The Response of Bacterial Communities to Nitrogen Fertilization Depends on Temporal and Spatial Scale

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Project Goals: We are interested in exploring the role microbial communities play in sustainable growth of dedicate bioenergy crops on marginal lands. Here we are exploring the response of soil microbial communities associated with switchgrass (*Panicum virgatum*) to nitrogen fertilizer across spatial and temporal scales. We will use this information to inform efforts to develop microbial communities with traits that improve bioenergy crop productivity and tolerance to stresses.

Understanding plant-microbial interactions is critically important for producing cellulosic energy crops. Plants interact with a diverse microbial community throughout their life cycle and this community can be utilized to increase yields with reduced application of fertilizers. However, microbial communities vary temporally and spatially, and we are only beginning to understand the scale and drivers of these processes. We have begun to explore the role of the microbial community in the response of the biofuel crop species *Panicum virgatum* to nitrogen fertilization across spatial scales from <1m to >500km (spanning the GLBRC Marginal Land Experimental sites in Michigan and Wisconsin) and temporal scales of weeks to years (spanning two growing seasons). We surveyed the bacterial community along with soil chemistry, weather data, and bacterial traits. We found that nitrogen fertilization had a weak effect on the bacterial community composition and this effect was dependent on spatial and temporal scale. The effect of fertilizer on the bacterial community was strongest and most variable at the southern Michigan Marginal Land site (Lux Arbor) and the effect peaked after application in 2016. This peak in fertilizer effect on the bacterial community corresponded with a peak in soil nitrate. Across all the environmental factors measured, soil moisture and variability in soil temperature were the major environmental drivers of bacterial community composition. However, models including distance, time, and environmental factors were only able to explain between ~18% and 25% of the bacterial community composition. Overall, we found that the response of the microbial community to nitrogen fertilization is dependent on short term flushes and soil nitrogen is likely not the major driver of the bacterial community in switchgrass bioenergy systems.

This material is based upon work supported in part by the Great Lakes Bioenergy Research Center, U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research under Award

Numbers DE-SC0018409 and DE-FC02-07ER64494 in addition to Award Number DOE DE-FOA-0001207 to the MMPRNT project.