

Use of chicken manure extract for biostimulation and enhancement of perchlorate rhizodegradation in soil and water Media

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Abstract

The influence of biostimulation using dissolved organic carbon (DOC) on rhizodegradation of perchlorate and plant uptake was studied under greenhouse conditions using soil and hydroponic bioreactors. One set of bioreactors planted with willow (*Salix babylonica*) plants was spiked with 300 mg L⁻¹ DOC in the form of chicken manure extract, whereas a second set was not treated with DOC. A similar experiment without willow plants was run in parallel to the planted bioreactors. The planted soil bioreactors amended with DOC reduced perchlorate from 65.85 to 2.67 mg L⁻¹ in 21 days for humic soil (95.95% removal) and from 68.99 to 0.06 mg L⁻¹ for sandy loam (99.91% removal) in 11 days. Nonplanted DOC treated soil bioreactors achieved complete perchlorate removal in 6 and 8 days for humic and sandy loam, respectively. Both planted and nonplanted soil bioreactors without DOC removed > 95% perchlorate within 8 days. Planted soil bioreactors respiked with perchlorate reduced perchlorate to nondetectable levels in 6 days. Hydroponics experiment amended with DOC reduced perchlorate from approximately 100 mg L⁻¹ to nondetectable levels within 7 to 9 days. Hydroponic bioreactors without DOC had low perchlorate removal rates, achieving 30% removal in 42 days. Leaf samples from sandy loam soil bioreactors without DOC had four times perchlorate phytoaccumulation than the DOC-treated plants. Similar results were obtained with the nonplanted bioreactors. Persistence of perchlorate in solution of planted hydroponic bioreactors without DOC amendment suggested that natural DOC from the plant exudates was not enough to biostimulate perchlorate reducing microbes. The hydroponic bioreactor study provided evidence that DOC is a limiting factor in the rhizodegradation of perchlorate.

Keywords; bioaugmentation, bioreactor, biostimulation, dissolved organic carbon (DOC), perchlorate, phytoaccumulation, rhizodegradation

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