

Will work for fertilizer: Plant roots trade food to soil bacteria for fertilizer

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Introduction

Just 1 teaspoon of soil can hold up to 1 BILLION bacteria, and these bacteria have been found to be sensitive to changes in soil chemistry. One way that plants can modify soil chemistry is by releasing carbon compounds (exudates) from their roots. There is some evidence that *Panicum virgatum* (switchgrass), a promising biofuel crop, may release root secretions (exudates) under low nitrogen conditions to attract nitrogen-fixing bacteria. This “behavior” certainly alters the microbial community surrounding the plant roots, and ultimately may alter how the microbial community functions.

The mutualism between switchgrass and soil microbes is beneficial to both organisms. This is because microbes receive carbon to utilize for energy and the plants receive nitrogen, a nutrient that is important for growth and development in plants. Gaining an in-depth understanding of this relationship, may allow for reduced fertilizer application to switchgrass fields. Reducing fertilizer inputs would have great benefits both for the environment and for the economic viability of biofuels.

The REU student selected to participate in this project will play a key role in examining how switchgrass root exudates influence microbial community structure, and how exudate chemistry influences microbial nitrogen fixation in fertilized and unfertilized switchgrass systems.

What the Student will Learn:

In order to develop specific research questions, develop hypotheses, and test those hypotheses, the REU student will learn the process of experimental design. Depending on the research questions the student develops, it is likely there will be incorporation of both field and lab components for their research. In the field, the student will learn how to core soil and measure gas flux. In the lab, the student will learn microbial techniques, which includes how to measure microbial biomass, utilize quantitative polymerase chain reactions (qPCR) of DNA and RNA to quantify nitrogen fixer abundance and activity. The student will also have opportunities to learn and participate in microbial community sequencing to identify microbes present under varying soil conditions and other microbial techniques as they are needed.

This REU fellowship will allow the student to place their work within a broader of understanding how soil microbial community dynamics influence nitrogen and carbon cycling. The student’s research will also provide insight into whether the mutualism can maintain commercial levels of biomass production without the use of chemical fertilizer. This would ultimately reduce fertilizer use, which has positive impacts both economically and for environmental sustainability.

The anticipated research project will take place at the Kellogg Biological Station from May 23 – August 5, 2016 (11 weeks). Most field sampling will occur during the early morning hours. Lab work, project related writing and literature research will typically happen during afternoon hours. We highly encourage our students to continue their collaboration with us developing their research project and analyzing data after the summer research session concludes.