LEAD PHYTOEXTRACTION. EXPERIMENTS IN GREENHOUSE

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Abstract: *Soil contamination can destroy the delicate equilibria between physical, chemical and biological processes, which influences soil fertility. The effects of soil contamination with heavy metals are already found in many zones of the entire world. In recent years increase the number of research focusing on the study of soil pollution with heavy metals due to various anthropogenic sources. Phytoremediation by* phytoextraction *is an extraction process and accumulation of contaminants/pollutants in plant tissues considered hiperaccumulators, including roots and aerial part.* This paper presents experiments in Greenhouse to establish *the effect that it has lead and treatment with EDTA (*ethylene *diamine acetic acid*) *on the capacity of lead translocation in* maize *plants.* There are *presented two cycles of vegetation on a Cambic chernozem soil polluted with two concentrations of Pb (*1000 mg Pb·kg^{-1}, 2000 mg Pb·kg^{-1}) and *different contents of EDTA. Treatment with EDTA on a chernozem* loaded *with 1000 mg Pb/kg soil (experiment I) did not affect plant growth and soil reaction in a molar ratio EDTA/Pb between 0.2 and 0.3. Lower concentrations of EDTA are not typical for* phytoextraction and *higher concentrations had negative effects on plants. Treatment with EDTA on a chernozem* loaded *with 2000 mg Pb/kg soil (experiment II*) *did not affect plant growth and soil reaction molar ratio of EDTA/Pb = 0.1. Higher concentrations of EDTA had negative affects plants and high soil acidification after cycle after cycle II. EDTA capacity to increase the lead solubility in soil (chernozem) in the phytoextraction process without negative effects on maize, can be implemented as a practical solution only low and moderate polluted soils with lead (total lead concentration <1000 mg Pb/kg) EDTA can be applied every two years in a concentration expressed in molar ratio EDTA/Lead between 0.2 and 0.3. Phytoextraction method is not suitable for soils heavily polluted with lead, with a total lead content >1100 mg Pb/kg.*

Key words: *soil pollution, lead, phytoextraction, Green House experiment.*

INTRODUCTION

Phytoextraction is a removal method of heavy metals from soil using direct absorption in plant tissues. The implementation of a phytoextraction program involves the cultivation of one or more plant species that are hiperaccumulator contaminants. Specific conditions for the application of the phytoextraction program in the case of a special polluted area is related with the fertilization, the vegetation period, pollution degree; these can be established by preliminary tests. Some techniques for the extraction of heavy metals in soils contaminated / polluted involve the use of chelating agents, the agents studied for their ability to mobilize metals and increase their accumulation in different plant species can be mentioned: EDTA, CDTA, DTPA, NTA, and others (EPA Project/600/SR-94/006, 1994, HUANG et al., 1997).

MATERIAL AND METHODS

The experiments have consisted in achieving two experimental series performed in Greenhouse to verify the reproducibility of parameters determined previously on selected plant and the conclusions of the preliminary laboratory tests.

Experiments were achieved in Mitscherlich pots with a 10 liters capacity, the same soil was used in the preliminary laboratory tests (cambic chernozem) and the plant used was also maize.

Experiments were achieved in two cycles:

Cycle I – represented the first stage consisting in the administration of treatment with Pb and EDTA on two concentrations levels1000 mg $Pb{\cdot}kg^{-1}$, 2000 mg $Pb{\cdot}kg^{-1}$, in 12 variants (V1-V12), in 3 repetitions and different EDTA/Pb ratios.

Cycle II – represented the stage to study the residual effect on the same plant and test conditions and variants set after the conclusion of Cycle I.

The vegetation period was 8 weeks in each of the two cycles, no phytosanitary treatments were applied plant or mineral or organic fertilizers.

After was effectuated the analysis of variance (Tukey test, Fisher test), statistical data showed a different evolution of these parameters according to treatment.

RESULTS AND DISCUSSIONS

Experiment I (Cycle I) - soil treated with 1000 mg $Pb{\cdot}kg^{-1}$, and different content of EDTA (molar ratio (0 and 0.5).

Experiment I (Cycle II) - soil treated with 1000 mg $Pb{\cdot}kg^{-1}$, and different content of EDTA (molar ratio (0 and 0.5) - remanent effect.

Figures 1, 2 and 3 show simultaneously the harvest I (Cycle I) and harvest II (Cycle II) - the fund remaining, the three indicators to measure plant parameters as leaf weight, plant height and Lead content in leaf experiment on a fund by 1000 mg $Pb{\cdot}kg^{-1}$ and different concentrations of EDTA.

The evolution of leaf weight, plant height and Pb content in leaf, can concluded that only up to variant V4 $\left(\frac{\text{Ligand}}{\text{Lead}} = 0.2\right)$ not recorded a significant decrease in biomass, ligand does not react negatively from this point of view though the lead concentration increased significantly.

There are considered as efficient treatment for phytoextraction in condition of lead concentration by 1000 mg Pb / kg soil, V4 $\left(\frac{\text{Ligand}}{\text{Lead}} = 0.2\right)$ and V5$\left(\frac{\text{Ligand}}{\text{Lead}} = 0.3\right)$ variants.

At the concentration of 1000 mg Pb / kg soil, in the 2nd cycle of vegetation, plant height and weight are not affected at concentrations of ligand (EDTA) which originally formed a ratio with lead between 0.2 to 0.5, the phytoextraction effect of the pollutant being significantly to this treatment.

By correlating the evolution of these indicators in the two cycles (series) of vegetation with the evolution of soil reaction at the end of the experiment, could be said that treatment with ligand (EDTA) on a soil loaded with 1000 mg Pb / kg stimulates the accumulation of lead in soil by maize plants without affecting the evolution of plants and soil characteristics of EDTA concentration value to ratio $\frac{\text{Ligand}}{\text{Lead}}$ that vary between 0.2 and 0.3.

Lower ligand concentrations are not specific to phytoextraction process on favorable terms, while higher concentrations has negative effects on plants and their growth is affected in the first cycle of vegetation.

Experiment II (Cycle I) - soil treated with 2000 mg $Pb{\cdot}kg^{-1}$, and different content of EDTA (molar ratio (0 and 0.4).

Experiment II (Cycle II) - soil treated with 2000 mg $Pb{\cdot}kg^{-1}$, and different content of EDTA (molar ratio (0 and 0.4) - remanent effect.

Figures 4, 5 and 6 show simultaneously the harvest I and harvest II corresponding to

Series I and II with the same indicators measured in case of experiment I (Green House) on a fund by 2000 mg Pb·kg^{-1} and different concentrations of EDTA.

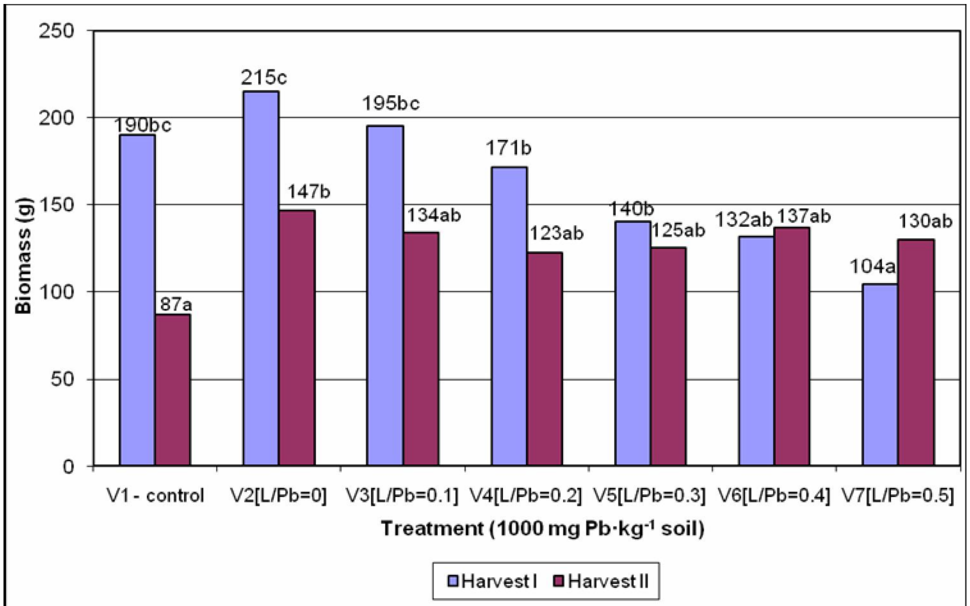

Figure 1: Plant weight related to the treatment (1000 mg Pb·kg^{-1}) in the first and second harvest (remanent effect, Green House)

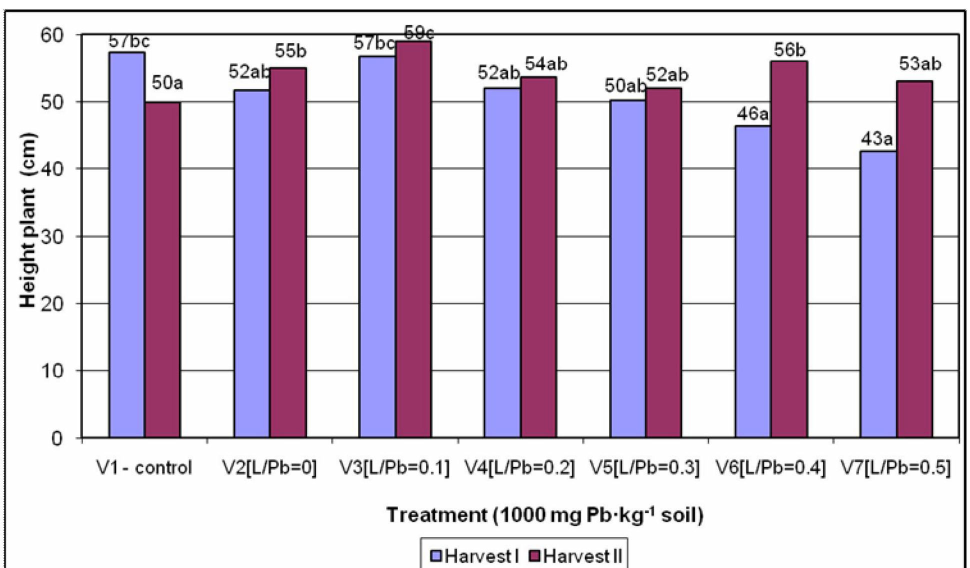

Figure 2: Plant height related to the treatment (1000 mg Pb·kg^{-1}) in the first and second harvest (remanent effect, Green House)

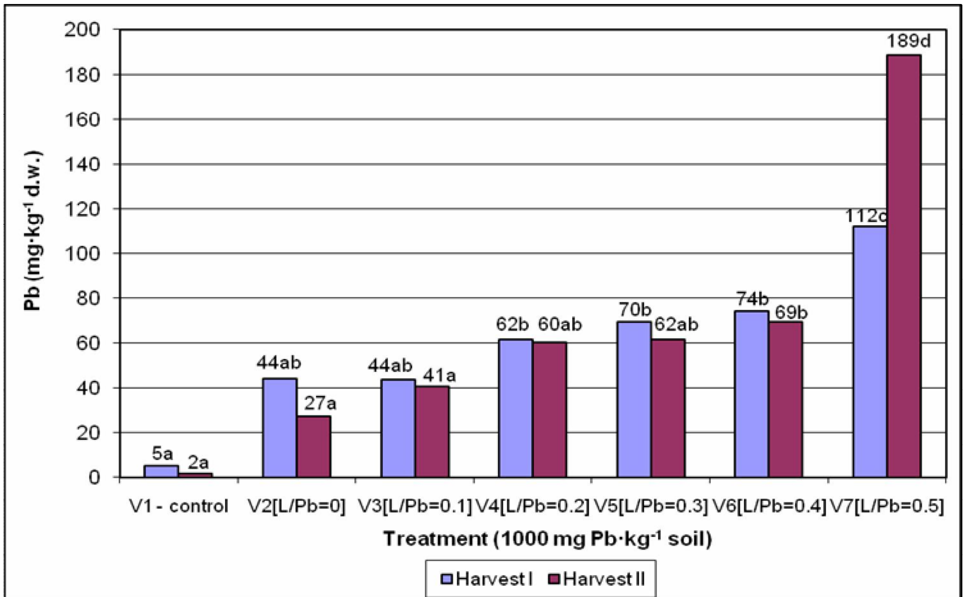

Figure 3: Lead concentration (mg·kg^{-1} dry matter) in maize related to the treatment (1000 mg Pb·kg^{-1}) in the first and second harvest (remanent effect, Green House)

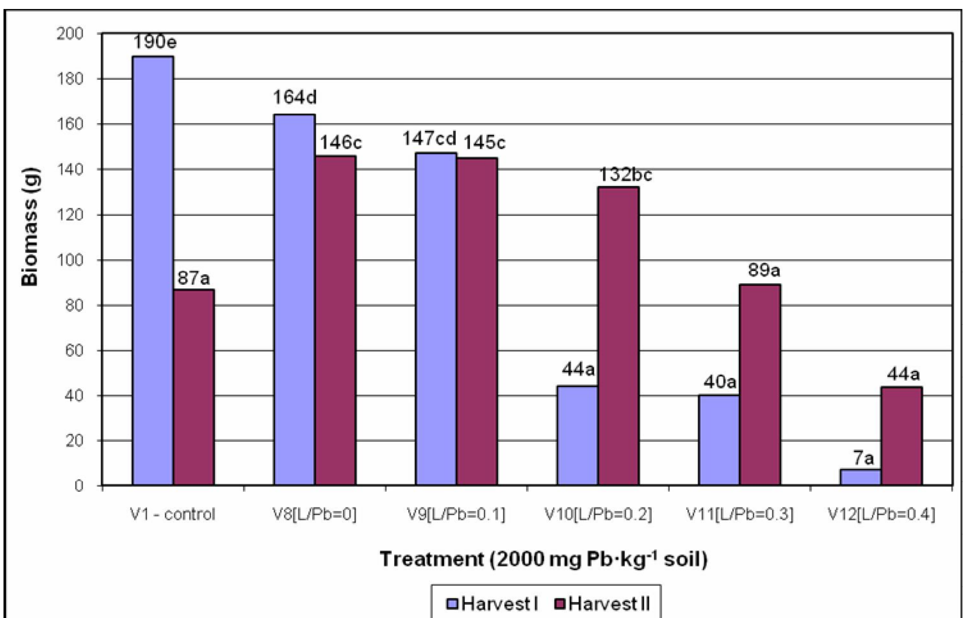

Figure 4: Plant weight related to the treatment (2000 mg Pb·kg^{-1}) in the first and second harvest (remanent effect, Green House)

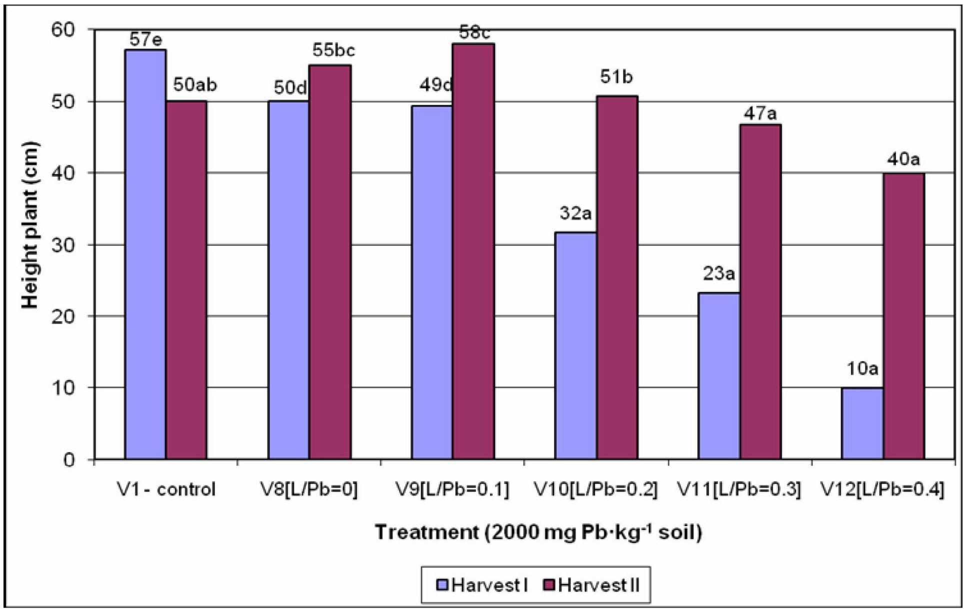

Figure 5: Plant height related to the treatment (2000 mg Pb·kg^{-1}) in the first and second harvest (remanent effect, Green House)

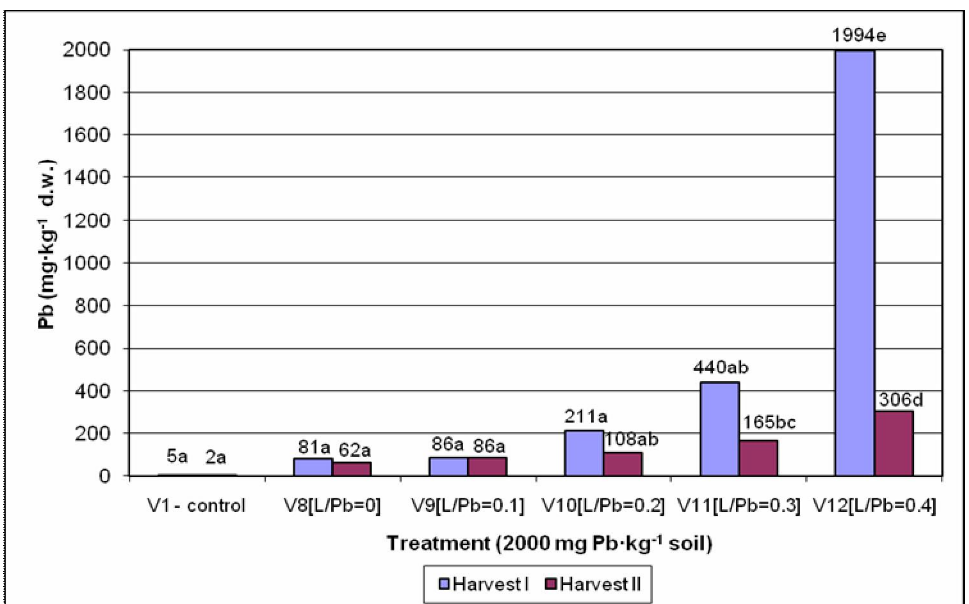

Figure 6: Lead concentration (mg·kg^{-1} dry matter) in maize related to the treatment (1000 mg Pb·kg^{-1}) in the first and second harvest (remanent effect, Green House)

Correlating statistical interpretations of the evolution of plant weight with lead accumulation of in vegetative part can be said that treatment effect the remanent effect of ligand (EDTA) on a soil initially loaded with 2000 mg Pb / kg from phytoextraction point of view appears to V10 $\left(\frac{\text{Ligand}}{\text{Lead}} = 0.2\right)$ and V11 $\left(\frac{\text{Ligand}}{\text{Lead}} = 0.3\right)$ variants.

By correlating the evolution of these indicators in the two cycles of vegetation with the evolution of soil reaction at the end of the experiment, could be said that treatment with ligand (EDTA) on a soil loaded with 2000 mg Pb / kg stimulates the accumulation of lead in soil by maize plants without affecting the evolution of plants and soil characteristics of EDTA concentration value to ratio $\frac{\text{Ligand}}{\text{Lead}}$ by 0.1.

Higher concentrations of ligand have negative effects on plants and soil acidification after the second cycle of vegetation.

CONCLUSIONS

Treatment with EDTA on a chernozem loaded with 1000 mg $Pb \cdot kg^{-1}$ soil (experiment I) did not affect plant growth and soil reaction in a molar ratio EDTA/Pb between 0.2 and 0.3. Lower concentrations of EDTA are not typical for phytoextraction and higher concentrations had negative effects on plants.

Treatment with EDTA on a chernozem loaded with 2000 mg $Pb \cdot kg^{-1}$ soil (experiment II) did not affect plant growth and soil reaction molar ratio of EDTA/Pb = 0.1. Higher concentrations of EDTA had negative affects plants and high soil acidification after cycle after cycle II.

EDTA capacity to increase the lead solubility in soil (chernozem) in the phytoextraction process without negative effects on maize, can be implemented as a practical solution only low and moderate polluted soils with lead (total lead concentration <1000 mg $Pb \cdot kg^{-1}$) EDTA can be applied every two years in a concentration expressed in molar ratio EDTA/Lead between 0.2 and 0.3.

Phytoextraction method is not suitable for soils heavily polluted with lead, with a total lead content > 1100 mg $Pb \cdot kg^{-1}$.

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