COPPER ACCUMULATION FROM TAILING REVEGETATION WITH GLASSLAND

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ABSTRACT

The phenomenon which take place in the phytoremediation processe of soils polluted with heavy metals is very difficult to be understood, due to complexity of dynamics in rizosphere zone. An important parameter for analysis of metal quantity accumulated in plant tissue is the bioconcentration factor (BCF) and is calculated either for a part of the plant, or for the whole plant using the formula: $BCF_{soil\ -plant} = Q_M / Q_S$, (quantity of metal accumulated in plant, mg/kg d.m. ratio to total concentration of metal from soil mg/kg d.m.). Correlating the metal concentration from soil/plant with BCF shows that the studied plants have affinity for metals in the following order Zn>Mn>Cu. On the other hand, plants demonstrate tolerance to Fe presence of 50-60 mg/kg d.m. Its accumulation is restricted through a mechanism specific to plants on values of 10^2 times lower then the quantity in the soil. By using of volcanic tuff as amendments, level of metals accumulation in plants is changed.

INTRODUCTION

A part of ions associated with roots are taken in plant cells. One part of ions are adsorbed in plants, in negative extracelular charged points (e.g., in points where there are functional groups like COO^-) from the cell wall of root. These can not be translocated in aerial parts, so they can not be by harvested as biomass. Metals uptake by plants is the most important stage in phytoextraction /1/ and can be followed through specific factors like bioconcentration factor /2-4/.

MATERIALS and METHODS

Used methods are presented in the other paper [5]. Sampling of soil and of plant tissue and their preparation for analysis was made after recognized standards. Metals analysis from water solution was realized by using of AAS spectrophotometry, with an Varian type instrument.

Adding volcanic tuff is aimed to retain water in the leachy structure and her liberation during the dryness period.

The parameter analyzed in the study was the bioconcentration factor noted with BCF that represent the metal quantity that can be transferred from soil in plant and is calculating either for a part of plant, either for total plant, using the formula:

$$BCF_{soil\text{-}plant} = Q_M / Q_S$$

where: Q_M – concentration of metal accumulated in plant mg/kg d.m., Q_S - total concentration of metal accumulate from soil, mg/kg d.m. /2-4/

RESULTS

Metals content from the experimental soil is showed in table 1. Copper concentrations ranged between 1115.0 -1637.2 mg/kg d.m., and those of zinc and manganese between 660.8-815 mg/kg d.m. The content of iron from waste minig deposit is great, 50-60 g Fe/Kg.d.m.
By analysis of aerial tissue of plants from experimental, table 2, it was revealed that some species accumulated a greater concentration of metals than others. Copper concentration can reach up to 66 mg/kg d.m. in *Valesiaca sp* and *Filipendula sp.* Iron was accumulated in greater concentrations, 190 - 538 mg/kg d.m.. Zinc and manganese concentrations do not cause a danger for ecosystem equilibrium from zone. It may be observed that *Festuca arundinaceea and Lotus corniculatus* are resistent to both parcel pollution and hydroclimatic conditions; they accumulated smallest concentrations of copper, 20-30 mg/kg d.m.., and iron 300-400 mg Fe/kg d.m.
From table 2, it may be observed that addition of supported volcanic tuff, allows a decreasing of Cu and Mn accumulation with 30-40%, comparatively with concentrations accumulated in plants harvested control.

Table 1. Total metals content from the experimental soil

Experimental parcels	**Metal content mg/kg d.m.**			
	Cu	**Mn**	**Fe**	**Zn**
Control lot	1637.2	708.6	60832.0	660.8
Treated with indigenous volcanic tuff 0.6 kg/m^2 lot	1115.0	717.3	50434.4	676.8
Treated with indigenous pillared tuff added as aqueous suspension 0.6 kg/m^2 lot	1246.9	797.8	53467.8	815.0

In table 3 are presented the calculating value of bioconcentration factor. The study of metals bioconcentration factor from soil in terrestrial part demonstrate that in the terrestrial part the lowest transfer factors are observed on *Festuca arundinaceea* and *Lotus caniculatus* species in case of the lots amended with pillared volcanic tuff or untreated lots. Generally, invading weeds seems that present a adequate system of adaptation and uptake of cooper up to 2 times greater then the sowed plants. Mn and Zn have a bioconcentration factor higher then Cu. The bioconcentration factor is situated in domain of 5-11 for Zn (average BCF=7.8) 1.7-8.0 for Mn (average BCF= 4.4), 1.8-5.9 for Cu (average BCF = 2.9), 0.3-0.7 for Fe (average BCF = 0.5). The decrease of BCF shows that the quantity of mobile metal bioavailable in soil for plant is decreasing. Changing BCF depended on the amendments added with the purpose of immobilization of metals.

Table. 2. Metals concentrations from aerial parts of plants cultivated on experimental lots.

Experimental parcels	Plant species	Metals content in aerial parts. mg/kg d.m.			
		Cu	Mn	Fe	Zn
Control	*Festuca arundinaceea*	20.60	17.58	297.53	41.48
	Lotus corniculatus	29.0	16.7	398.26	76.16
	Salvia pratensis	39.14	11.99	273.3	36.4
	Capsulla bursa-pastoris	36.75	34.18	538.46	72.64
	Filipendula Sp	42.58	39.40	192.7	44.16
	Sinapis arvensis	62.67	33.7	322.9	52.2
Lot with sterile amended with grinded indigenous volcanic tuff 0,6 kg/m^2	*Festuca arundinaceea*	28.60	19.8	277.44	61.50
	Lotus corniculatus	28.4	17.7	368.26	56.16
	Medicago lupulina	28.2	12.75	282.1	47.96
	Salvia pratensis	57.2	58.1	307.2	52.0
	Filipendula Sp	26.76	50.0	-	50.96
	Sinapis arvensis	37.21	19.7	274.89	43.12
	Valesiaca Sp	66.01	56.55	369.47	52.85
Lot with sterile amended with pillared indigenous volcanic tuff added as aqueous suspension 0,6 kg/m^2	*Festuca arundinaceea*	21.60	13.58	280.3	40.7
	Lotus corniculatus	20.54	10.27	397.26	56.16
	Salvia pratensis	19.52	23.97	342.46	66.1
	Filipendula Sp	66.17	65.2	500.0	73.53
	Sinapis arvensis	57.22	33.13	299.4	69.3
	Rucoina Sp	30.31	24.7	266.77	44.5
Domain		20-66	10-65	190-538	40-73

The bioconcentration factor is situated in domain of 5-11 for Zn (average BCF =7.8 ,) 1,7-8,0 for Mn (average BCF = 4,4), 1,8-5,9 for Cu (average BCF = 2,9), 0,3-0,7 for Fe (average BCF = 0,5). The decrease of bioconcentration show that the quantity of mobile metal biodisponibil in soil for plant is decreasing. Changing BCF in made in function of added amendments with the purpose of immobilization of metals, plant characteristics.

CONCLUSIONS

Waste minig deposit covered with vegetal soil, presents high concentrations of Cu and Fe. Mean values for transfer factor of metal were: copper, 2.9 X10^{-2}; manganese 4.4 X10^{-2}; and zinc 7.8 X10^{-2}. Concentrations of accumulated metals were 10^2 –10^3 times smaller than that present in waste minig deposit, uncovered or covered with vegetal soil.

By correlating of metals concentations from soil/plant with transfer factor, it was revealed that plants had affinity for metals in the following order: Zn>Mn>Cu. All analysed plants tolerated high iron concentrations, but its accumulation is limited through plants specific mechanisms, up to 10^2 times smaller than concentration from soil. Adding of amendaments reduced metals accumulation degree, especially in cultivated plants.

Table. 3. Values of bioconcentration factor of metals from soil into aerial part

Experimental parcels	Plant species	Bioconcentration factor $BCF_{soil\text{-}aerialpart}$ $X10^{-2}$			
		Cu	Mn	Fe	Zn
Control	*Festuca arundinaceea*	1.8	2.4	0.5	6.2
	Lotus caniculatus	1.7	2.3	0.6	11.0
	Salvia protensis	2.4	1.7	0.4	5.8
	Capsulla bursa-pastoris	2.2	4.8	-	10.1
	Filipendulas Sp	2.6	5.5	0.3	6.7
	Sinapis arvensis	3.8	4.7	0.5	7.8
Lot with sterile amended with grinded indigenous volcanic tuff 0,6 kg/m^2	*Festuca arundinaceea*	2.5	2.7	0.6	9.0
	Lotus caniculatus	2.5	2.4	0.7	8.7
	Medicago lupulina	2.5	2.7	0.6	7.0
	Salvia protensis	5.0	8.0	0.6	7.6
	Filipendulas Sp	2.3	6.4	0.4	7.5
	Sinapis arvensis	3.3	2.7	0.5	6.3
	Valesiaca Sp	5.9	7.9	0.7	7.5
Lot with sterile amended with pillared indigenous volcanic tuff aqueous suspension 0,6 kg/m^2	*Festuca arundinaceea*	1.6	4.7	0.5	5.0
	Lotus caniculatus	1.7	1.3	0.7	7.0
	Salvia protetis	1.5	3.0	0.6	8.2
	Filipendulas Sp	5.3	61	-	6.9
	Sinapis arvensis	4.4	4.0	0.6	8.6
	Rucoina Sp	2.4	3.1	0.5	5.6

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