RAPID A-CI RESPONSE (RACIR) AS A METHOD TO DETECT DROUGHT EFFECTS IN TWO GOSSYPIUM SPECIES WITH CONTRASTING METABOLIC STRESS-RESPONSE STRATEGIES

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Abstract

Drought has been shown to reduce net carbon assimilation in upland cotton through primarily stomatal limitations. That is to say, by decreasing stomatal conductance, drought reduces intercellular CO_2 concentration to the point where Rubisco is substrate-limited, whereas the light reactions and electron transport appear to be unaffected by drought. Confounding factors such as leaf age and elevated leaf temperature are often inseparable under drought conditions. For example, in addition to a substrate limitation, drought typically results in elevated leaf temperatures and a decrease in Rubisco activase activity is thought to be the primary limitation to photosynthesis under heat stress. Experiments done in Pima cotton showed that electron transport was the primary limitation to photosynthesis under high leaf temperature conditions. One major limitation to differentiating between stomatal and non-stomatal limitations to photosynthesis under drought or heat stress is the time necessary to complete an A-C_i response curve under field conditions. A recent paper published in Plant, Cell and Environment describes a method for generating A-C_i curves in as little as five minutes (rapid A-C_i response; RACiR), making field-scale data collection more feasible within a narrow window of time. With this in mind, Pima and Upland cotton were grown in Stoneville, MS under contrasting irrigation regimes (irrigated and dryland). An analysis of the thylakoid and carbon fixation reactions throughout the growing season was conducted in an effort to elucidate the limitations to net photosynthesis under drought conditions. Briefly, in the onset of drought, net photosynthesis was reduced in pima by 13%, along with a reduction in actual quantum yield and electron transport, whereas no effect was observed for upland cotton.