© 2015 IJSRST | Volume 1 | Issue 6 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
1st International Symposium of Applied Biology CIBA 2015 USTO-MB, Algeria in association with IJSRST

# Study of Contamination by Copper and Zinc of some Spontaneous Plant at Telamine Lake

**Haddad Fatma Zohra, Benaissa Noureddine, Zitouni Boutiba, Zoubida ElHadj**
Department of Biology, University of Oran, Laboratory Network for Environmental Monitoring (LRSE), Oran, Algeria

## ABSTRACT

One of the major current issues in environment is soil contamination by many toxic elements and compounds including heavy metals. These contaminated sites, often have a very diverse flora tolerating high levels of heavy metals. The objective of this work is to study the behavior of some wild plants towards copper and zinc contamination and to test the hypothesis that the zinc (Zn) and copper (Cu) concentration may be explained by the availability in the soil and biomass of the organ. The obtained results showed that the metal concentration in plants is weakly correlated with its presence in soil. Our survey, in agreement with many previous studies, shows that there is no direct link between the total content of Cu and Zn in soil and concentration in plants. In fact, for an element to be assimilated by a plant, it must be in the soil solution and bioavailable. As this study also confirmed, absorption capacity vary according to plant species and, in a plant, according to the considered organ.

**Keywords:** Heavy metals, contamination, plants, flora, zinc, copper.

## I. INTRODUCTION

Heavy metals are naturally present in rocks, they are released during it alteration to form the geochemical background [11]. Natural concentration of these heavy metals in soils varies depending on the nature of the rock, its location and its age. However, the major source of contamination is anthropogenic. In recent decades, the heavy metals intake in soil in the world extended [5].The atmosphere, water, and soil contamination by many toxic elements and compounds has become a major environmental problem.

These contaminated sites, often have a very diverse flora tolerating high levels of metals. The study of these resistant plants, for their detoxification, immobilisation or absorption capacity of heavy metals, could be an interesting tool, not only to estimate the risk of potential transfer of heavy metals in the ecosystem, but also as soil remediation tool. The challenge is not only the preservation of soils for agricultural production for a growing population, but also the recovery of degraded and contaminated soils.

It is in this context of sustainable development that this study was undertaken, the main objective being to select species of native flora able to accumulate metals in their plant tissues in the purpose of their subsequent use in phytoremediation.

## II. METHODS AND MATERIAL

### A. Presentation of the Study Area

Télamine lake (figure 1), is located in the east of Oran, commune of Benfreha, at an altitude of 95 m, while the village lies at an altitude of 107m. It occupies an elliptical depression oriented SSW –NNE whith coordinates of 0°42 'W longitude and 35°38' N latitude. It is divided into three separate bowls extending over 6 km long and 1 km wide, with an area of 2400 ha.


**Figure 1:** Study Area

### B. Collection and plant packaging

The plants are collected in dry weather with roots, stems and leaves. They are cleaned of coarse earth elements stick, before being packaged separately in closed plastic bags. Soil samples are collected in the same time under the around rhizosphere plants area and are put in bags of the same type. They are then transported to the laboratory in a cooler to undergo mineralization.

The identification of plant taxa was made with the help of some taxonomic works such as «La nouvelle flore d'Algerie» of Quezel et Santa (1962-1963), «La Flore du Sahara» of Ozenda (1977), «La flore d'Afrique du nord» of Maire (1952), «La Flore descriptive et illustrée de la Corse» of Coste (1937).

The collected plants were cleaned, then separated into stems, leaves and roots.They were then dried in an oven for 72 hours at a temperature of 70 °C to be finally reduced to a fine powder using a mortar and pestle. 30 mg of powder was dissolved in 3.5 ml of mixture ($HNO_3$ / $HClO_4$) at the rate of (7V/1V), incubated in the dark for 24h and then diluted in 5 ml of $HNO_3$ 0.2% [9].

Soil samples were also dried in an oven for 24 hours at a temperature of 105 ° C, then sieved through a sieve with round holes of 2 mm diameter to separate the fine earth (fraction less than 2 mm), on which are performed the analyzes.

The assay is performed by Atomic absorption spectroscopy with flame equipped with a graphite oven of type AA 30/40 Zeeman, Statistical analysis was performed with the help of Microsoft STATISTICA software.
The results were expressed by their average and their error, the significant differences were established at $p < 0.05$ in accordance with post-hoca LSD test.

## III. RESULT AND DISCUSSION

### A. Botanical identification

Five plant species were chosen from the spontaneous flora, the kept species are the most numerous on the assumption that these species are best suited to the conditions in situ.

The identified species are: E1: *Chenopodium album*, E2: *Spergularia salina*, E3: *Malva sylvestris*, E4: *Suaeda fructicosa* and E5: *Urtica pilulifera*.

### B. Changes of zinc and copper concentrations in plant parts

The assessment of contaminant levels is performed in leaves, stems and roots. The average of concentration is calculated for each plant. Figures 2 and 3 represent the mean concentrations of zinc and copper in each organ for the five sampled plants.

#### 1. Variation in zinc concentrations

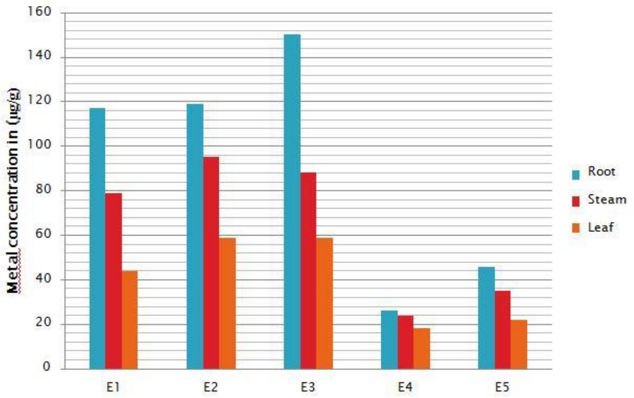


**Figure 2 :** Comparative studies of changes in zinc concentrations in plants (roots, stems and leaves)

The obtained results show high concentrations of zinc in underground parts of the five plants (Figure 2) with a greater accumulation in *Malva sylvestris* followed by *Spergularia salina* and *Chenopodium album*. These concentrations are higher than the rate found in soil (5.99 and 31.63 mg.kg-1.) and that for all the sampled plants. This can highlight a bioaccumulation power of zinc in these three plants.

According to Dauguet (2010), for an element to be assimilated by a plant, it must be in the soil solution and bioavailable. Zinc concentration in the soil solution depends on the amount of zinc in this soil, of the solubility of the particular compound of zinc and the adsorption extent. The solubility varies significantly among the various zinc compounds; zinc sulfat is very soluble in the soil solution, while zinc oxide is relatively insoluble. Zinc can be absorbed in the clay minerals, but also can form stable compounds with the soil organic matter, including the hydroxides, oxides and carbonates.

That is why a study detailing sufficiently the behavior of metals in the soil and in the plant must be undertaken in order to understand the behavior of these metals in the SOIL-PLANT matrix.

### 2. Variation in copper concentrations

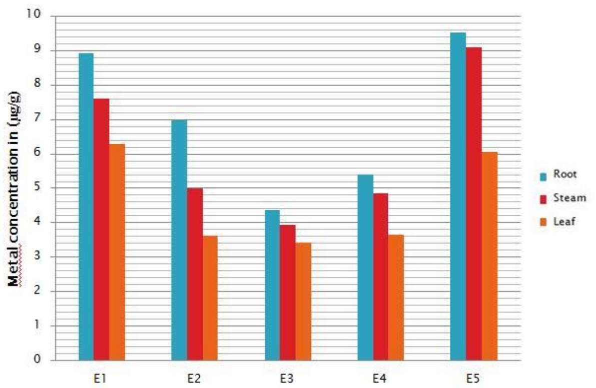


**Figure 3 :** Comparative studies of changes in copper concentrations in plants (roots, stems and leaves)

Copper concentrations in soil vary considerably depending on the soil type, Soil amendments, proximity to anthropogenic sources, Proximity to natural ore veins and composition of bedrock and parent material [2].

As for Zn and according to Figure 3 a bioaccumulation of copper is also observed in the roots compared to aerial parts, only this bioaccumulation is low compared to the levels of copper in the soil (25,3 et 59,73 mg·kg-1), this phenomenon can be explained by the fact that copper is strongly adsorbed to soil particles; therefore, it is much less mobile than other trace elements [1]. The result that the deposited copper tends to accumulate in the ground [16]. Different types of soil have limited retention capacity for copper ions, and leaching can occur when deposited copper levels exceed this capacity [4].

Factors that influence the availability of copper in the soil are, pH, cation exchange capacity (CEC), the organic content, the presence of iron oxides, manganese and aluminum and the redox potential [4]; [16].

Adriano (1986) demonstrated that the soil's ability to adsorb the copper increases with increasing pH, according to Bahi (2012), the soils of Telamine Lake have a pH ranging from 7.9 to 8.4, This would explain its high adsorption capacity of copper.

### C. Interspecific Variations in trace metal concentrations

In order to identify the species that accumulates more trace metals in Télamine lake, we collected and analyzed samples of five plants that dominate the plant community of our site. It should be noted that no study reports the trace metal contamination in Télamine Lake.

The figures (4 and 5) represent the variation of copper and zinc concentrations in the tested species. Statistical analysis reveals significant variations between species E4: *Suaeda fructicosa* whith E1: *Chenopodium album* and E2: *Spergularia salina* with E3: *Malva sylvestris* (E3>E2>E1>E4) ($p<0,05$) and between E5 : *Urtica pilulifera* with E2 : *Spergularia salina* and E3: *Malva sylvestris* (E3>E2>E5) ($p<0,05$).

**1. Interspecific Variations in zinc**

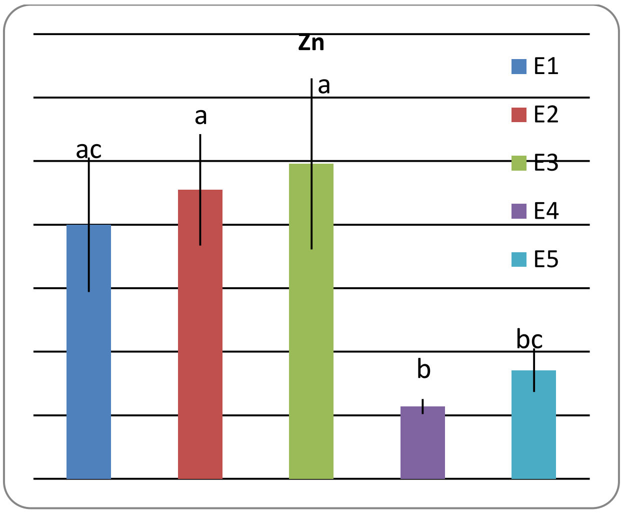


**Figure 4** : Comparative Study of the interspecific variation in Zinc concentrations

According to the results the levels of zinc in plants follow the following order: E3 > E2 >E1>E5>E4. The higher rate was obtained at both plants E3 and E2 identified as *Malva sylvestris* and *Spergularia salina* with rate of 99.13 and 90.96 ppm by dry material respectively. Both species may show an interesting bioaccumulating potential and a laboratory experimental study can be considered.

**2. Interspecific Variations in copper**

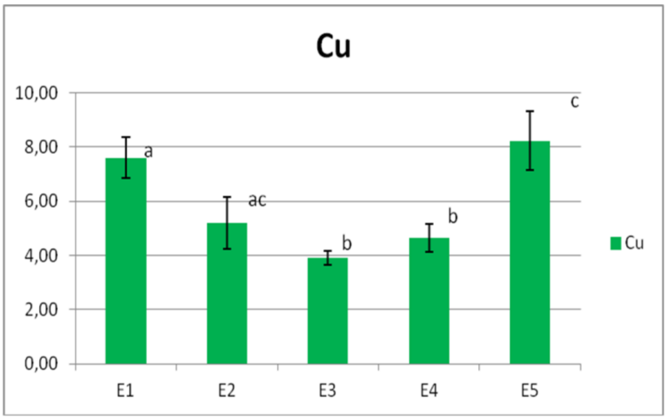


**Figure 5 :** Comparative Study of the interspecific variation in copper concentrations

Based on our, results copper contents in studied plants follow the following order: E5> E1> E2> E4> E3. The higher rate was obtained at both E1 and E5 plants identified as *Urtica pilulifera* and *Chenopodium album* with rates of 8.22 and 7.60 ppm respectively of dry matter.

Copper rates obtained are considerably lower than those of zinc this can be explained by the fact that it has a high affinity for organic matter and it binds more strongly than other trace elements [7]; [4]; [16]; [1]. According to Fuller (1977) and Gibson and Farmer (1984), it occurs in soil solutions often tied to dissolved organic matter and will be released in ionic form only under severe oxidation conditions or by microbial decomposition of organic matter.

## IV. CONCLUSION

This study demonstrated that the MTE concentration in plants is weakly correlated with its presence in the soil, because for an element to be assimilated it must be bioavailable. The transition in solution is under the influence of various factors, the most important is the PH and the organic matter content [15].

Removal ability of an MTE varies according to the targeted metal, the plant species and, in a plant, from an organ to another.

In our situation *Malva sylvestris* present the greatest potential to investigate for Zn contamination whereas for Cu *Urtica pilulifera* would be the best choice.

In conclusion, for a sustainable technological development, it is essential to continue research that not only must involve soil science, agronomy, physiology, ecophysiology and genetics but also disciplines able to answer questions by running a particular biomass and possible recycling of metals in metal production. In this context, process engineering certainly has a key role to play in building this new industry.

## V. REFERENCES


[1] B. J. Alloway. 1990. Soil processes and the behaviour of metals, dans Heavy metals in soils, B.J. Alloway, éd. Blackie and Son Ltd.,Glasgow.

[2] Conseil Canadien des Ministres de l'Environnement (CCME). 1999, Recommandations canadiennes pour la qualité de l'environnement,

[3] Conseil Canadien des Ministres de l'Environnement (CCME). 1997. Canadian soil quality guidelines for copper:Environmental and human health. Ébauche.

[4] D. C. Adriano. 1986. Trace elements in the terrestrial environment, Springer Verlag, New York.

[5] H. B. Singh, A. Tabazadeh, M. J. Evans, B. D. Field, D. J. Jacob, G. Sachse, J. H. Crawford, R. Shetter, and W. H. Brune. 2003. Oxygenated volatile organic chemicals in the oceans: Inferences and implications based on atmospheric observations and air-sea exchange models, Geophys. Res. Lett., 30(16), 1862, doi:10.1029/2003GL017933.

[6] H. COSTE (ABBE). 1937. Flore descriptive et illustrée de la France de la Corse et contrées limitrophes, Tome 1

[7] J.O. Nriagu. 1979. The global copper cycle, dans Copper in the environment: Part 1, Ecological cycling, J.O. Nriagu, éd. John Wiley and Sons, Toronto

[8] K. Bahi. 2012. Contribution à l'Etude phytoécologique des Zones Humides de la régiond'Oran, These de magistere, univ. Oran.

[9] K. Vogel-Mikuš, D. Drobne, M. Regvar. 2005. Zn, Cd and Pb accumulation and arbuscular mycorrhizal colonization of pennycress Thlaspi praecox Wulf. Brassicaceae from the vicinity of a lead mine and smelter in Slovenia. Environmental Pollution 133: 233-242.

[10] M. J. Gibson, J.G. Farmer. 1984. Chemical partitioning of trace metal contaminants in urban street dirt. Sci. Total Environ. 33:49–57.

[11] PH. Bourrelier, J. Berthelin. 1998. Contamination des sols par les éléments traces : les risques et leur gestion. Ed. Lavoisier, Paris.

[12] P. QUEZEL, S. SANTA. 1962-1963. Nouvelle flore de l'Algérie et des régions désertique méridionales. CNRS Editions, vol 2, Paris. 1170p.

[13] P. OZENDA. 2001. Flore et végétation du Sahara, 3ème éd. CNRS Editions. 662p.

[14] R.MAIRE. 1952. Flore de l'Afrique du Nord, Lechevalier, Paris; publiée par : GUINOCHET M. et FAUREL L., vol. I à III

[15] S. Dauguet, L. Denaix, C. Nguyen, E. Royer, P. Levasseur, M. Potin-Gautier, P. Pouech. 2010. Mesures des flux d'éléments traces (Pb, Cd, As, Cu. Zn), dans les sols, végétaux, porcs et lisiers des exploitations porcines du sud –ouest. Innovations Agronomiques 17, 175-190.

[16] W. Slooff, , R.F.M.J. Clevan, J.A. Janus et J.P.M. Ros. 1989. Integrated criteria document copper. Rapport no. 758474009. National Institute of Public Health and Environmental Protection, Bilthoven, Pays-Bas.

[17] W.H. Fuller. 1977. Movement of selected metals, asbestos, and cyanidein soil: Applications to waste disposal problems. EPA-600/2-77-020. Préparé pour le Municipal Environmental Research Lab, Cincinnati, OH