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Assessing willows for phytoremediation of TCE - Uptake, transformation and microbial degradation

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Willow trees are known to be capable to take up, transform und transpire trichloroethylene (TCE). To trace the fate of TCE in water and plant biomass single willows were grown in glass cylinders filled with 25cm quartz sand covered by a 20cm thick humus layer. About two third of the sand layer was water saturated. The experiment was repeated once with the same plants in two consecutive years (2010 and 2011). TCE was added in nominal concentrations of 0 mgL^{-1}, 144mgL^{-1}, 288mgL^{-1} and 721mgL^{-1} (in five replicates of each treatment). Additionally unplanted cylinders were set-up and spiked with 721mgL^{-1} TCE. In 2011 a ^{13}C enriched TCE solution ($\delta^{13}C$ = 110,28 ‰) was used. Periodically water and biomass (leaves and bark) were sampled and TCE content and metabolites were analyzed. To determine the presence of TCE degrading microorganisms, the concentrations of TCE and its metabolites, the isotopic ratio of carbon ($^{13}C/^{12}C$) of TCE and the abundance of ^{13}C labeled microbial PLFAs (Phospholipid fatty acids) were monitored. Preliminary results did not indicate microbial degradation. Whilst chlorophyll fluorescence measurements on day 10 indicated no effects of TCE on primary photochemistry of photosystem 2 (PSII), pots treated with 721mgL^{-1} TCE showed a significantly (α=0,05) decreased evapotranspiration rate within the first four days. More than 98% of TCE disappeared from plant cylinders one month after addition of TCE at any initial concentration, whereas unplanted pots did not show any TCE reduction. TCAA and DCAA were found to be the dominant metabolites while less TCOH and TCE accumulated in plant tissue.