Abstract

Carbon (C) compounds exuded from plant roots comprise a significant and reactive fraction of belowground C pools. These exudates substantially alter soil directly surrounding plant roots and play a vital role in the global C cycle, soil ecology, and ecosystem mobility of both nutrients and contaminants. Root exudates are difficult to study due to their low concentration, fast turnover, and limited spatial distribution throughout the soil. This study will utilize isotope tracer methods to distinguish plant- and microbially-derived organic compounds and NMR techniques to handle complex matrices of organic compounds and low concentrations. Cd, a toxic heavy metal, forms stronger bonds with reduced S- and N-containing compounds than with carboxylic acids, which may influence exudate composition in hyperaccumulator and tolerant plants grown in Cd contaminated soils. We hypothesize that hyperaccumulator plants will exude a larger amount of aromatic N and di- and tri-carboxylic acid containing molecules, while plants that exclude heavy metals from uptake will exude a larger proportion of reduced S containing molecules. This study will utilize hyperaccumulator and non-hyperaccumulator plants grown in two Cd-contaminated soils which differ in their Zn:Cd ratio. A pulse-chase methodology using the C stable isotope, ^{13}C, will be employed to differentiate plant-derived compounds from background soil and microbial-derived compounds. A combination of one-dimensional and two-dimensional NMR techniques will be used to obtain detailed information regarding chemical structures within exudate samples. Information from these studies will be used to guide future investigations into the effects of external factors on exudate composition, as well as the inform scientists and farmers alike about the role that exudates play in plant strategies to deal with nutrient deficiencies and soil contamination.