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CONTROLLED STUDIES OF PHYTOREMEDIATION BY IRRIGATION WITH
CHLORINATED HYDROCARBON POLLUTED GROUNDWATER: COMPARISON OF
TRANSGENIC AND WILD-TYPE POPLAR

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Trichloroethylene (TCE) was used as an industrial solvent and is responsible for widespread groundwater contamination. TCE is a known animal carcinogen and a suspected human carcinogen. At least one third of all sites on the National Priorities List are contaminated with TCE. Physical and biological methods have been used for removing TCE from contaminated groundwater. However, these remediation methods can be costly to install and maintain. Phytoremediation is an emerging technology for treatment of contaminated soils, sediments and water. TCE taken up by plants can be diffused through the stem, transpired through the leaves, or degraded by plant metabolism. Plants also aid microbial degradation of TCE by modifying the geochemical environment in the rhizosphere. While diffusion and transpiration allow TCE to escape to the atmosphere, plant or microbial metabolism can degrade TCE to non-toxic products such as CO₂ and Cl⁻. Thus metabolism is the preferred fate of TCE in phytoremediation. TCE metabolism in plants has been enhanced by introducing cytochrome P450 2E1, the gene responsible for chloroethene degradation in mammals. Phytoremediation of TCE-contaminated sites is an attractive alternative to both physical and biological remediation techniques because it can be inexpensive, requires little or no maintenance and has long-term applicability. Unfortunately, phytoremediation applications have been limited because contaminant concentration in the groundwater does not always decrease after the addition of plants to the system. The objective of this research is to quantify the extent to which hybrid poplar trees can cause a decrease in TCE concentration in a flow-through apparatus, and to compare the effects on TCE concentration with that of transgenic poplar. Hybrid poplar trees are being grown in a flow-through system consisting of glass columns. The columns are sealed around the tree stems to prevent TCE-loss. Sampling ports on the side of the columns allow for vapor samples to be taken at several depths throughout the column. Vapor samples were analyzed by GC-FID to obtain a profile of TCE concentration in the rooting medium. Using this apparatus we will be able to study phytoremediation by irrigation of polluted groundwater under controlled conditions and to determine the efficacy of transgenic and wild type poplar for removal of TCE. This research is funded by NIEHS P42 ES 04696 with additional support from NSF BES-9911676, and DOE DE-FG07-96ER20256.