24. A versatile phenotyping system and analytics platform reveals diverse temporal responses to water limitation in Setaria

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http://sviridis.org/
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Project Goals: "A Systems-Level Analysis of Drought and Density Response in the Model C4 Grass Setaria viridis". The specific aims of the proposal are to: 1) Identify QTL for the effect of drought and density on biomass and seed yield components of Setaria. 2) Conduct in–depth physiological profiles in roots and leaves of a subset of selected lines 3) Integrate datasets and develop metabolic and gene networks for Setaria 4) Develop transformation technologies for Setaria viridis 5) Functionally examine the role of candidate genes deduced by network models; and 6) Develop protocols and best practices for monitoring gene flow in transgenic Setaria. To achieve these aims we will produce one of the most extensive molecular characterizations of plant growth in the field to date, generating several million data points that will be collected from physiological and molecular genetic studies. We will develop novel informatics models and network tools that will guide future molecular characterization in S. viridis and guide breeding efforts in major feedstock targets.

Phenotyping has become the rate-limiting step in using large-scale genomic data to understand and improve agricultural crops. Here, the Bellwether Phenotyping platform for controlled- environment plant growth and automated, multimodal phenotyping is described. The system has capacity for 1,140 plants, which pass daily through stations to record fluorescence images, near infrared images, and visible images. Plant Computer Vision (PlantCV) was developed as an open-source, platform independent quantitative image analysis community resource. In a four week experiment, wild Setaria viridis, and domesticated Setaria italica had fundamentally different temporal responses to water availability. While the lines produced similar levels of biomass under limited water conditions, Setaria viridis maintained the same water use efficiency under water replete conditions, while Setaria italica shifted to less efficient growth. Overall, the Bellwether Phenotyping platform and PlantCV software detected significant effects of genotype, and environment on height, biomass, water-use efficiency, color, plant architecture, and near-infrared traits. All ~79,000 images acquired during the course of the experiment are publically available. We have also collected data using this system on Setaria RIL and association panels.

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