

STUDY OF HEAVY METALS ACCUMULATION INDEX IN PLANTS USED IN POLLUTED SOILS PHYTOREMEDIATION PROCESS

STUDIUL COEFICIENTULUI DE ACUMULARE A METALELOR GRELE ÎN PLANTELE UTILIZATE ÎN PROCESUL DE FITOREMEDIERE A SOLURILOR POLUATE

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*The mine tailings have a high content in heavy metals, especially Zn, Cu, Mn, Pb, Ni, Cr and others. In phytoremediation activities of mine tailings dumps were used plant species with high capacity to adapt to the physical-chemical properties of this inorganic waste. During the vegetation period, on any soil type, the cultivated plant species extract and accumulate high amounts of heavy metals in roots and terrestrial parts. Metal translocation rate from soil and accumulation in tissues is dependent to metal species biodisponibility capacity from soil organic-mineral structures in correlation with a series of factors like: pH, ionic change capacity, temperature, water retention a.o. Through this experiment was studied the metals amount of accumulation in plants, in roots and also in terrestrial parts. So, in case of *Medicago sativa* and *Festuca arundinacea*, using the Zn, Cu and Mn uptake coefficient was analyzed the rate of translocation in order to monitor the accumulations dynamic. It turned out that *Medicago sativa* plants registered a higher uptake coefficient value on Cu and Mn. *Festuca arundinacea* plants have a higher rate of accumulation in case of Zn. Also, in case of mine tailings polluted soils, the Zn, Cu and Mn translocation degree is higher and in case of soils polluted with mine tailings and with biosolids addition is lower.*

Key words: mine tailings, uptake coefficient, translocation degree, heavy metals

Introduction

Sandy wastes from mining exploitations contain variable amounts of metal in form of low soluble or insoluble species, smooth or rough particles. Starting and maintaining grassy plants adapted for this terrain allow becoming overgrown with grass the arid and semiarid areas. [2, 3, 5]

Plants metabolically activity include through some plant exudates, the absorbance processes in rhizosphere area. Using this equipment, the plants can biodisposition the metals bounded to sterile inorganic matter or even organic

colloids. On other side, it is known the organic matter capacity to form stable compounds, metals hard soluble or insoluble like humic acids, or more soluble like fulvic acids that become more or less available for plants. [1, 2, 3, 5]

U.S. Environmental Protection Agency (USEPA) inlaid an uptake coefficient of metals from soil by plants, noted with UC (uptake coefficient).

This coefficient is calculated using the formula:

$$UC = \frac{Q_A}{Q_T} \times 100, \text{ in which:}$$

UC = uptake coefficient (%)

Q_A = metals amount accumulated in terrestrial part (mg/kg DS)

$Q_T = Q_A + Q_R$

Q_R = metals amount accumulated in roots (mg/kg SU). [4]

The aim of the paper was to calculate the Zn, Cu and Mn uptake coefficient in case of *Medicago sativa* and *Festuca arundinaceea*, two forage plants, cultivated on soils mix with mine tailings and biosolids.

Materials and Methods

On experimental field of Ecology and Biotechnologies of waste products recycling from Faculty of Animal Sciences and Biotechnologies Timisoara, was organized a experimental block in eight parcels, four of them for each experimental plant species. The surface of experimental parcel was 3m². The four parcels were differentiated as follow:

- M – the blank variant – natural plain soil in type of unpolluted levigate chernozem,
- V₁ – soil polluted with mine tailings in amount of 200 to/ha, waste mine-soil in ratio of 2,5:1,
- V₂ – unpolluted soil treated with biosolids in amount of 40 to/ha,
- V₃ – soil polluted with mine tailings in amount of 200 to/ha and treated with biosolids in amount of 40 to/ha.

Terrain preparing and seeding was done in 16-19 of March 2007 period, and the biomass was cropping in the last decade of September.

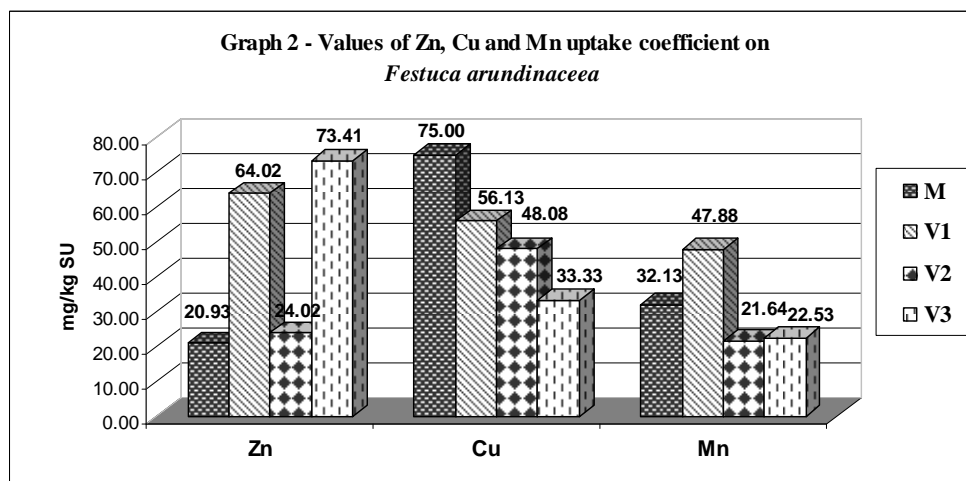
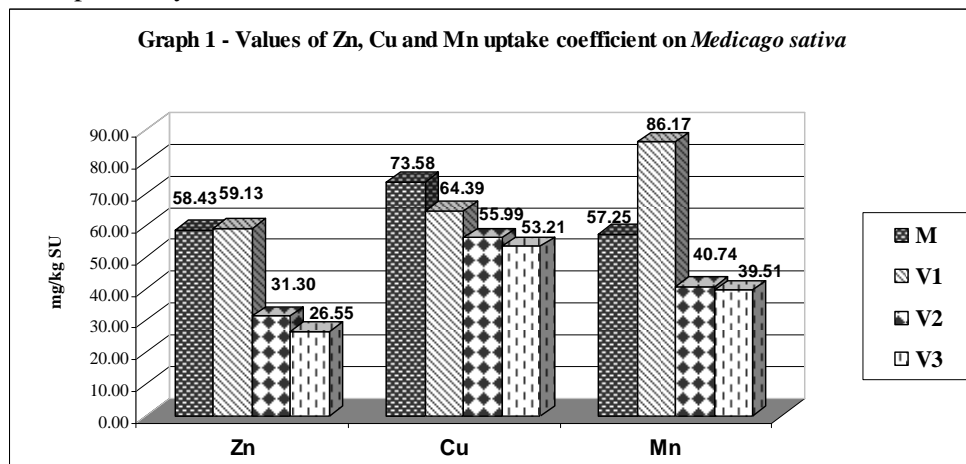
Chemical analyzes were done recording to the laws in force. For metals analyzes was used a Varian Spectra AAS spectrophotometer with atomic absorption.

Results and Discussions

Zn, Cu and Mn uptake coefficient (UC) values in case of *Medicago sativa* and *Festuca arundinaceea* plants are presented in graphs 1 and 2.

It turns out that in case of V₁ experimental variant with a 2.5:1 ratio for mine tailings-soil, the *Medicago sativa* specie registered at the end of vegetation period the highest rate of Mn accumulation (86.17 mg), followed by those of Cu

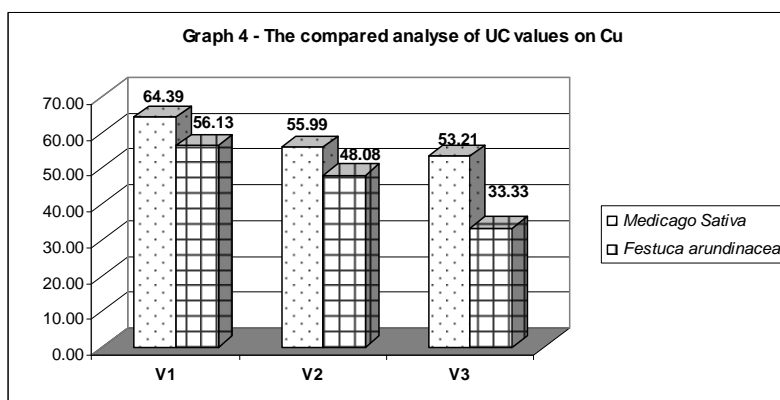
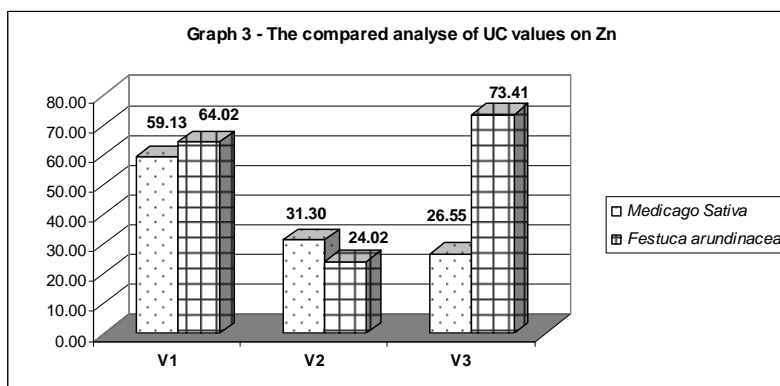
and Zn. The addition of 40 to/ha biosolids on the unpolluted soil (V_2) or on mine tailings polluted soil in ratio of 2.5:1 (V_3) has equally increased the uptake coefficient for the three metals. Results that for alfalfa the Zn, Cu and Mn biodisponibility is reduced, favorable to nutritive substances from biosolids.



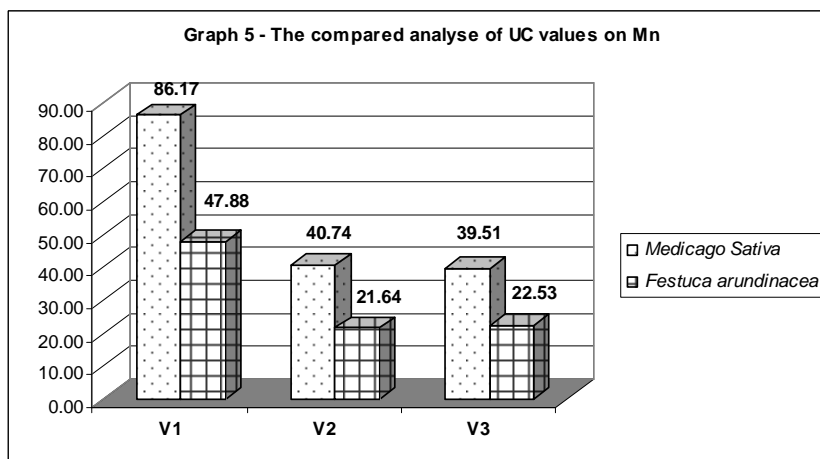
Also, the *Festuca arundinaceea* plants have a high uptake coefficient of all metals in case of V_1 and of Zn in case of V_3 . In case of Cu and Mn the uptake coefficient is increased from V_2 to V_3 , equally to alfalfa.

The comparative study of the uptake coefficient is presented in graphs 3, 4 and 5.

So, in case of Zn from mine tailings polluted and biosolids addition soils, the tall fescue plants registered a higher uptake coefficient compared to alfalfa plants.



In case of Cu and Mn, the alfalfa plants have an obvious higher translocation degree. The translocation differences between the two species are more obvious in case of Mn, which is accumulated in the terrestrial parts of the plants twice then in case of alfalfa.



Conclusions

1. On both plant species, the Zn, Cu and Mn translocation degree is higher in case of mine tailings polluted soils and lower in the case of biosolids addition.
2. Any soil type, the *Medicago sativa* plants record an uptake coefficient higher of Cu and Mn, and the *Festuca arundinacea* plants in case of Zn.

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