PHYSIOLOGICAL RESPONSES OF THREE COTTON GENOTYPES TO IRRIGATION TREATMENT AND SEASONAL VARIATION IN THE WATER STATUS OF THE SOIL-PLANT-ATMOSPHERE CONTINUUM

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Abstract

Water is the most limiting factor governing agricultural productivity worldwide. Depending upon the timing and duration, drought can limit yields substantially in cotton. The objective of this research was to quantify the physiological responses of a range of commercial cotton cultivars to contrasting irrigation treatments in southern Georgia. Classical gas exchange measurements were combined with fluorescence-based measurements of photosystem II quantum yield and electron transport rates to help identify the underlying mechanisms of drought-induced limitations to net carbon fixation under field conditions (i.e. respiration, photorespiration, and gross photosynthesis). To more adequately characterize metabolic responses to the water status of the soil-plant-atmosphere continuum, additional measurements included pre-dawn and midday leaf water potential, and leaf-air vapor pressure deficit. No interaction was observed between irrigation treatment and cultivar. However, net photosynthesis declined concomitantly with more negative pre-dawn- and midday leaf water potentials in the dryland treatment when compared with the University of Georgia 100% Checkbook scheduling approach. Also, associated with a decrease in net photosynthetic rate under dryland conditions, decreases in gross photosynthesis, dark respiration, stomatal conductance, transpiration rate, and water-use efficiency were also observed. Total electron transport rates through photosystem II were unaffected by drought stress, whereas photorespiration was significantly increased. These data will assist in better quantifying the physiological responses of modern cotton cultivars to varying degrees of water deficit stress.