FIELD-GROWN COTTON EXHIBITS SEASONAL VARIATION IN PHOTOSYNTHETIC HEAT TOLERANCE WITHOUT EXPOSURE TO HEAT STRESS OR WATER DEFICIT CONDITIONS

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Abstract

Fast fluorescence (OJIP analysis) is used to fully characterize photochemical sensitivity to environmental stresses for many plant species, but its utilization for characterizing thermotolerance acclimation to abiotic stress in field-grown plants is relatively unexplored. To this end, the temperature responses of maximum quantum yield of photosystem II (Fv/Fm), variable fluorescence (Fv/F0), quantum yield of electron transport (φEo), and efficiency of PSI electron acceptor reduction (REo/ABS) were characterized from the OJIP transient for leaves of three Gossypium hirsutum cultivars (DP 1252 B2RF; PHY 339 WRF, and PHY 499 WRF), at three sample times during the growing season (June 21, July 2, and July 18, 2013), and under three irrigation regimes. The temperature at which each parameter declined 15% from the optimum (T15) served as the high temperature threshold for all parameters. T15 varied with sample date (highest on July 2 for all parameters), being 2°C (Fv/F0) to 5.5°C (φEo) higher on July 2 relative to June 21, despite optimal temperature conditions and plant water status (predawn water potential) on all sample dates. T15 values, assessed using different fluorescence-based parameters, were highly correlated, but differed in magnitude, where Fv/F0 and φEo were more sensitive to high temperature than either Fv/Fm or REo/ABS. We conclude that 1) seasonal variation in thermotolerance may be influenced by plant age in addition to the environmental acclimation responses reported previously and 2) that thermotolerance is clearly dependent upon the chlorophyll fluorescence-based parameter evaluated. Both factors should be carefully considered in studies addressing thermotolerance acclimation in field-grown plants.