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Tracking switchgrass photosynthate via 13CO2 pulse-chase into the rhizosphere microbiome and metabolome

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Abstract: This project aims to increase our understanding of plant-microbe interactions, specifically the exchange of plant C for microbially derived nitrogen. Plant exudates are a high energy foods for microbes that exert control on plant nitrogen availability because they fuel microbial N-mineralization and N-fixation rates, which are energy intensive processes. Nitrogen is the most commonly limiting nutrient for plants, especially in marginal lands, which are unsuitable for food crops because of low productivity and vulnerability to environmental stress. These lands are ideal for bioenergy cropping systems. The exchange of plant carbon for microbially derived nitrogen creates direct links and feedbacks between rhizosphere microbiome function and plant productivity that will ultimately determine the productivity and sustainability of bioenergy cropping systems. Through this research we will address the question: how does the bioenergy crop switchgrass, growing in marginal land soils, utilize root exudates to obtain N via microbially mediated N transformation processes? This research will use new tools to characterize root exudate chemistry and for the first time couple DNA stable isotope probing and metagenomic sequencing with compound specific analysis of isotopically labelled root exudates to help us better explore the connections between plant root exudate chemistry and the dynamics of the rhizosphere microbiome. The focus of this research is consistent with the DOE mission of "developing clean, renewable and sustainable alternative fuel sources from lignocellulosic biomass." These data can be used by ecologists, biogeochemists and modelers to improve our knowledge of bioenergy cropping systems with the goal of ultimately using these data to inform management decisions that will improve productivity, efficiency and sustainability of these systems.