PHENOTYPING COTTON WATER USE WITH MULTISPECTRAL DRONE IMAGERY AND GEOSPATIAL FAO-56 METHODS

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Abstract

Data-driven techniques to estimate crop water use will be advantageous in the development of drought-tolerant cotton varieties. The objective was to develop an approach to estimate daily water use for cotton varieties using multispectral drone imagery to estimate basal crop coefficients for a geospatial implementation of FAO-56. Two cotton field experiments were conducted in the same field during 2016 and 2017 in central Arizona: 1) a test of one cotton variety (DP 1549) responding to 16 irrigation strategies with water use estimated from weekly neutron soil water content measurements and 2) a test of 8 cotton varieties responding to 4 irrigation strategies and two planting dates with small plot size and large plot numbers prohibiting soil water content measurements. Analytical methods were evaluated with water use data from the former study and applied to estimate cotton water use for all treatments in the latter study. Weekly multispectral images were collected with a MicaSense RedEdge camera mounted on a hexacopter drone and orthomosaicked using Pix4D software. Images were calibrated by comparing digital numbers to measured spectral reflectance of targets deployed at the field edge during overflight. A supervised maximum likelihood classification was used to identify vegetation and bare soil image pixels for calculation of percent canopy cover within the area of each experimental plot. Soil texture measurements at 160 locations across the field provided data for calculating soil water holding characteristics via Rosetta pedotransfer functions and for analyzing spatial soil variation via ordinary kriging. Using drone-based canopy cover to estimate FAO-56 basal crop coefficients and with soil water limits defined geospatially, a Python-based FAO-56 algorithm was used to calculate cotton water use uniquely for each experimental plot. When combined with yield measurements, the methodology can be used to estimate crop water use efficiency for individual treatment plots in breeding trials.