FIELD-GROWN COTTON CULTIVARS EXHIBIT GENOTYPIC AND SEASONAL DIFFERENCES IN PHOTOSYSTEM II HEAT TOLERANCE

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Abstract

Previous investigations have demonstrated that photosystem II (PSII) thermostability acclimates to prior exposure to heat and drought, but contrasting results have been reported for cotton (*Gossypium hirsutum* L.*)*. We hypothesized that PSII thermotolerance in *G. hirsutum* would acclimate to environmental conditions during the growing season and that there would be differences in PSII thermotolerance between commercially-available U.S. cultivars. To this end, three cotton cultivars were grown under dryland conditions in Tifton Georgia, and two under irrigated conditions in Marianna Arkansas. At Tifton, measurements included PSII thermotolerance (T_{15}, the temperature causing a 15% decline in maximum quantum yield), leaf temperatures, air temperatures, midday (1200 to 1400 h) leaf water potentials (Ψ_{MD}), leaf-air vapor pressure deficit (VPD), actual quantum yield (Φ_{PSII}) and electron transport rate through PSII (ETR) on three sample dates. At Marianna, T_{15} was measured on two sample dates. Optimal air and leaf temperatures were observed on all sample dates in Tifton, but PSII thermotolerance increased with water deficit conditions (Ψ_{MD} = -3.1), and ETR was either unaffected or increased under water-stress. Additionally, T_{15} for PHY 499 was ~5°C higher than for the other cultivars examined (DP 0912 and DP 1050). The Marianna site experienced more extreme high temperature conditions (20 to 30 days $T_{max} \geq 35$°C), and showed an increase in T_{15} with higher average T_{max}. When average T_{15} values for each location and sample date were plotted versus average daily T_{max}, strong, positive relationships (r^2 from .954 to .714) were observed between T_{max} and T_{15}. For all locations T_{15} was substantially higher than actual field temperature conditions. We conclude that PSII thermostability in *G. hirsutum* acclimates to pre-existing environmental conditions; PSII is extremely tolerant to high temperature and water-deficit stress; and differences in PSII thermotolerance exist between commercially-available cultivars.