Use of invasive herbaceous plants for biomonitoring pollution with toxic metals

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INTRODUCTION

Pollution with metals is a global environmental challenge, due to their potential toxicity, persistence and non-biodegradability. Invasive herbaceous plants are good bioindicators of soil pollution with metals, considering its high ability to adapt to scarce environments with low nutrient and high metal content.

The objective of the study was to assess the suitability of invasive herbaceous plants to be used for biomonitoring of soil pollution with toxic metals.

MATERIALS AND METHODS

Soil samples (3 g) were digested with 28 ml *aqua regia* (7 ml of 65% HNO_3 and 21 ml of 37% HCl) on a sand bath for at least 2 h and diluted to 100 ml with ultrapure water.

Plant samples (0.5 g) were digested with 2 ml 30% H_2O_2 and 5 ml 65% HNO_3 in a closed PTFE vessels using a microwave digestion system.

The metal contents (Cd, Cr, Cu, Ni, Pb and Zn) in soils were determined by inductively coupled plasma optical emission spectrometry using an 5300 Optima DV (Perkin Elmer, US) spectrometer, while in plant samples by inductively coupled plasma mass spectrometry using an Elan DRC II (Perkin Elmer, US) spectrometer.

RESULTS AND DISCUSSIONS

With few exceptions, the concentrations of Cu, Zn, Cr and Ni in soils (Table 1) were lower than the alert thresholds (AT) for sensitive soil uses set by the Romanian legislation (Order 756/1997). In case of Pb, the alert threshold was exceeded in 2 soil samples. On this two soil samples the presence of dandelion specimens were observed. The alert threshold for Cd was exceeded in 3 soil samples. On this soil samples all three studied plant species were present.

Table 1. Concentration (mg/kg) of metals in soil

Concentration	Cu	Pb	Zn	Cd	Cr	Ni
Min.	13.7	15.9	51.1	1.3	18.9	22.2
Max.	93.6	76.6	298	3.3	71.0	74.9
Average	36.7	32.4	104	2.4	42.5	43.6
AT	100	50	300	3	100	45

CONCLUSIONS

The findings suggest that dandelion, ryegrass and coltsfoot tolerate concentrations above the alert level and have mechanisms that exclude the uptake of toxic metals as well as high levels of essential metals.

SAMPLING

Coltsfoot, perennial ryegrass and dandelion leaves together with the adjacent soil were sampled from an urban (Cluj-Napoca) area.

Coltsfoot (*Tussilago farfara L*)

Perennial ryegrass (*Lolium perenne*)

Dandelion (*Taraxacum officinale*)

The soil samples were air dried, grinded and sieved to pass 250 µm mesh sieves. The leaves were washed in ultrapure water, oven dried at 105±5°C and powdered.

RESULTS AND DISCUSSIONS

The concentration of metals in plants varied from element to element and species to species (Figure 1). Generally, the average concentration of metals was comparable in dandelion and coltsfoot and much lower in ryegrass.

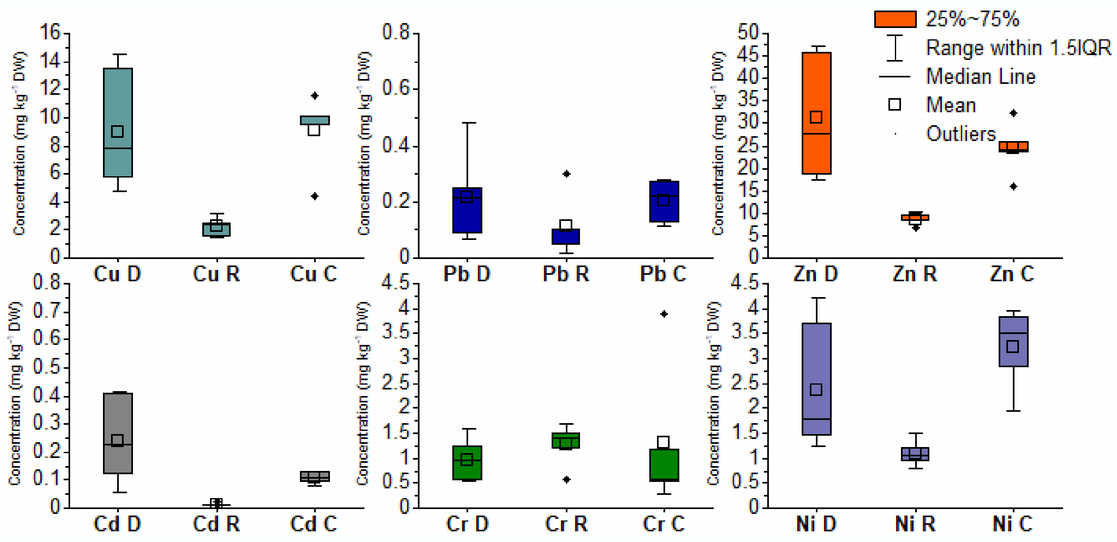

Figure 1. Concentration of metals in dandelion (D), Ryegrass (R) and coltsfoot (C)

The soil to plant transfer factors (TFs) were below 0.7 for all metals and all plant species, indicating that the studied plats exclude the metals from the uptake (Figure 2). The highest TFs scores were observed for Cu and Zn, elements that in low concentrations are essential for the plants growth.

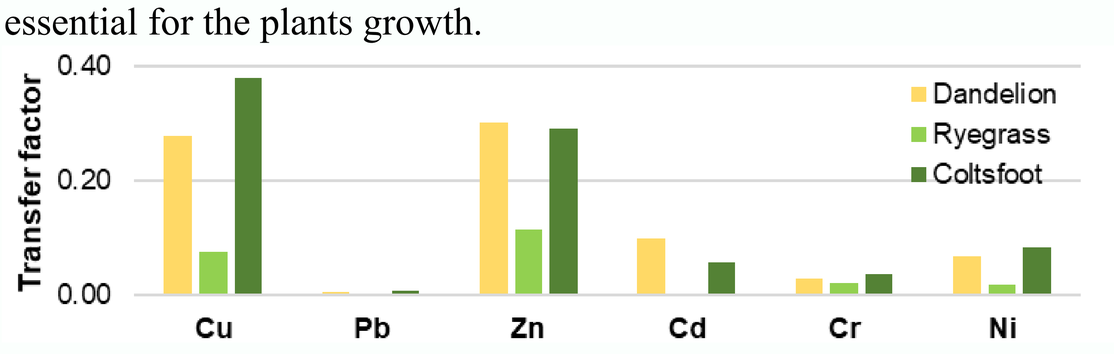

Figure 2. Soil to plant Transfer factor of metals

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