

Switchgrass Growth and Transcriptomic Responses to Nitrogen Availability and the Rhizosphere Microbiome

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Project Goals: The main goal of the over-arching project, “Connecting nitrogen transformations mediated by the rhizosphere microbiome to perennial cropping system productivity in marginal lands”, is to better understand the connections between plant and microbial genomics, transcriptomics, and productivity in the context of varying soil nitrogen availability.

Switchgrass (*Panicum virgatum* L.) has received substantial research attention as a potential bioenergy crop. In particular, switchgrass is noted for its relatively low soil fertility requirements, allowing the possibility of production in marginal lands to avoid competition with existing crops. In addition to the greenhouse gas benefits resulting from the use of switchgrass as an alternative to fossil fuels, soil fertility management strategies utilizing biologically-fixed rather than industrially-fixed N sources could help to maximize those benefits. Although it has been suggested that interactions with N₂-fixing microbes in the rhizosphere may increase nitrogen acquisition by switchgrass (Bahulikar et al. 2014), few empirical studies have investigated these interactions or the factors influencing them. Here, we conducted a greenhouse study of switchgrass variety “Cave-in-Rock”, factorially-manipulating nitrogen availability as well as the presence/absence of marginal land soil microbes. We predicted that if soil microbes improve N availability in the switchgrass rhizosphere, any beneficial effects of soil microbes would be most evident in the low N treatment. Measurement of aboveground biomass, leaf traits, and root morphology is currently underway. We will also assess root transcriptomes to characterize switchgrass responses to nitrogen deficiency and microbial inoculation, and soil metagenomes in order to characterize the microbes functioning in the switchgrass rhizosphere. Lastly, we are characterizing root exudates of switchgrass grown in sterile culture under both high and low nitrogen conditions to identify potential signaling molecules or growth substrates for rhizosphere microbes. We expect the results of this study to provide insight into possible mechanisms supporting productivity of switchgrass in low-fertility soils.

References

1. Bahulikar RA, Torres-Jerez I, Worley E, Craven K, and Udvardi MK. 2014. Diversity of nitrogen-fixing bacteria associated with switchgrass in the native tallgrass prairie of Northern Oklahoma. *Applied and Environmental Microbiology* 80: 5636-5643.

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