Identifying productive energy sorghum germplasm for water-limited and nitrogen-limited environments using classical and advanced phenotyping methods - one piece of the puzzle for creating sustainable biomass production systems

Daniel Schachtman*[1] (Daniel.schachtman@unl.edu), Zachary Brenton[2], Asaph Cousins[3], Cody Creech[1], Ismail Dweikat[1], Stephanie Futrell[1], Emily Goren[4], Stephen Kresovich[2], Allyn Pella[1], Jessica Prenni[5], Jiating Li[1], Peng Liu[4], Ellen Marsh[1], Yeyin Shi[1], Amy Sheflin[5], Bala Sonawane[3]

[1] University of Nebraska, Lincoln, NE; [2]Clemson University, SC, [3]Washington State University, Pullman, Washington, [4]Iowa State University, Ames, Iowa, [5]Colorado State University, Fort Collins, CO

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Project Goals:

1. **Conduct deep census surveys of root microbiomes concurrent with phenotypic characterizations of a diverse panel of sorghum genotypes to define the microbes associated with the most productive lines under drought and low nitrogen.**
2. **Associate systems-level genotypic, microbial, and environmental effects with improved sorghum performance using robust statistical approaches.**
3. **Develop culture collections of sorghum root/leaf associated microbes**
4. **Perform controlled environment experiments for in-depth characterization and hypothesis testing of $G_{sorghum}$ x $G_{microbe}$ x $E_{interactions}$.**
5. **Validate physiological mechanisms, map genetic loci for stress tolerance, and determine the persistence of optimal microbial strains.**

This is a multifaceted project involves both plant genetics and studies of the soil microbial communities associated with sorghum. The overall objective is to create a sustainable biofuel feedstock system for production on marginal soils that lack sufficient moisture and nutrients. Part of the group is focused on understanding the relationship between soil microbes and sorghum genotype (See poster by Chiniquy et al.), culturing sorghum associated bacteria, characterizing the changes in the soil microbiome due to abiotic stresses and gaining a fundamental understanding of the genotypic changes in root metabolites and how those interact factors interact with soil microbe community composition (See poster by Sheflin et al.).

This poster will provide an update on the plant germplasm screening that was conducted in 2017. Two locations were used to characterize the abiotic stress tolerance of 24 sorghum lines. One field was located in western Nebraska and used to study response to drought conditions and the other field in eastern Nebraska was used to characterize response to low nitrogen. End of season relative biomass and height data will be presented. In order to further characterize the physiological and biochemical responses to stress more advanced methods are being developed. Plants and plots were characterized by both hyperspectral reflectance and UAV flights which were calibrated using data collected on individual leaves for chlorophyll, nitrogen content, specific leaf area and sucrose content of leaves and stems. Those results will be presented. Using these more advanced phenotyping methods we plan to characterize segregating populations of energy sorghum for nitrogen and water use efficiency in 2018 with the aim of mapping these traits. In addition, leaves were collected for carbon and nitrogen isotope analyses which we aim to use for development of more advance physiological tools for further in-depth characterization of water and nitrogen use efficiency of this germplasm (see poster by Cousins et al.).

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