TRANSLOCATION FACTOR OF METALS FROM SOILS POLLUTED WITH CADMIUM AND ZINC IN BARLEY CROP.

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ABSTRACT

Translocation factors characterize how metal have access in different tissue part of the plant. They vary in function of metal nature, concentration in soil and plant particularities. Organic matter adding aimed to fertilize entail the increase of translocation factor value of metals present in soil to terrestrial parts, decreasing the reserves from root. The mixture of organic matter in type of biosolids and pillared indigenous volcanic tuff aqueous suspension, had entailed the decrease of translocation factor TF (ratio between metal quantity from a part of tissue and total quantity of metal in plant). Cd, Zn and Pb translocation factor from root to terrestrial parts is reduced with 70-92% related to unfertilize and non amended polluted soil.

INTRODUCTION

Plants develop in limits of some mechanisms through which they extract metals from soil solution and transport it inside plant. Pursuant to understanding this mechanisms is enough to explain what happens to a low level of metal in soil or opposite to an excess accumulation in plants tissue. Metals uptake mechanism in plant root is a complex process that involves metals transfer from soil solution to root surface and then, their entrance in root cells. In general, metals bioavailabill fraction from soil is the one of free ions of metal from soil. In function of soil solution nature, the plant can develop a strategy that minimizes the potential of metals uptake in tissue. Plants have the capacity to influence solubility and metals species concentration from rizosphere through rizosphere exudates and through pH change from limitrophe area /1-3/.

The present study aim the evaluation of metal bioaccumulation degree in straw and grain parts compared to total quantity uptaked from soil through translocation factor TF. TF in straw is calculating after the next formula:

$$TF = (Q_M./ Q_T)x\ 100\%.$$

Where:

Q_M – metal quantity accumulated in tissue part (straw, or grains, or roots) of the plant mg/kg s.u.

Q_T - metal quantity accumulated in plant $Q_T = Q_S + Q_G + Q_R$ mg/kg s.u.

Q_S – metal quantity accumulated in straw mg/kg s.u.,

Q_G – metal quantity accumulated in straw mg/kg s.u.,

Q_R - metal quantity accumulated in root mg/kg s.u. /4-5/

MATERIALS and METHODS

The study was carried out on parcel in surface of 10 m^2/lot. The parcels was prepared and sowed in 2007 September-October period. Was studied 4 parcels variants: soil polluted with heavy metals, polluted soil and treated with pillared indigenous volcanic tuff aqueous suspension, (pillared indigenous volcanic tuff patent), polluted soil fertilized with biosolids (municipal sludge) and polluted soil fertilized with biosolids mixed with pillared volcanic tuff aqueous suspension,. The quantity added on the experimental parcel was of 5 to/ha represented by sludge adding with 5% d.s. on a thickness of 1-1.5 cm. The sludge was from Timisoara wastewater treatment unit, part fermented, black, with 95% humidity.
The amendment adding of pillared volcanic tuff (prepared in laboratories of INCD ECOIND Timişoara) was done as aqueous solution. In quantity of 2 to/ha d.s. Experimental lots polluted, fertilized and amended was ploughed and leaved for biogeochemical stabilization for 30 days in the period of 10 of September – 10 of October. The seed was in concordance with demanded quality indicators, with a purity of 90% and a 90% germination. Previously, the seed was treated against diseases and pests.

Sowing density was 400-500 germinated seed/mp. Distance between line was 12.5 cm and depth was of 3.5 cm. was sowed 160 to seed/ha. The plants enter the winter deep-rooted and the culture resist to frostiness of -14^{0}C. The agrarian practices done for the barley crop was the usual ones. During barley crop, winter of 2007, spring and summer of 2008 was periodically followed the conditions of barley crop Analysis of plant metal accumulation in the aerial parts of the plants (stem, leaves, grains) and roots parts was done on dried plants. Plant sampling was done according to the methodology described in STAS 9597/1-74, and the sample analysis was done according to STAS 9597/17-86.

Plant extracts analysis was done using a spectrophotometer with atomic absorption, Varian Spectra AAS.

RESULTS

In table 1 is presented total quantity of metal accumulated in tissue of *Hordeum vulgare* specie in the final development phase of the plant.

Table 1. Total quantity of metal from plant tissue q_t

Parcel	Total quantity of metal Q_T mg/kg d.m.		
	Cd	Pb	Zn
Control	5,0	14,3	184,6
Polluted	52,9	103,1	118,0
Polluted, amended with pillared volcanic tuff	57,7	45,8	231,9
Polluted, fertilized with biosolids	20,4	45,0	147,7
Polluted, fertilized with biosolids, amended with pillared volcanic tuff	14,5	8,2	33,8

In table 2 is presented the translocation factor of metals in different parts of plant in ripening phase.

Table 2. Translocation factor of metals in different parts of barley

Parcel	Translocation factor		
	Cd	Pb	Zn
TF straw			
Control	2	13,0	3,0
Polluted	-	7,2	11
Polluted, amended with pillared volcanic tuff	0,8	9,0	12
Polluted, fertilized with biosolids	4	64	14
Polluted, fertilized with biosolids, amended with pillared volcanic tuff	1,4	44	32
TF grain			
Control	2,0	2,0	14
Polluted	-	2,0	11
Polluted, amended with pillared volcanic tuff	0,9	5,0	14
Polluted, fertilized with biosolids	3,4	1,1	10
Polluted, fertilized with biosolids, amended with pillared volcanic tuff	1,4	20,0	26
TF roots			
Control	96	85	83
Polluted	94,1	91	78
Polluted, amended with pillared volcanic tuff	98,3	86	74
Polluted, fertilized with biosolids	92,6	24,9	67
Polluted, fertilized with biosolids, amended with pillared volcanic tuff	97,2	36,0	42

From table 1 result that soil fertilize with biosolids and Tuf – Al_n entail the decrease with 70-92% of Cd, Pb and Zn accumulated quantity in total tissue of the plant compared to the plants cultivated on the others variants of soil. It can be observe in table 2 that adding pillared tuff or mixture of pillared tuff with fertilizer have had as consequence the decrease of translocation factor for Cd in aerial parts of plants, in the domain of 0.8-0.9 in absence of fertilizer and to TF = 1.4 in presence of fertilizer. Adding amendments based on pillared tuff lead to decrease of mobile ions quantity from soil, respectively their biodisponibility.

Biosolids adding entail cadmium solubilization through forming of soluble complexes that are translocated from roots to terrestrial parts. Especially in straw, translocation factor is increasing with 44-64%. In grains, the effect is lower, increasing only with 20%. A similar situation is observed for zinc translocation in case of biosolids adding in heavy metals polluted soils.

In case of lead, adding biosolids and pillared tuff entail the lowest total metal accumulation from grain.

CONCLUSIONS

- Adding organic matter biosolids have had as effect the metals solubilization in plants sap and translocation from root to terrestrial parts. Translocation is made preference in straw for Pb and Zn.
- Adding pillared volcanic tuff maintain the translocation factor low so in absence of organic fertilizer, biosolids, insofar in his presence, especially for access of Cd ion.
- Translocation factor depend of pollutant concentration and nature, soil characteristics and plant characteristics,

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