Third National Congress of Recycling and Reuse of Renewable Organic Resources in Agriculture
Islamic Azad University, Khorasgan Branch (Isfahan)
Agricultural Faculty, Waste and Wastewater Research Center
13-15 May 2008

A quantitative approach to predict plant metal content at polluted sites

H. Khodaverdiloo[1] and M. Homaee[2]
1. Assistant Professor, Department of Soil Science, Urmia University, Urmia, Iran
2. Associated Professor, Department of Soil Science, Tarbiat Modares University, Tehran, Iran

Cadmium, due to its high solubility and mobility, is one of the most important heavy metal in terms of its high possibility to enter into human food chain. Therefore, Cd contaminated soils need an effective technique to be remediated. However The objective of this study was to assess the potential of Land Cress and Spinach for Cd phytoextraction with a new quantitative approach. Using the analogy between root water uptakes under drought/salinity stresses, an approach was proposed to establish some macroscopic reduction functions for plant yield and metal uptake under contamination stress. To obtain the necessary data, large quantity of a sandy loam soil was thoroughly mixed with $CdCl_2$ providing a homogeneous concentration of Cd within the soil matrix. The contaminated soils were then carefully packed into the designated pots. Land Cress (*Barbarea verna*) and Spinach (*Spinacia oleracea L.*) seeds were germinated in the pots containing 8 kg of contaminated soil. The concentrations of Cd in the soil and plant samples were determined using flame and graphite furnace atomic absorption spectrometry. Some accepted reduction functions of root water uptake, then, were calibrated to derive their parameter values and also to test their agreement with the experimental data. The least square optimization procedure was used to fit the reduction functions to the observations. Combining plant yield model with those of plant concentration of Cd, a simple model was derived to predict the total Cd uptake by each crop of Land Cress and Spinach. Using the derived models, then the potential for Cd phytoextraction of Land Cress and Spinach was assessed by calculating the number of crops needed to remediate the Cd below the remediation targets at a Cd-contaminated soil for an initial concentration of soil Cd of 50, 20, 10, and 5 mg kg^{-1}. The results indicated the reasonability of general forms of root water uptake reduction functions to apply to phytoextraction. The model simulations revealed that the phytoremediation of moderately-contaminated soils (below 10 mg Cd kg^{-1} soil) with Spinach is more feasible than that of Land Cress. Further similar studies for essential elements such as Zn, Se and Co may be useful in increasing their availability in soils or using plant materials with the elevated metal concentrations as fertilizers.

Keywords: Cd, Land cress, Modelling, Phytoextraction, Spinach

[1] Corresponding author Email: h.khodaverdiloo@urmia.ac.ir