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THE PROBABILITY OF CALCULATING THE POLLUTION LIMIT IN MINERAL-CONTAMINATED SOILS AND THE PHYSIOLOGICAL EFFECT OF THE SURROUNDING PLANTS

Estabraq Mohammed Ati1,
Rana Fadhil abbas 2,
Zena Hassan Jazar 3,
Dr. Reyam Naji Ajmi 4
1,2,3,4 Department of Biology Science, Mustansiriyah University, POX 46079, Iraq-Baghdad.
reyam80a@uomustansiriyah.edu.iq

Abstract:
Pollution is a problem on a global scale that could have negative effects. In order to address this issue, it is important to take into account the primary sources of soil pollution, such as cemeteries. The primary goal of the current study was probability of calculating the pollution limit in mineral-contaminated soils and the physiological effect of the surrounding plants. Three fundamental sites the cemetery area and leaf Cupressus dupreziana .following three time periods of sampling, elements and factors such as (Pb ,Zn, Cd). Due to the site's exposure to soil disturbance, traceable elements were measured and chemically obtained using x-ray fluorescence (XRF). Samples were analyzed using ICPES for the qualitative detection of these elements after soil samples were digested for a control factor limiting the PTL threshold. The element's proximity to the sample is indicated by the relative proximity (RP), which is calculated by dividing the ICPES value on the XRF results of the sample. The component's biodegradability had a value at sites 2 and 1, respectively, and the highest value was discovered in areas 2 and 3. In the order Pb, Zn, and Cd, its plant absorption is 26%, 10%, and 7%. According to the data gathered, cemeteries have a significant potential to contaminate

Keywords: Indication Pollution, Soil, Physiological effect, elements.

1- INTRODUCTION

Cemeteries must be managed effectively if environmental, social, and ecological effects are to be contained. However, due to urban sprawl, the areas close to the cemeteries have become populated and residential (Allén, 2003). Due to the exponential rise in human population, sustainability is starting to be felt. The establishment of cemeteries may have a negative impact on health and may have an impact on suburban areas. Consequently, it may be necessary to take preventative measures or even mitigation (Canning, *et al.* 2010). Cemeteries are typically built based on the standards and technical expertise of a given community because they are necessary components of society's unavoidable infrastructure period (Hala and Frank, 2009). In one of Iraq's governorates, Najaf, there is a Wadi al-

Salam cemetery. It is bordered on the south by the Imam Ali bin Abi Talib , on the east by the Najaf road leading to Karbala, and on the west by the Dead Sea, also known as the ancient Sea of Najaf. Religious accounts that lack historical context attest to the cemetery's pre-Islamic origins. There are millions of bodies in this seven hundred hectare-sized cemetery. With a population density of a million, Najaf is one of the biggest cities in Iraq, but it is also known as the "city of the dead," which is home to millions of people. The bodies and remains stretch along Valley for more than ten kilometers. There are two different types of graves in a cemetery: tombs that are up to 80 cm high and catacombs that are five to eight meters below ground. Over 1,400 years of burials have taken place in this cemetery, which is listed as a World Heritage Site by UNESCO, when the battle against ISIS began in 2014, it was reported that the cemeteries had expanded beyond the borders. It is estimated that during the Iraq War, 200–300 bodies were buried there every day, and that by 2010, the rate had dropped to less than 100 per day and 500,000 funerals per year of Najaf Governorate (Hala and Frank, 2009).

A human body takes between 15 and 25 years to decompose completely or to its ideal state (APHA, 1998). Temperatures outside and burial depth have a big impact on how quickly dead bodies decompose (Nguyen and Nguyen, 2018). The decomposition of the bodies will be accelerated when the surrounding temperature is between 20 and 25 C, while it will take longer when the surrounding temperature is between -5 and -6 C. (WHO, 2013), Since microorganisms are the main decomposers in soils, soil moisture also affects decomposition through its impact on soil microbial activity (WHO, 2013). The human body is a source of organic matter whose decomposition could be sped up to take between two and five years under the right environmental conditions and with the help of insects, scavengers, and microorganisms that aid in the process (Ajmi, 2019). Leachates are produced during the decomposition of inhumed bodies and are typically made up of water, proteins, fats, mineral salts, and carbohydrates. As they are not retained by vegetation, they can infiltrate the soil and cause eutrophication as well as the growth of microbial pathogens, such as bacteria and viruses (WHO, 2012).

Leachate is produced at rates of 0.4 to 0.6 L per kg of body weight, or up to 40 L per adult human body weighing 70 kg, accounting for 62% of the mass of decomposed material (Scalenghe and Pantani, 2020). Those used in funeral rituals are 60% water, 30% mineral salts, and 10% of substances like putrescine, cadaverine, and heavy metals in addition to chlorine and formaldehyde (Cruz, *et al.* 2017). According to the findings of successful studies conducted by numerous researchers, cemeteries may resemble a specific type of municipal solid waste landfill site. As a result, cemeteries may cause soil pollution and present a risk to human health (WHO, 2013; Cruz, *et al.* 2017). According to the research done by Van Haaren in 1951, cemeteries have a negative impact on soil quality by raising the levels of electrical conductivity (EC), chlorides, sulfates, and bicarbonates (Guayasamn Vergara, 2021). Engelbrecht also documented the spread of infectious diseases in society and the infiltration of hazardous substances from cemeteries into soil in 1998 (Nita, *et al.* 2014). Studies conducted in South Africa also showed the cemetery's negative effects on the quality of the soil and groundwater resources 9. Additionally, a study demonstrated how the effects of cemeteries on soil pollution were caused by the buildup of specific substances and elements in the soil (WHO, 2013). By measuring various factors, the current study aimed to more thoroughly examine the contamination potential of a cemetery on soil quality. Analyses of the soil quality in representative cemeteries revealed contamination linked to burial customs and a rise in trace metal concentrations as a result of the use of coffins with painted metals.

2. Experimental

2.1. Sampling

In this study, sampling was done at three locations, one of which was a cemetery and the other was not, serving as real and blank sampling, respectively. The sampling process took place in February 2022. Three repetitions at depths between 10 and 30 cm were used to sample the depths. 1 m of burial depth and leaf *Cupressus dupreziana* from each cites were sampling .Metals are considered some high potential risk pollutants based on the findings of studies completed in Iraq with various burial conditions; however, lead was studied as the only heavy metal in the present study. This study looked at Pb, Cd, and Zn as heavy metals that can accumulate in the body of a person over their lifetime and are measurable. according to (Baden and Coursey, 2002).

2.2. Analysis of the samples or the analytical methods

2.2.1:X-Ray Florescence (XRF).

Prepare drying soil samples, according to (Ni ta, *et al.* 2014), they were crushed into aggregates and evenly distributed on polyethylene sheets outside. The soil samples were thoroughly homogenized and sieved with Retsch aluminum test-sieves with vibratory electronic sieve shaker to fine particle sizes of about 75 m in order to prevent contamination from an outside source and minimize the effects of the soil matrix because XRF spectrometers only analyze a sample's surface layer, which must be representative of the entire sample, every sample was meticulously and uniformly prepared into pellets with smooth surfaces and equal densities. The loose powdered samples (75 m) were ground or milled until they had a particle size of 60 m or less. Prior to mixing, 4 g of each sample were weighed with 0.9 g of powdery Hoechst wax containing cellulose, starch, polyvinyl alcohol, or other organics (Nguyen *et al.* 2019). The resulting mixture (sample and binding material) was added to deformable aluminum cups (screw-top grinding jars) and milled thoroughly and homogeneously using the RETSCH Mixer Mills (MM 301), which also assisted in further pulverizing the sample. The combined mass of the mixture was 4.9 g. Using a SPECAC hydraulic press with a 15 tons (or 15,000 kg) maximum pressure limit, each powdered sample was manually formed into pellets with the same diameter (32 mm) and thickness (3 mm)referred to (Baden and Coursey, 2002).

2.2.2: Preparation Samples for Top Wave Analysis:

As stated by (Baden and Coursey, 2002), the preparation of all samples, including plant and soil samples, for element concentration analysis This technique measures the concentrations of (Zn, Pb, and Cd) in soil, but all samples must first be melted and regulated into liquid using a particular technique. The samples were then prepared for Top wave analytic Jena type analysis using this method validation as a reference.

In the digestion vessel, weigh 0.5 g of the samples for soil samples. Add 8 ml of HNO3%65 and 2 ml of HF to the samples after that. The sample was then diluted with 100 mL of deionized water using the method of dilution for water sample analyses after being filtered through two pieces of filter paper (1 mm). The digestion vessel was cautiously opened in a fume hood while donning hand, eye, and body protection because a sizeable amount of gas would be produced during the digestion process. After that, the samples were quantitatively transferred to Falcon tubes and diluted with deionized water to a volume of 15 ml. For the quality control analysis, 0.250 g is transferred into a Teflon container and reconstituted with 2 ml DW, then 4 mL of HNO3 according to (Baden and Coursey, 2002).

2.2.3: Inductively Coupled Plasma Emission Spectrometry (ICP-ES):

The samples were diluted 1:1 with 0.2% (v/v) HNO3 from the standard solutions, which had previously been prepared by Top Wave, before centrifuging them for 20 minutes at 2 000 rpm. All sample vials, sample cups, and glassware were cleaned before use by soaking in 10% (v/v) HNO3 and raising with de-ionized water. The appropriate standards for each element were developed within the range of concentrations of the elements in the samples. The results were obtained using three duplicate measurements. Gas moving through a high energy field, which ionizes the gas and significantly heats it, creates an argon plasma. An ICP-ES operated by nebulizing a liquid mist and injecting it into the plasma's core. The sample mist enters the plasma at temperatures that reach, most chemical compounds dissociate as a result of the intense heat, and the atoms' energy absorption results in excitation and ionization energy transitions. The excited elements' specific spectral emissions are produced by these transitions, the spectral lines into concentrations for a predetermined set of elements after the ICP-ES spectrometer divides the spectra produced by the plasma into distinct spectral lines. ICP-ES has a broad linear range of 4-6 orders of magnitude for the majority of elements. This suggests that a variety of concentrations in samples can be accommodated with fewer dilutions. The outcomes of analytical work are evaluated all at once through the use of a computer program called smart analyzer. Results are displayed in units of mg/dm3 (ppm). In order to calculate the mean, standard deviation

(SD), and relative standard deviation (RSD%) of the parallel results for the heavy metals (Zn, Pb, Cu, Sr, and Ti) (WHO, 2013).

2.2.4: Pollution Threshold Limit (PTL).

For these different elements, relative proximity (RP) was used to thoroughly compare the raw data from XRF versus ICP-ES. Because RP only considers samples with values higher than the controlled threshold limit, monitoring is necessary (PTL). As shown in Equation, to determine the RP, divide the total number of detected XRF results over the PTL by the total number of detected field samples of ICP-ES results (APHA, 1998):

$$RP = No.ICPES$$
$$No.XRF$$

2.2.5: Estimation of relative water content in leaf tissue:

The relative water content of plant leaves was estimated by taking a fresh plant leaf, weighing it, and then transporting it to a Petri dish containing distilled water and left to float until saturation (for 24 hours), after which it is weighed once to find out the swelling weight, then the leaves are dried using an electric oven at 70 °C (for a period of 24 hours) and to find out the relative water content, we apply the following equation according to the method (Turner,C. 1981).

$$\text{Relative water content (\%)} = \text{fresh weight} - \text{dry weight} / \text{full weight} - \text{dry weight} \times 100$$

2.2.6 :Determination of the amino acid proline in paper tissues.

The concentration of the amino acid proline in the leaves of the five plants taken from the study sites as mentioned in (Scalenghe,etal 2010) using a spectrophotometer at a wavelength of (520) nanometers.

2.2.7 :Estimation of the degree of stability of cytoplasmic membranes and leaching of ions:

The degree of stability of the cytoplasmic membranes and the percentage of damage index then it was done by electrical conductivity of leaf cut infiltrates with a device Autoclave period, and then the paper tissues were killed by placing them in the sterilization device . The electrical conductivity of the filters was re-measured and estimated at 15° minutes, after cooling them to a temperature of (25) C damage evidence ratio according to equation and as follows:

$$I= [1- (1- T1/T2) / (1- C1/C2)] \times 100\%$$

The reading represents the electrical conductivity of a control treatment before and after tissue killing. C and 2 C1. The reading represents the electrical conductivity of each treatment before and after tissue killing, respectively. T and 2 T1. Flame, sodium and potassium ions were also determined for the leaching of the leaf anatomy apparatus.

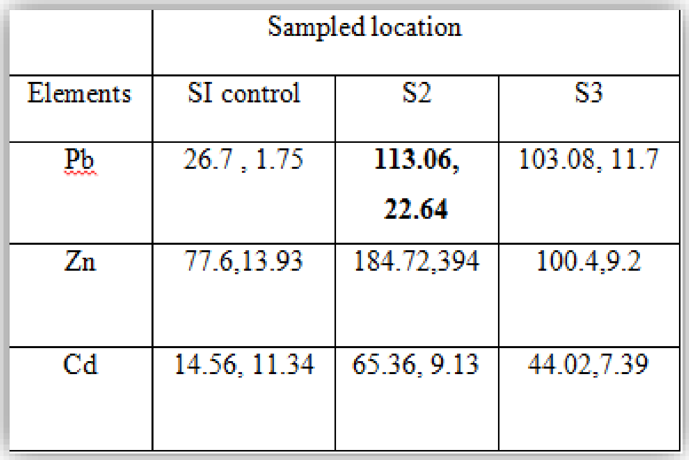
3. Results and Discussion

Several crucial methods for tracking elements were used to measure their concentrations, but the cumulative ratios, which are :

3.1 X-Ray Florescence (XRF):

Pb, Zn, and Ca, the three most important elements that were highlighted in this study, were quantified to ascertain the accuracy of the elemental ratio and were found to have a consistent composition. The results for the soil samples indicated the presence of the following elements, which were quantified and measured using X-ray fluorescence to identify traceable elements in Table (3-1), the quantities of Cu and Zn in other cities exceeded the set limits, and there was a significant variation with normal results for the control site. With few exceptions, the average results showed concentrations below detection, with the exception of the cemetery, which had the highest concentration of the Pb element because it was exposed to soil disturbance at a rate of 50 to 100 times per day because it was an old cemetery according to (WHO, 2012 and 2013).

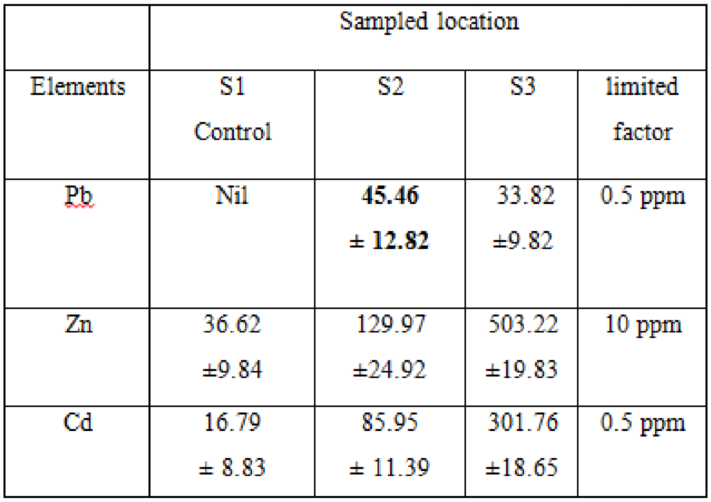
Table (3-1): Mean ± SD of chemical composition of (Sr, Ti, Pb, Zn, Ca) elements in Soil (ppm) measured in XRF with limited factor WHO (2012).



	Sampled location		
Elements	SI control	S2	S3
Pb	26.7 , 1.75	**113.06, 22.64**	103.08, 11.7
Zn	77.6,13.93	184.72,394	100.4,9.2
Cd	14.56, 11.34	65.36, 9.13	44.02,7.39

The following step involved re-analyzing the data with ICPES in order to qualitatively identify these components. After digesting soil samples, the monitoring factor PTL is calculated to ascertain the soil samples' capacity to absorb these elements from incidents occurring during the accumulation process. ICPES data was used to display the elemental concentrations in soil in Table (3-2).

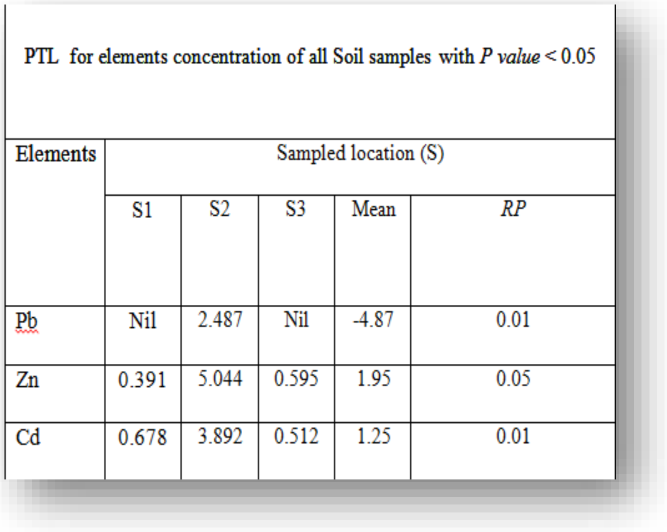
Table (3-2) Concentration of (Pb, Zn, Ca) elements in Soil (ppm) measured In the ICPE spectrometry.



	Sampled location			
Elements	S1 Control	S2	S3	limited factor
Pb	Nil	**45.46 ± 12.82**	33.82 ±9.82	0.5 ppm
Zn	36.62 ±9.84	129.97 ±24.92	503.22 ±19.83	10 ppm
Cd	16.79 ± 8.83	85.95 ± 11.39	301.76 ±18.65	0.5 ppm

Interpretation of the Elements Results elements (Pb,Zn,Ca) by PTL the permissible exposure level for pollutants in Table from comparisons between XRF and ICPES Qualitative and Quantitative in Soil Samples as one of the most crucial indicators for tracking body decomposition and the extent of its accumulation for short-term and long-term (3-3). The regression lines for the XRF value and ICPES value for these elements are shown in Figure, in contrast. The regression lines provide a description of the minimized.

Table (3-3) PTL elements concentration of soil samples.



PTL for elements concentration of all Soil samples with *P value* < 0.05

Elements	Sampled location (S)				
	S1	S2	S3	Mean	*RP*
Pb	Nil	2.487	Nil	-4.87	0.01
Zn	0.391	5.044	0.595	1.95	0.05
Cd	0.678	3.892	0.512	1.25	0.01

The following table analyzes the distance between the line and the data points of each method that demonstrates how well the slope of regression indicates that the results from XRF measurements and ICPES experiments are identical. The interpretation of the monitoring results for the elements and their accumulation can be guided by the screening test of high values when selecting sampling locations. Only samples with values above the controlled threshold limit over the pollution threshold limit are taken into account by (PTL), As a result, the RP is determined by dividing the total number of detected results over the PTL by the total number of ICPES of XRF results, as shown in the following table. Their regression lines' general evaluations were used to carry out the thorough interpretation. Based on the outcomes and as shown in the tables, the fate of these elements in the soil can be explained in the following ways:

Element zinc (Zn) : Only the values over the PTL then 26% of the data exist in close proximity to each other, according to the result of this element in pollution sites samples, which demonstrates the sensitivity and accuracy of factors and approximately and converging parallel these soil samples have a linear regression slope of 0.027. Because of the type of soil and the highest bioavailability of pollution threshold limit, very few soil analyses are conducted, which is an indicator of the soil's quality (Tudor, *et al* 2013; Schneider, *et al.* 2015).

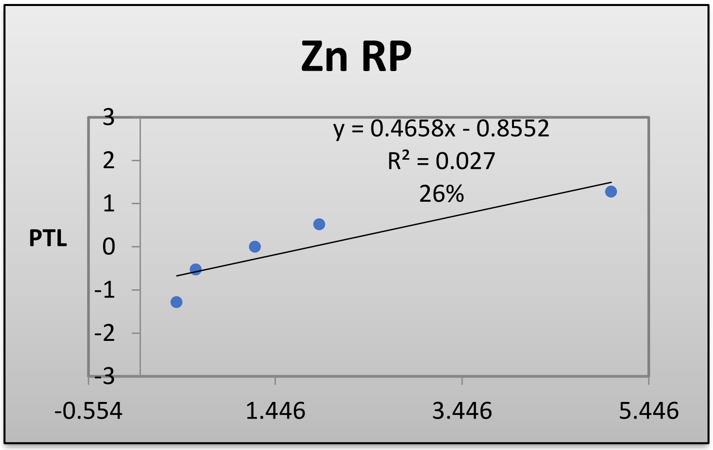


Figure (3-2) The maximum percentage of Zn that is bioavailable due to pollution

Element lead (Pb): Results showed good accuracy in identifying this element. The areas appear to have low concentrations of lead and an accumulation of tetraethyl lead from the traffic congestion in this area because most people visit cemeteries to pay their respects, giving Pb a very low potential for interference from other factors. This shows that there is air pollution in the area and has nothing to do with bioavailability. Due to controlling only the values over the PTL, the information above has high screened measurement values that indicate a high level of reliability. Additionally, 10% of the data are positioned in close proximity to one another (3-2) R2 value is 0.93 , this agree (Fistola, 2011; Schneider, *et al.* 2015).

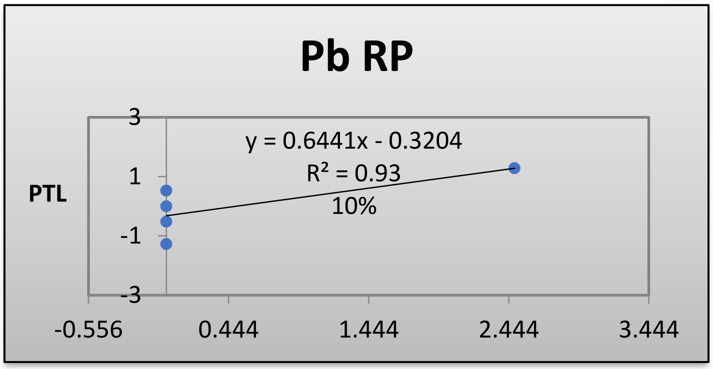


Figure (3-24) The maximum percentage of Cd that is bioavailable due to pollution.

Element Cadmium (Ca): There is no significant relationship and percentage of plant uptake normal conditions and under the influence of the type of accident becomes somewhat non-existent, and the majority of cadmium is either a feeder or compensated in the composition of the analyses to repair the damage, so there is no significant relationship and percentage of plant uptake element low in abundance to some extent this agree with (Peluso, *et al*. 2006; Larkin, 2011). The RP is only 5 % (3-3) show the regression R2 value of 0.011.

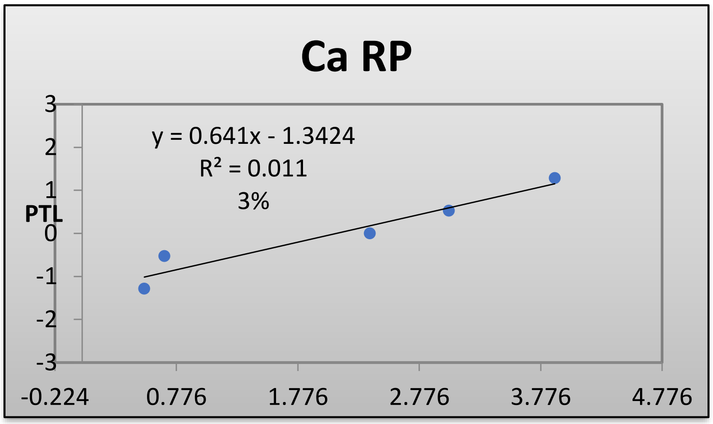


Figure (3-3) The maximum percentage of Cd that is bioavailable due to pollution.

4. Conclusion

Standard analytical techniques identified by using ICPES give a bioavailability of elements in soil that is highest in areas exposed to control elements, where an indicator of activity in cemeteries, while the lead element was higher in the vicinity to the movement of cars in cemetery, where there was an abundance of vitality for this element. The use of PTL expressed by relative proximity (RP) resulting from the ICPES results is divided into XRF, giving a clear view of samples that's allowing for analysis.

Water content of paper tissue: -

It is clear from the results that there is a decrease in the water content in the leaf tissues of the plants that were exposed to pollution, and the decrease was significant and amounted to 27.801 because the soils contaminated with heavy elements led. There was a significant decrease in the water content of plant leaves. This decrease may be attributed to the increase in the concentration of heavy metals in the soil of the study area, which leads to the loss of protoplasm because of its natural properties and thus affects the various metabolic processes as well lead heavy elements.

This leads to a tightening and decrease in the water potential, which leads to a decrease in the water content of the plant .Also, high concentrations of heavy metals may lead to the destruction of the walls of the vascular bundles and the occurrence of change in the components of the wood, which affects the process of transporting water inside the plant, and the presence of heavy elements, the differences in the osmotic potential as a result of its effect on the absorption and growth of the roots, which affects the water content in the plant tissues. As for the influence of regions, it was noted that the plants were superior significantly developing in the studied characteristic compared to the rest of the regions and amounted to 68.644 and the significant increase in the concentration of proline in the leaf tissues of the plant in this region.

Its effect is clear on some physiological processes and the concentration of heavy metals in proline content in leaf tissues for plants and hit 8.876 (mg / gm of the weight of the wet matter) and this may be due to the increase in the concentration of heavy elements in the soil and water of the study area, which works inducing changes in the various metabolic processes within the plant cell and thus affecting the concentration.

Proline in the plant, and the reason may also be attributed to the occurrence of water stress as a result of the increase in the speed of transpiration or because of the inhibition of root growth in plants grown in these soils, which leads to a defect in the soil.

Cellular distribution to build and oxidize proline, as well as increase enzymatic starch for hydrolytic enzymes of protein and thus helps to increase the content of proline and the concentration of proline increases as a result of stopping

Protein production or as a result of the demolition of existing proteins, as well as due to changes in some enzymes from an increase or decrease in their concentration.

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