Traits for Development of Sustainable Energy Sorghum Biofuel Feedstock Production in Marginal Environments

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Website for project: https://sorghumsysbio.org/

Overall project goals:

- Establish a foundational, systems-level understanding of plant, microbial, and environmental interactions that will lead to translational strategies to enhance growth and sustainability of sorghum through improved genetic and microbial adaptations to water and nutrient limited environments.

Specific objectives addressed by this poster:

- Phenotypic characterizations of a diverse panel of sorghum genotypes across multiple years to define the most productive lines under drought and low nitrogen conditions.
- Associate genotypic and environmental effects with improved sorghum performance using robust statistical approaches.

This sustainable systems project involves both plant genetics and studies of the soil microbial communities associated with sorghum. Part of this group is focused on understanding the relationships between soil microbes, abiotic stress and sorghum genotypes using culture independent methods and by culturing sorghum associated bacteria. Another major area of the grant is the development of energy sorghum germplasm that is responsive to soil microbes and remains highly productive even under conditions of water deficit and low nitrogen.

This poster will provide an update on the characterization of one recombinant inbred population (RIL) segregating for the ability to maintain growth under low nitrogen conditions and the screening of the bioenergy association panel (BAP) [3] under water deficit conditions.

Field work conducted in 2016 and 2017 evaluated 24 – 30 sorghum lines including founder lines of a Nested Association Mapping panel (NAM) [1]. Under sufficient and low nitrogen conditions, lines were evaluated for biomass and specific traits using a hyperspectral radiometer. Drone flights also provided data for biomass [2]. Sufficient variation for growth under low nitrogen conditions was identified in 2017. In 2018 progeny from the parents Grassl (recurrent female parent) X Rio were evaluated for growth on low nitrogen soils and possible gene mapping.

These NAM founder lines were also grown under water limited conditions in 2017, but the variation was not sufficient enough to allow for the use any of the existing RIL populations for further studies. Therefore the (BAP) [3] in which more variation for tolerance to drought was expected was evaluated under water-deficit in 2018.

A primary objective of the work in the 2018 field season for both the low nitrogen and water deficit studies was to measure the relative biomass at the end of the season. However additional information on traits was collected and focus was placed on developing high throughput methods for evaluating germplasm. These traits will complement biomass measurements and be used to understand the physiological mechanisms underlying growth in these marginal environments.

Advanced phenotyping methods as well as brute force approaches, were used to collect data on the RIL population leaf nitrogen, chlorophyll, specific leaf area and whole plant nitrogen use efficiency using a hyperspectral radiometer in 250 progeny of the NAM population from the Grassl X Rio cross. Those results will be presented.

Under drought conditions the BAP was evaluated for traits that have been previously studied in grain sorghum but not energy sorghum that potentially impact drought tolerance. These traits include leaf wax composition [4], canopy temperature, leaf angle [5], specific leaf area and osmoregulation. Those preliminary results will also be presented.

References

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This project is funded by the DOE BER Sustainable Bioenergy Research Program, Award DE-SC0014395, and was also supported by DOE JGI Community Science Program.