

Absorption Capacity of Heavy Metals in the Case of *Typha Latifolia* Plant Species

ALEXANDRA DANA CHITIMUS¹, VALENTIN NEDEFF^{1,2*}, ION SANDU^{3,4}, CRISTIAN RADU⁵, EMILIAN MOSNEGUTU¹, IOAN GABRIEL SANDU^{4,6}, NARCIS BARSAN^{1*}

¹Vasile Alecsandri University of Bacau, Faculty of Engineering, 157 Calea Marasesti, 600115, Bacau, Romania

²Gheorghe Ionescu Sisesti, Academy of Agricultural and Forestry Sciences, 61 Marasti Blvd., 01146, Bucharest, Romania

³Alexandru Ioan Cuza University of Iasi, Arheoinvest Interdisciplinary Platform, Scientific Investigation Laboratory, 11 Carol I Blvd., 700506, Iasi, Romania

⁴Romanian Inventors Forum, 3 Sf. Petru Movila St., Bloc L11, III/3, 700089, Iasi, Romania

⁵Romanian Waters - National Administration of Siret Basin, 1 Cuza Voda St., 600274, Bacau, Romania

⁶Gheorghe Asachi Technical University of Iasi, Materials Science and Engineering Faculty, 53A D. Mangeron Blvd., 700050, Iasi, Romania

The main objective of the current research is to determine the absorption capacity of heavy metals (zinc and cadmium) in the case of Typha Latifolia plant species (root, stalk, leaf, flower). The plant samples were taken from the Bistrita river banks, respectively upstream of Bacau city, Romania, in Bogdan Voda area, and downstream of Bacau city. A very high absorption capacity of zinc and cadmium was recorded, in the case of Typha Latifolia plant species (especially in the stalk of the plant- 26.91 ÷ 68.18 %, lower than in the root of Typha Latifolia plant species). A lower absorption capacity of zinc and cadmium was recorded, in the flower in the case of Typha Latifolia plant species (84.73 ÷ 96.4 % lower than in the root of Typha Latifolia plant species).

Keywords: zinc, cadmium, absorption capacity, Typha Latifolia, Bistrita river

Metals can be found in the soil under various forms associated with mineral and organic components of the solid phase [1-11].

Heavy metals constitute an important category of stable toxic pollutants. Unlike organic pollutants, metals are not biodegradable, they generally have little mobility and, for this reason, they persist in storage compartments (soil, sediments, water surface and underwater) for a long time [3, 12-34].

Thus, heavy metals with concentration levels in the soil higher than 0.1 % become toxic for plants, altering the structure of the plant community in a polluted habitat [3, 8, 9, 22, 27-37].

There are plants which can adapt to and tolerate high metal concentration levels (metallophytes), and there is a limit level for each plant [3, 8-13, 23].

The transport of heavy metals in the soil is carried out in liquid or suspension form, either by means of plant roots or by connecting with microorganisms in the soil [1-5, 8, 9].

This paper describes the absorption capacity of heavy (zinc and cadmium) in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower).

Experimental part

Sections taken into consideration for taking samples of plants are presented in figure 1. The sampling of vegetation was taken from two locations/areas along the Bistrita River (Bogdan-Voda, upstream of Bacau city and second location -downstream Bacau city) from the banks of the tributaries [3].

Typha Latifolia (fig. 2) is a plant species which accumulates heavy metals, so its investigation leads to significant results [3].



Fig. 1. Sections taken into consideration for taking samples of soil and plants along the Bistrita River [3]

Plants samples were taken for three levels [3]:

- minimum level: soil-water interface level of 0 cm;
- medium level: soil-water interface level of 50 cm, on the river bank;
- maximum level: soil-water interface level of 100 cm, on the river bank.

The zinc and cadmium content in the case of *Typha Latifolia* plant species has been determined by using the atomic absorption spectrometer (AAS), ZEENIT AAS version (Fig. 3) [38].

* email: vnedeff@ub.ro; narcis.barsan@ub.ro



Fig. 2. *Typha Latifolia* [3]



Fig. 3. Atomic absorption spectrometer (AAS), Zeenit 700 version [38]

Results and discussions

Figure 4 represents graphically the absorption capacity of cadmium from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower) in the sampling point Bistrita River - Bogdan-Voda, upstream of Bacau city.

The highest absorption capacity of cadmium in the sampling point Bistrita River - Bogdan-Voda, upstream of Bacau city, was detected in the root of *Typha Latifolia* plant species, and the lowest absorption capacity of cadmium was observed in the flower.

The percentage values of the cadmium concentration determined in the stem, leaf and flower compared with the root of the *Typha Latifolia* plant species for the sampling point Bistrita - Bogdan Voda River, upstream of Bacau, was:

- *Steam* (for the minimum level of soil-water interface, it was 65.11 % lower than in the root of plant; for the medium level of soil-water interface, it was 57.99 % lower than in the root of plant; for the maximum level of soil-water interface, it was 38.24 % lower than in the root of plant);

- *Leaf* (for the minimum level of soil-water interface, it was 85.04 % lower than in the root of plant; for the medium level of soil-water interface, it was 94.86 % lower than in the root of plant; for the maximum level of soil-water interface, it was 82.36 % lower than in the root of plant);

- *Flower* (for the minimum level of soil-water interface, it was 93.35 % lower than in the root of plant; for the medium level of soil-water interface, it was 97.54 % lower than in the root of plant; for the maximum level of soil-water interface, it was 96.4 % lower than in the root of plant).

Figure 5 represents graphically the absorption capacity of zinc from the soil in the case of *Typha Latifolia* plant

species (root, stalk, leaf and flower) in the sampling point Bistrita River - Bogdan-Voda, upstream of Bacau city.

The highest absorption capacity of zinc in the sampling Bistrita River - Bogdan-Voda, upstream of Bacau city, was detected in the root of *Typha Latifolia* plant species, and the lowest absorption capacity of cadmium was observed in the flower. The values of zinc concentration detected in the stalk were much higher than those from the leaf of *Typha Latifolia* plant species.

The percentage values of the zinc concentration determined in the stem, leaf and flower compared with the root of the *Typha Latifolia* plant species for the sampling point Bistrita - Bogdan Voda River, upstream of Bacau, was:

- *Steam* (for the minimum level of soil-water interface, it was 62.33 % lower than in the root of plant; for the medium level of soil-water interface, it was 30.21 % lower than in the root of plant; for the maximum level of soil-water interface, it was 25.21 % lower than in the root of plant);

- *Leaf* (for the minimum level of soil-water interface, it was 80.5 % lower than in the root of plant; for the medium level of soil-water interface, it was 67.76 % lower than in the root of plant; for the maximum level of soil-water interface, it was 58.57 % lower than in the root of plant);

- *Flower* (for the minimum level of soil-water interface, it was 89.98 % lower than in the root of plant; for the medium level of soil-water interface, it was 93.81 % lower than in the root of plant; for the maximum level of soil-water interface, it was 91.86 % lower than in the root of plant).

Figure 6 represents graphically the absorption capacity of cadmium from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf and flower) in the sampling point Bistrita River - downstream Bacau, downstream of Bacau city.

The highest absorption capacity of cadmium from the soil, in Bistrita River - downstream Bacau, downstream of Bacau city, was detected in the root of *Typha Latifolia* plant species, whereas the lowest absorption capacity levels of cadmium were observed in its leaf and flower.

The values of the cadmium concentration determined in the stem, leaf and flower compared with the root of the *Typha Latifolia* plant species for the sampling point Bistrita River - downstream Bacau, downstream of Bacau, was:

- *Steam* (for the minimum level of soil-water interface, it was 44.72 % lower than in the root of plant; for the medium level of soil-water interface, it was 65.53 % lower

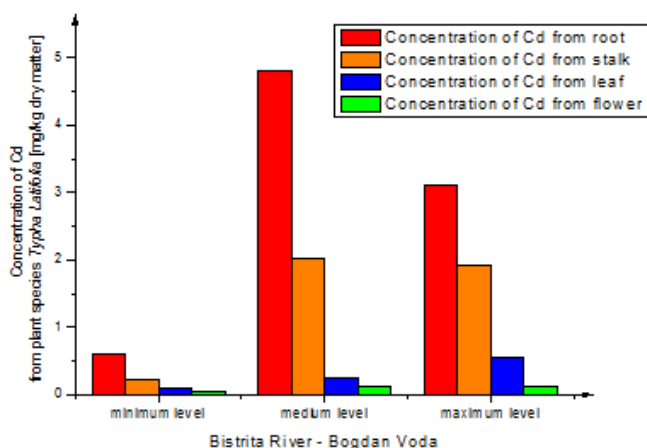


Fig. 4. The absorption capacity of cadmium from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower) in the sampling point Bistrita River - Bogdan-Voda, upstream of Bacau city

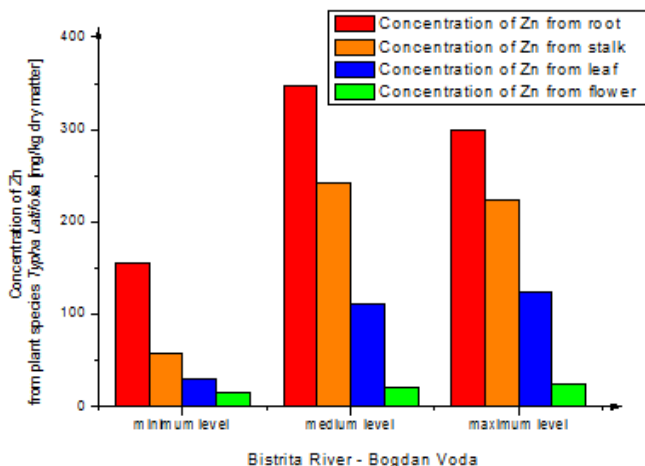


Fig. 5. The absorption capacity of zinc from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower) in the sampling point Bistrita River - Bogdan-Voda, upstream of Bacau city

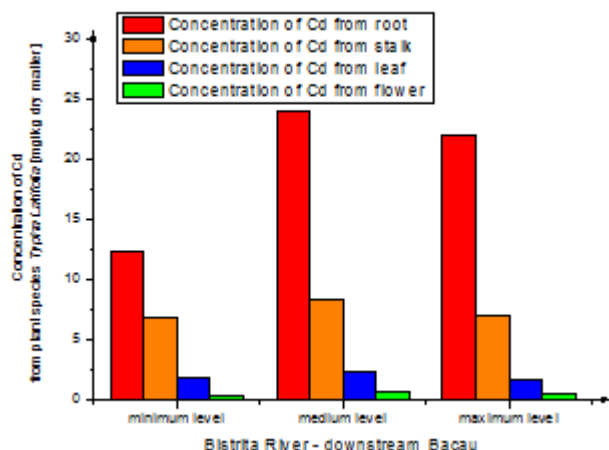


Fig. 6. The absorption capacity of cadmium from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower) in the sampling point Bistrita River - downstream Bacau, downstream of Bacau city

than in the root of plant; for the maximum level of soil-water interface, it was 68.18 % lower than in the root of plant);

- *Leaf* (for the minimum level of soil-water interface, it was 87.73 % lower than in the root of plant; for the medium level of soil-water interface, it was 89.87 % lower than in the root of plant; for the maximum level of soil-water interface, it was 92.94 % lower than in the root of plant);

- *Flower* (for the minimum level of soil-water interface, it was 97.28 % lower than in the root of plant; for the medium level of soil-water interface, it was 97.04 % lower than in the root of plant; for the maximum level of soil-water interface, it was 97.48 % lower than in the root of plant).

Figure 7 represents graphically the absorption capacity of zinc from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower) in the sampling Bistrita River - downstream Bacau, downstream of Bacau city.

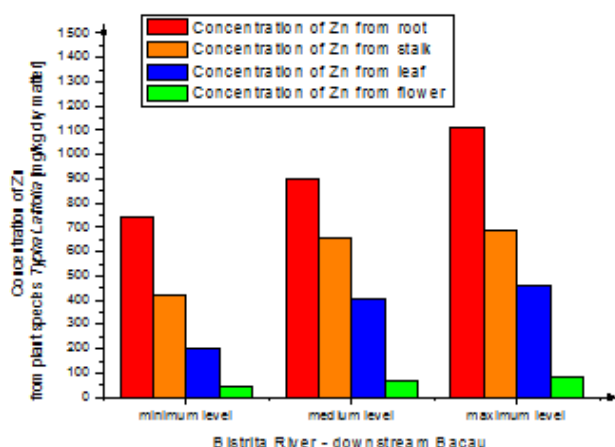


Fig. 7. The absorption capacity of zinc from the soil in the case of *Typha Latifolia* plant species (root, stalk, leaf, flower) in the sampling point Bistrita River - downstream Bacau, downstream of Bacau city

The highest absorption capacity of zinc in the sampling point Bistrita River - downstream Bacau, downstream of Bacau city, was detected in the root of *Typha Latifolia* plant species, and the lowest absorption capacity of cadmium was observed in the flower.

The percentage values of the zinc concentration determined in the stem, leaf and flower compared with the root of the *Typha Latifolia* plant species for the sampling

point Bistrita River - downstream Bacau, downstream of Bacau, was:

- *Steam* (for the minimum level of soil-water interface, it was 42.99 % lower than in the root of plant; for the medium level of soil-water interface, it was 26.91 % lower than in the root of plant; for the maximum level of soil-water interface, it was 37.86 % lower than in the root of plant);

- *Leaf* (for the minimum level of soil-water interface, it was 72.84 % lower than in the root of plant; for the medium level of soil-water interface, it was 55.23 % lower than in the root of plant; for the maximum level of soil-water interface, it was 58.65 % lower than in the root of plant);

- *Flower* (for the minimum level of soil-water interface, it was 94.07 % lower than in the root of plant; for the medium level of soil-water interface, it was 92.29 % lower than in the root of plant; for the maximum level of soil-water interface, it was 92.64 % lower than in the root of plant).

Conclusions

The studies conducted in the urban residential area of Bacau show that upstream of Bacau city there is no significant presence of heavy metals in the soil but important loads can be detected on the Bistrita River, downstream of Bacau city. These loads result from the industrial platform of Bacau city and from the discharge of municipal wastewater produced throughout the ages.

In relation this aspect, significant loading rates for cadmium, and zinc were identified both in the soil and in *Typha Latifolia* plant species.

The values of the concentration of cadmium detected in the flower of *Typha Latifolia* in the sampling points Bistrita River - Bogdan-Voda, upstream of Bacau city and in Bistrita River - downstream Bacau, downstream of Bacau city were 84.73 % ÷ 96.4 % lower than in its roots.

The values of the concentration of zinc detected in the flower of *Typha Latifolia* in the sampling points Bistrita River - Bogdan-Voda, upstream of Bacau city and in Bistrita River - downstream Bacau, downstream of Bacau city were 89.98 % ÷ 94.07 % lower than in its roots.

Comparing the absorption capacity of heavy metals from the soil in the case of *Typha Latifolia* plant species it was observed that it is a very good accumulator of cadmium and zinc in the root of the plant.

Typha Latifolia plant species proved to be a very good accumulators of heavy metals, especially in their roots, a fact which shows that they can be used in soil phyto-remediation processes, particularly in phyto-extraction and phyto-stabilisation processes for the removal of heavy metals from contaminated soils.

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