A MODEL TO ESTIMATE COTTON CANOPY TEMPERATURE IN THE DESERT SOUTHWEST

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Abstract

Temperature impacts the development and reproductive performance of cotton. In humid regions, the energy balance of the cotton crop dictates that canopy temperatures closely mimic ambient air temperature. Air temperature can therefore be used as a reasonable proxy for canopy temperature in humid regions. In the Desert Southwest (DSW), lower humidity alters the crop energy balance, resulting in canopy temperatures that can run as much as 8°C cooler than ambient air temperature. An effective and simple means of estimating cotton canopy temperature in the DSW is therefore needed to 1) assist growers with in-season crop management, 2) aid crop modeling efforts and 3) assist breeders in selecting heat tolerant varieties. A simple canopy temperature model was developed in Tucson, AZ from field measurements of canopy temperatures and standard meteorological measurements. The model splits the 24-hour day into day and night segments, using hourly measurements of solar radiation to identify day and night periods. Mean daytime canopy temperature (CTd in °C) can be estimated using the equation CTd = ATd - 1.43 x VPD + 0.5 (r^2 = 0.89) where ATd and VPD are the mean daytime air temperature in °C and vapor pressure deficit in kPa, respectively. Night canopy temperature (CTn in °C) is estimated using the equation CTn = ATn + 1.95 x ea - 5.95 (r^2 = 0.72) where ATn and ea are mean nighttime air temperature in °C and vapor pressure in kPa, respectively. Model assessment and validation were performed in the field at Yuma, AZ during 1997 by comparing modeled canopy temperatures with measurements made with infrared thermometers. Modeled canopy temperatures were found to be within 1°C on 80% of the days. Errors in excess of 2° C were observed on 10% of the days and associated with either overcast, rainy days or nights with high winds.

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