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Title:

Leaf Water Status Estimated from Visible-NIR Polarization Measurements

Abstract:

Remotely sensing the water status of plant canopies remains a long term goal of remote sensing research. Existing approaches to remotely sense canopy water status, such as the Crop Water Stress Index (CWSI) and the Equivalent Water Thickness (EWT), have limitations. The CWSI, based upon remotely sensing canopy radiant temperature in the thermal infrared spectral region, does not work well in humid regions, requires estimates of the vapor pressure deficit near the canopy during the remote sensing over-flight and, once stomata close, provides little information regarding the canopy water status. The EWT is based upon the physics of water-light interaction in the 900-2000nm spectral region, not plant physiology. Our goal is development of a remote sensing technique for estimating plant water status based upon measurements in the VIS/NIR spectral region, taking advantage of polarization physics. This technique would potentially provide remote sensing access to plant dehydration physiology – to the changes in cellular photochemistry and structure associated with water deficits in leaves.

In this research, we used crossed optical polarization filters to measure the VIS/NIR light reflected from the leaf interior, R, as well as the leaf transmittance, T, for 78 corn (*Zea mays*) and soybean (*Glycine max*) leaves having relative water content (RWC) values between 0.60 and 0.98. Our results show that as RWC decreases R increases while T decreases. Our results tie R and T changes in the VIS/NIR to leaf physiological changes – linking the light scattered out of the drying leaf interior to its relative water content and to changes in leaf cellular structure and pigments.