

Title Soil Microbes Affect Switchgrass Germination More than Seedling Growth Under Drought

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Project Goals: Switchgrass, a bioenergy candidate, can grow in marginal, drought-prone soils, but is limited by drought-sensitive early life stages. We investigated how soil microbial communities affect switchgrass germination and seedling growth during drought. These findings can be used to inform how switchgrass establishment could be improved by selecting or manipulating soil microbial communities that improve switchgrass germination and growth under drought.

A limitation to the bioenergy potential of switchgrass (*Panicum virgatum*), is its drought-sensitive early life stages (e.g. germination and seedling establishment). Single microbial isolates have been shown to improve switchgrass germination and growth under drought,^{1,2} but less is known about how whole soil communities influence switchgrass drought tolerance. Additionally, little is known about how the degree of host-association in the soil communities affects switchgrass drought responses. For instance, soils with a high degree of microbial-host association, collected from mature switchgrass fields, have negative effects on early switchgrass growth³, but no studies to our knowledge have investigated if host-specific, mature switchgrass soil microbes affect germination and, further, if these interactions shift under drought.

We used a greenhouse experiment to investigate how switchgrass germination and seedling growth under drought is affected by microbial presence (sterile bulk vs. live bulk soils) and the degree of microbial-host association (bulk vs. mature switchgrass rhizosphere soils). We found that drought negatively affected switchgrass germination and growth, and that microbially-mediated drought tolerance is stronger during germination than seedling growth. Seeds sown into live soils had 40% higher germination and 63% higher survival than sterile soils under drought. The degree of host-microbial association also had greater effects on germination than seedling growth, but the effects differed under drought and ambient conditions. Under ambient conditions, more seeds germinated in host-specific, rhizosphere soils, but this was reversed under drought. The initially similar bacterial community composition of the bulk and rhizosphere soils also changed during germination but did not diverge during seedling-growth, suggesting that germination-specific signaling may recruit microbes which may aid in germination and survival under drought. In summary, this study shows that microbially-mediated drought tolerance differs for switchgrass germination and seedling life-stages, where germination is more sensitive to drought and more responsive to differences in microbial communities. Future efforts to improve switchgrass establishment during drought should focus on germination-specific microbial interactions.

References

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