Remote Sensing Methods For Measurement Of Soil And Crop Water Status In A Humid Environment

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ABSTRACT

Presently, producers in the Mid-South have adopted no standard method to monitor soil moisture or crop water stress for irrigation purposes. In order to maintain acceptable productivity levels in the region, irrigation is becoming increasingly important. This increased reliance on irrigation has contributed to a decline in the ground water. Confounding this loss of ground water is the common occurrence of surface flooding from inadequate drainage. We are interested in developing a rapid detection method for determination of available soil water and crop water status for irrigation scheduling and water management. We are exploring visible and thermal remote imagery for its potential in estimating available soil water and detecting crop water status. Critical to the deployment of sensing methodologies as crop management tools is the potential to detect the onset of stress conditions. An additional complication is that, while the water potential of the soil and individual leaves or plants can be measured with a fair degree of accuracy, extrapolation from these well-defined measures for a small portion of a field to an estimate of whole field canopy water status is error-prone. Changes in canopy structure and leaf angle alter the reflectance from the individual leaves, and introduce deviations in the recorded spectra due to increases in reflectance from the soil and lower canopy layers. These factors, together with atmospheric distortions, alter the reflectance spectra of a crop canopy from that recorded for individual leaves or plants within that canopy. This study explores the feasibility of remote sensing in the thermal and visible regions for detecting the onset of water stress in cotton canopies under the humid growing conditions of the Mid-South. Soil water availability was altered in research plots through changes in tillage and irrigation. To allow rapid scanning of the test plots, a boom containing a spectroradiometer and infrared thermometer was built and mounted on a four-wheeler. The sensors mounted on the boom could be positioned at various heights in the middle of the test plots and repositioned easily for rapid scanning of the crop canopy. Concurrent measurements of insolation, air temperature and spatial position were taken. The measured individual leaf spectral characteristics were then approximated by Fourier transformations, which describe the spectra and reduce the information from 512 bands to 20 pairs of harmonics. These spectra from soil and vegetation were then randomly mixed and visualized using an imaging software package. The resultant synthetic spectra were remarkably similar to remote images of crop fields obtained from aerial sources.