179. New tools for studying water deficit responses in roots

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http://sviridis.org/, http://foxmillet.org/

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.

Droughts are the consequence of common weather patterns that strike important agricultural areas around the world and affect food security. Water deficit and elevated temperatures are common stresses that plants experience during drought and have been extensively studied in field, green house and laboratory settings. Water is not uniformly distributed in soil and plants that develop deeper root systems are known to be able to better withstand lack of water by avoiding dry soil.

Experimental conditions that mimic water deficit in the lab often use gel-based media and dissolved osmolytes that reduce water potential. These conditions usually elicit a reduction in root growth, which allows the plant to economize resources. Such tolerance mechanism may be less important to field-grown plants where sustaining biomass and productivity are important targets. A new integrated plant growth and imaging system termed GLO-Roots (Growth and Luminescence Observatory for Roots) has recently been developed that allows root systems to be characterized in soil grown plants. Physiologically relevant water-deficit conditions have been designed that cause drying of the soil column from the top down, which causes roots to grow faster and deeper. Such changes in root architecture likely represent adaptive avoidance responses that facilitate water uptake from deep in the soil column. Use of dual-color luciferase reporter systems allow root structure and gene expression to be studied simultaneously and provide tools for characterizing the molecular-genetic pathways controlling changes in growth and gravitropism observed during water deficit. We have adapted GLO-Roots successfully in Arabidopsis, Brachypodium and Tomato and will soon begin studies in Setaria viridis.

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