PHYSIOLOGICAL RESPONSES OF *GOSSYPIUM HIRSUTUM* TO CONTRASTING IRRIGATION REGIMES

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Abstract

Competition with municipalities for water resources, concerns about negative environmental impacts, and the economics associated with bringing irrigation water from source to field has recently given impetus to research on improving irrigation efficiency. Despite extensive research on cotton's response to water deficit, a clear understanding of how underlying physiological mechanisms interact to decrease source strength and drive yield loss is not fully understood. To this end, cotton was grown in 2012 and 2013 according to the University of Georgia's "Checkbook" recommendations, as well as under dryland conditions. To gain an understanding of how yield stability is affected by physiological response, a suite of physiological parameters were measured both pre-dawn mid-day. For 2012 (a relatively hot, dry year), dryland cotton exhibited a 35% loss in lint yield, whereas no treatment effect was observed for 2013 (although both treatments were similar to 2012 dryland yields). We found that differences in pre-dawn leaf water potential Ψ_{PD} were strong indicators of differences in other parameters. Specifically, when Ψ_{PD} was lower, net photosynthesis (P_N), gross photosynthesis (P_G), transpiration (E), and stomatal conductance (g_s) decreased. In addition, when E and g_s decreased in response to water deficit, the proportion of P_G lost to dark respiration (R_D) increased. Water use efficiency showed no obvious response to Ψ_{PD}; however, there was a consistent decline as each growing season progressed. Canopy temperature was found to increase when Ψ_{PD} was low. Interestingly, all chlorophyll fluorometric parameters (F_v/F_m, Φ_{PSII}, ETR) showed no biologically relevant response to Ψ_{PD}. This suggests that carbon available for maintenance and growth (P_N) is limited by decreased g_s, P_G, and increased R_D under drought stress, with no evidence for limitations upstream of the carbon reactions.