PHYSIOLOGICAL APPLICATIONS FOR DIAGNOSING COTTON WATER USE EFFICIENCY

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Abstract

Water is the number one limiting element in crop production worldwide; however, rapid and reliable methods for selecting cultivars with high water use efficiency (WUE) by physiological methods are limited. The objective of the present study is to identify physiological responses of cotton to water stress and determine techniques to distinguish more water use efficient cultivars. Two experiments were conducted using two cotton lines differing in drought tolerance. Plants of the more tolerant cultivar, TAMCOT 22, and the less tolerant experimental line, TAM 89E-51, were grown under glasshouse conditions at the Plant Growth Facility of the Institute of Plant Genomics and Biotechnology. Experiments represented two growth stages (4-node and early bloom) at which plants experienced a water stress event. Physiological measurements were collected as plants became water stressed and upon recovery. Single-leaf measurements of transpiration rate, stomatal conductance, and net photosynthetic activity did not adequately explain differences in water use efficiency between the two cultivars. Biomass partitioning taken after the recovery period explained the response each cultivar had after experiencing a water stress event. The cultivars did not respond the same to water stress when the stress event occurred at the 4-node growth stage versus early bloom. This indicates that cultivars will respond differently to water stress depending on their maturity. Distinguishing water use efficiency or drought tolerance between cotton cultivars should not be based on how the cultivar responds during a water stress at a single growth stage. Rather, the assessment should be based on the severity and duration of the stress event at several growth stages.