Posters
Shawnee A

P51

PHYTOREMDIATION OF LEAD USING SUNFLOWERS AND EDTA

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Lead is rather difficult to separate from polluted soils because it precipitates with most common anions, such as SO42- , PO43- , CO32-, S2-. Current cleanup methods are either too expensive, time-consuming, or devastating to soil properties.

In this research, common sunflowers were grown hydroponically and their potential for uptake and translocation of lead was assessed. EDTA was added to Hoalgand nutrient solution to study its role in lead transport between sunflower tissues. Daily gravimetric transpiration data were also recorded to examine toxicity of lead to sunflowers.

Pre-rooted sunflowers were relocated from soil to 400 ml bioreactors. About 200 ml Hoalgand solution was initially put into each flask. Hoalgand solution was resupplied when about 30 ml was left in the flask. After 7 days of cultivation, sunflowers were weighed and divided into four groups: control (1), lead-added (2), EDTA-added (3), and lead-EDTA-added (4). The concentration of lead was set to about 50 PPM above soil background (a representative soil-water concentration) in order to assess lead toxicity. The ratio of lead to EDTA was 10: 1. After exposure, each sunflower was cut into roots, shoots, and leaves. Samples were treated and measured with recommended method in AA WinlabTM Software by Perkin Elmer 3300.

The uptake efficiency of whole sunflower was calculated with mass balances. Lead uptake varied was from 59% to 78% for the individual sunflowers. There was no significant difference of uptake efficiency between group 2 and group 4 (no EDTA versus added EDTA) which was 67% (stdv.=8%, n = 3) and 74% (stdv.=6%, n = 4), respectively. These results indicate that lead availability in hydroponic solution was not limited and chelation by EDTA may only increase the bioavailability of lead in soil. Soil experiments are currently underway to investigate this possibility.

Although the presence of EDTA did not affect lead uptake, it did significantly influence lead transport between plant tissues. Generally, roots of groups 2 and 4 showed a great ability to retain lead (from 28,000 to 42,000 mg Pb/ kg Dry Weight). This conclusion, that roots accumulate lead, was similar to other reports. The effect of EDTA on lead transport is clear when shoot and leaf concentrations are compared for the two groups. The sunflowers in group 2 showed higher shoot uptake than group 4, 563 (stdv.=286, n = 4) and 232 (stdv.=44, n = 3) mg Pb/ kg DW, respectively.

This trend was reversed with respect to leaf tissues where about 1000 rng Pb/ kg DW (stdv.=207, n = 3) was translocated for group 4 and no lead was detected in leaves of group 2.

During 10 days of exposure, the normalized transpiration (defined as 1 for controls) decreased slightly for group 4. Although no distinct visible symptoms such as chlorosis were noticed for any group, the trend of transpiration decline for group 4 indicated a slight toxicity for the 50 mg/L dosage. Longer toxicity experiments are needed and the ability of sunflowers to complete the life-cycle (go to seed) should be determined since the accumulation of lead in aerial tissues may present larger bioaccumulation issues.

Key words: remediation, sunflower, lead, EDTA

Top of Page

Return to Main Table of Contents
(to see full list of programs and abstracts)

Sub-Menu of Event Programs
(to see specific list of abstracts)

Tuesday, May 20, 1997

Metals Kansa A

Remediation of Munitions Compounds Kansa B

Analytical Methods Kansa C/D

General Topics Kansa B

Wednesday, May 21, 1997

Metals Kansa A

Zero-Valent Metals Kansa A

Remediation Kansa A

Vegetation-based Remediation Kansa B

Partnerships & Innovative Technologies Kansa C/D

Nonaqueous Phase Liquids Kansa C/D

Thursday, May 22, 1997

Biofilms & Barriers Kansa A

Bioremediation Kansa B

Partnerships & Technology Innovations Kansa C/D

Remediation Kansa C/D

Posters