Title: Using semi-mechanistic models for quantifying abiotic stress in rice.

Position: Associate Professor

Affiliation: Department of Biological Sciences, University of Arkansas, Fayetteville AR

Abstract:

To ensure global food security, phenotyping crops for survival in future climates, including drought resistance, is urgently needed.  Growing rice, a globally important cereal crop with high water requirement, in a drought prone future will need identification of genotypes that are resistant to drought. Popular modern methods of high throughput phenotyping screen a large number of plants for specific traits, but these methods lack the ability to directly measure photosynthesis, an important indicator of yield, and to predict plant response under stress. Here, we developed and tested a mechanistic model to predict the photosynthesis response to drought stress in 8 rice genotypes (310588, 310723, 311620, 311677, 311795, 311792, Nagina 22, and Zhe 733). The model is a two-parameter Michaelis-Menten equation, with an Amax parameter, predicting maximum photosynthesis rate, and a Θ50 parameter, which describes the percent soil moisture at 50% loss of maximum assimilation. We tested the model on plants in manipulative field and growth chamber experiments, and validated model predictions of drought sensitivity with field generated yield data. Based on the Θ50 parameter values, we ranked the selected genotypes along a gradient of drought sensitivity. 311677 and 311795 were found to be most sensitive to drought, while 311792 and 311620 had a low sensitivity to drought. The parameter Θ50 provides a way to quantify and rank drought sensitivity of different genotypes and could be a useful tool in phenotyping studies.