and reduce the number and size of the gaps [11]. The current research aims to study the anatomical changes in the tissues of the growing wild cane in the rivers and homes of Diyala province as a result of the accumulation of cadmium, and it is expected that the results of this study will contribute to deepening the understanding of this plant's response to stress resulting from this element, and evaluating the possibility of its use in environmental monitoring programs and plant treatment For polluted water, the results will also help in determining the relationship between the levels of pollution with cadmium and anatomical changes in the tissues of this plant, which enhances the possibility of its use as a vital indicator of environmental pollution with these elements.

2 MATERIALS AND METHODS

2.1 The Selection of Study Sites

This study was conducted in five districts belonging to the Diyala/Iraq Governorate, where several sites were chosen along the rivers and homes that are exposed to various sources of pollution with heavy elements. The selection process was carefully done to ensure accurate representation of varying pollution levels, with a focus on areas affected by industrial, agricultural and home waste. The various environmental factors that may affect the distribution of heavy metals in soil and water have been taken into account.

2.2 Sampling Collection

The samples were collected on 10/2/2023 until 11/15/2023 from the districts of Diyala Governorate, where the sites were carefully chosen to ensure geographical and environmental diversity. The vegetable samples were collected, then washed, cleaned and placed in clean plastic bags with the site's registration and date on it, and then took samples of water from each site using sterile plastic packages of 1 liter, and added a few drops of concentrated nitric acid (HNO_3) to control the pH as well as to prevent the precipitation of heavy metals and the packages were tightly closed, and finally the soil samples were collected from the bottom of the samples The vegetation that was taken to study at a depth ranges between 0-30 cm using a manual tool and was placed in plastic bags with the registration of the sample number and the location that is site and the date, and the temperature and the PH in the water were measured directly for all the sites from which the sample was taken, and all samples were transferred to the laboratory for the necessary laboratory analyzes (see Table 1) [12] .

Table 1: PH and temperature for the five sampling sites.

Location	Water Type	PH	Temperature (°C)
Khanaqin	River water	7.03	22
	Drainage water	7.63	21
Baquba	River water	7.50	19
	Drainage water	7.83	20
Al-Khalis	River water	7.22	25
	Drainage water	7.71	24
Al-Muqdadiya	River water	7.18	22
	Drainage water	7.49	24
Balad Ruz	River water	7.39	20
	Drainage water	7.55	21

2.3 Chemical Analysis of Samples

After completing the collection of samples and transferring them to the laboratory, placed in the electric oven (Oven), where the vegetable samples were placed at a temperature of 60 ° C for four days, while the soil was placed at a temperature of 100 ° C for 48 hours, in order to dry them from moisture and then the leg samples were grinded by a ceramic mortar, and they were stamped across an sieve with a 2 mm diameter.

500 mg of each sample was taken and placed in a glass gep, adding 9 ml of nitric acid (HNO_3) concentration of 65%, 1 ml of hydrogen peroxide (H2O2 30% concentration), root and leg samples while 8 ml of nitric acid (HNO_3), 65% and 2 ml of hydrogen peroxide (H2O2) is added Focus 30%, for paper samples.

500 mg of each dried soil sample was weighed and placed in a glass spike added 9 ml of nitric acid (HNO_3 concentration), of 65%, and 1 ml of hydrogen peroxide (H2O2 30%concentration).

Then the samples were transferred to the microbial digestive system at a temperature of 180 °C for 30 minutes (see Table 1). The samples were nominated using filtration and the concentrations of heavy elements were measured using the ICP -OES device based on the method approved by [13].

2.4 Preparation of Plant Samples and Laboratory Procedures

2.4.1 Preparing Anatomical Clips

The vegetable samples were extracted from the alcohol solution (70%), and was washed with distilled water to remove any residue of the alcohol, samples were cut to make very thin luminous clips to the extent of reaching a bright anatomical clip showing the tissues and cells clearly and with a thickness ranging from (5-7 cm) using a sharp dissection code under the anatomy microscope, the clips were transferred to a minor solution Diluted with distilled water with a concentration of 5 % to get rid of chlorophyll dye for 5-10 minutes. Glycerin solution, then gently put the slices to avoid the formation of air bubbles, After completing the preparation of the sample, and its golden pladium, the microscopic features were examined using the FE-SEM [15].

2.4.2 Preparation of Plant Sample Sections

The vegetable clips of the leg were prepared using the hand securityment, samples were cut into parts of 4-6 cm from specific areas, then fixed in a solution

Table 2: Cadmium concentration in water, soil and leg for wild cane plants in the five sites.

Location	Water Type	Soil	Stem	Mean±std	p-value
Khanaqin	River water	0.07	ND	0.02±0.04	0.015*
	Drainage water	0.15	ND	0.05±0.09	
Baquba	River water	ND	ND	0.00±0.00	0.043*
	Drainage water	0.15	ND	0.05±0.09	
Al-Khalis	River water	0.08	ND	0.03±0.05	0.022*
	Drainage water	0.15	ND	0.05±0.09	
Al-Muqdadiya	River water	0.01	0.01	0.00±0.01	0.008**
	Drainage water	0.13	ND	0.05±0.07	
Balad Ruz	River water	0.01	ND	0.00±0.01	0.062
	Drainage water	0.08	ND	0.03±0.05	

*Significant at probability level $p < 0.05$ **Significant at probability level $p < 0.01$

(F.A.A), which contains 50 ml of ethanol alcohol (95%), 10 ml of formalin, 5 ml of olive acid, and 35 ml of distilled water, for a period of 48 hour. After that, the samples were washed twice with ethanol alcohol (70%) to remove the effects of the stabilizer, and then kept in alcohol with the same concentration until the anatomy is performed [14].

2.5 Statistical Analysis

Data was analyzed using SPSS (version 22), where the arithmetic average and standard deviation were calculated to describe the variation of values of cadmium concentration in water and soil and the legs of the wild reed plant within different environments. To assess and impact on the anatomical qualities of the plant tissues, the contrast analysis (Anova) was used to compare the differences between different sites, with the adoption of ($P < 0.05$) as a standard to determine the significance Statistics.

3 RESULTS

Table 2 shows the results of cadmium concentration in the water, soil and the stem of wild the cane plants. Cadmium was not been detected in water samples in all locations, whether in river water or wastewater. The means (± standard deviation) showed a clear variation between wastewater and river water, as wastewater in all sites was recorded higher compared to river water. The wastewater was recorded in the locations of Khanaqin, Baquba and Al -Khalis, the highest value (0.05 ± 0.09), while the pure site recorded the highest value for river water (0.03 ± 0.05) (see Fig. 1).

Cadmium concentrations in the soil ranged from undetected at the Baquba site to 0.15 ppm in drainage water soil at several sites. As for the concentration of cadmium in the stem, most sites have recorded uncomfortable values, except for the stem of the plant in the river waters at the Muqdadiya site (0.01) parts per million.

Statistical moral tests revealed the presence of moral differences ($P < 0.05$) between river water and wastewater in four of the five locations, with the highest moral at the Al -Muqdadiya site ($P = 0.008$), while Balad Rose site did not show a significant difference ($P = 0.062$).

Table 3 shows the presence of clear anatomical and moral changes in the growing wild cane in the waters of the locally compared to its counterpart in clean water, where a decrease in the thickness of the vascular package ranged between 7.44% in the Baquba site and 34.01% in the site of Muqdadiyah. As for the diameter of the wood container, it witnessed a greater decrease, as the rate of decrease reached 69.35% in the Baquba site, followed by Muqdadiya and Blarages sites by 25.00% (Fig. 2).

Table 4 illustrates the wood pot in the leg of the wild cane in the five sites based on the measurements of the electronic microscope scanned in clean rivers and the waters of the clients. All sites showed a decrease in the diameter of the wood pot in the developing plants in the waters of the locally compared to river water. The Baquba website recorded the highest rate of decrease (52.6%), followed by the Baldrouz sites (35.1%), then Sharean (29.5%). Al -Khalis site also recorded the lowest decrease (19.4%), followed by Khanaqin (21.4%). The average decrease in Qatar was the wood container for all sites (31.6%)) (Fig. 3 and 4).

Table 3: The percentage of change in the anatomical measurements of the leg of the cane plant within the study sites.

Location	Anatomical criterion	River water	Drainage water	Percentage change (%)
Khanaqin	Vascular bundle thickness	103.4	86.3	-16.54
	Xylem vessel diameter	2.5	2.3	-8.00
Baquba	Vascular bundle thickness	111.5	103.2	-7.44
	Xylem vessel diameter	6.2	1.9	-69.35
Al-Khalis	Vascular bundle thickness	105.5	93.5	-11.37
	Xylem vessel diameter	2.4	1.9	-20.83
Al-Muqdadiya	Vascular bundle thickness	88.5	58.4	-34.01
	Xylem vessel diameter	4.4	3.3	-25.00
Balad Ruz	Vascular bundle thickness	118.2	106.5	-9.90
	Xylem vessel diameter	3.2	2.4	-25.00

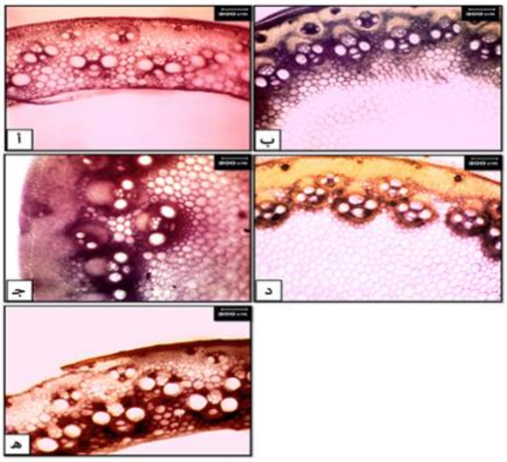

Figure 1: Stem from clean water.

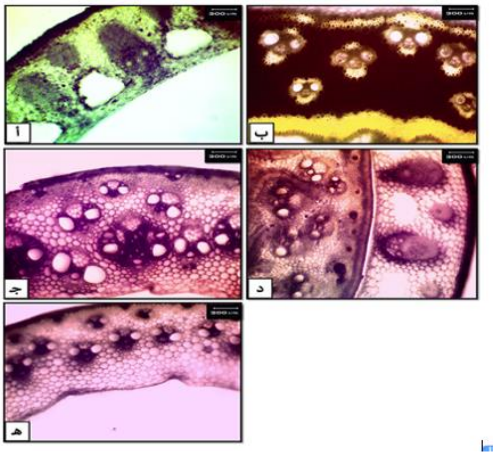

Figure 2: Stem from drainage water.

Table 4: The diameter of the wood bowl in the leg of the wild cane based on the e-microscopic microscope measurements (SEM).

Location	Xylem vessel diameter in river water	Xylem vessel diameter in drainage water	Difference	Percentage decrease (%)
Khanaqin	2.8	2.2	0.6	21.4
Baquba	9.7	4.6	5.1	52.6
Al-Khalis	3.6	2.9	0.7	19.4
Al-Muqdadiya	4.4	3.1	1.3	29.5
Balad Ruz	5.7	3.7	2.0	35.1
Average	5.24	3.30	1.94	31.6

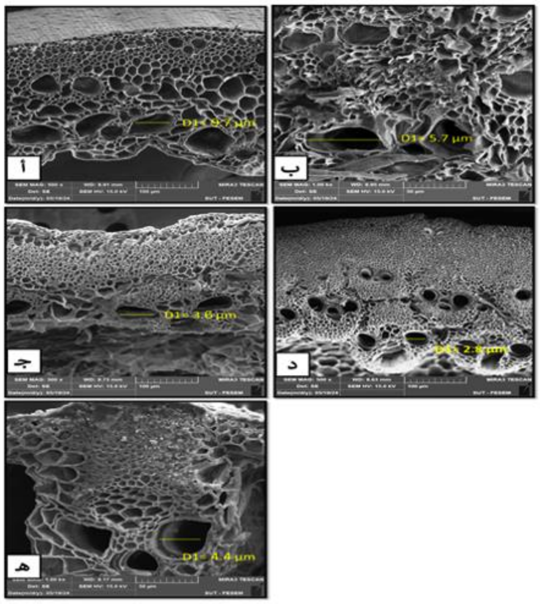

Figure 3: SEM images of stem cross-sections water.

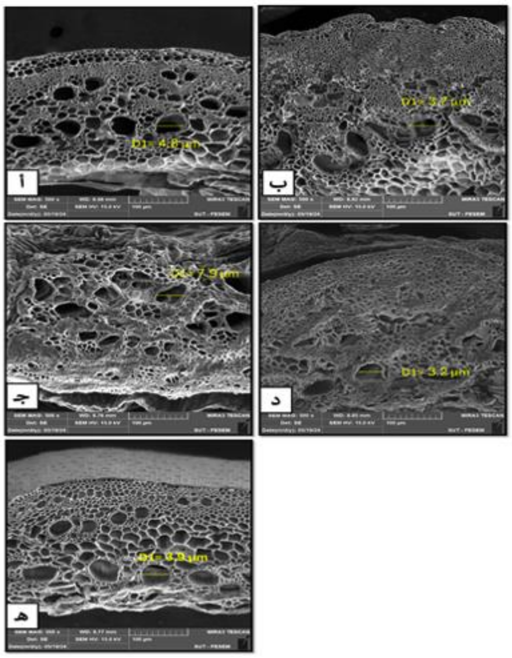

Figure 4: SEM images of stem cross-sections from the river from drainage water.

4 DISCUSSION

The results of the study showed that the concentration of cadmium in the leg of the wild cane was zero in all locations except for the site of

Muqdadiyah in the river waters, where the concentration reached 0.01 mg/kg. This indicates that the wild cane plant tends to stabilize the heavy elements in the roots instead of transferring them to the air parts, which corresponds to a study that emphasized the ability of water plants to reduce the accumulation of cadmium in the air tissue [16], in addition, another study found that some aquatic plants have the ability to enhance the stabilization of heavy metals in the roots through complex physiological mechanisms such as the production of proteins that It is associated with cadmium [17]. Another study also showed that the acidic soil increases the cadmium installation in the roots, which limits its transition to the air parts [18]. The current study also indicates a noticeable decrease in the thickness of the vascular package and the diameter of the wood bowl in the developing plants in the waters of the yield compared to river water. The average decrease in the thickness of the vascular package was 34.01% in Muqdadiya, while the decrease in the diameter of the wood container was 69.35% in Baquba according to optical microscope measurements, while the SIM microscopic measurements (SEM) that amounted to 52.6%. Exposure to cadmium leads to the contraction of wooden vessels and inhibiting the activity of the vascular Campium, which negatively affects the transportation of water and nutrients, which was confirmed by a recent study on the chickpea plant, where a decrease in the diameter of the wooden vessels and its number was observed, as a result of the accumulation of cadmium in the vascular tissues [19]. Another study also showed that cadmium reduces the synthesis of cellulose and ligans, which leads to a decrease in the thickness of the vascular package and the contraction of the vascular diameter in the peas as a result of anatomical changes and vascular deformities caused by cadmium [20]. On the other hand, a recent study conducted on the willow plant indicates that some plants develop compensatory mechanisms to improve water transportation and reduce the effect of cadium on wooden vessels by enhancing the root mass and expanding the size of the secondary vessels [21]. A recent study also confirmed that the use of microbial sedimentation technology with ochrobactrum splash. POC9 can effectively reduce the vital availability of cadmium in the soil and its toxic effect on plants.

5 CONCLUSIONS

The study revealed that most types of juices and soft drinks available in the local markets in Baghdad contain levels of heavy elements that fall within the permissible limits according to the standards of the World Health Organization. However, recording abuses in the concentrations of some elements such as silver (AG), chromium (CR), and aluminum (AL) in some samples indicates the need to be cautious, as the average concentration of silver (0.2746) parts per million exceeding the permissible limit 0.1, and the risk index reached 1.569143, while the risk index of aluminum reached 2.346857 as a result of the dose exceeding The permitted daily. As for the lanes of arsenic, cadmium and chrome remained within the safe borders, while the cumulative index of health risks to all elements reached 5,1855, indicating the possibility of health risks when repeated consumption of these products. The study recommends tightening control over these products and educating consumers of the need to moderate the consumption of soft juices and drinks and choose healthy alternatives when possible.

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