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Promises and challenges of eco-physiological genomics in the field: Tests of drought responses in switchgrass

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Abstract

© 2016 American Society of Plant Biologists. All rights reserved.Identifying the physiological and genetic basis of stress tolerance in plants has proven to be critical to understanding adaptation in both agricultural and natural systems. However, many discoveries were initially made in the controlled conditions of greenhouses or laboratories, not in the field. To test the comparability of drought responses across field and greenhouse environments, we undertook three independent experiments using the switchgrass reference genotype Alamo AP13. We analyzed physiological and gene expression variation across four locations, two sampling times, and three years. Relatively similar physiological responses and expression coefficients of variation across experiments masked highly dissimilar gene expression responses to drought. Critically, a drought experiment utilizing small pots in the greenhouse elicited nearly identical physiological changes as an experiment conducted in the field, but an order of magnitude more differentially expressed genes. However, we were able to define a suite of several hundred genes that were differentially expressed across all experiments. This list was strongly enriched in photosynthesis, water status, and reactive oxygen species responsive genes. The strong acrossexperiment correlations between physiological plasticity-but not differential gene expression-highlight the complex and diverse genetic mechanisms that can produce phenotypically similar responses to various soil water deficits.

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