Review

Review of commonly used remote sensing and ground-based technologies to measure plant water stress

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Abstract

This review provides an overview of the use of remote sensing data, the development of spectral reflectance indices for detecting plant water stress, and the usefulness of field measurements for ground-truthing purposes. Reliable measurements of plant water stress over large areas are often required for management applications in the fields of agriculture, forestry, conservation and land rehabilitation. The use of remote sensing technologies and spectral reflectance data for determining spatial patterns of plant water stress is widely described in the scientific literature. Airborne, space-borne and hand-held remote sensing technologies are commonly used to investigate the spectral responses of vegetation to plant stress. Earlier studies utilised multispectral sensors which commonly collect four to seven spectral bands in the visible and near-infrared region of the electromagnetic spectrum. Advances in sensor and image processor technology over the past 3 decades now allow for the simultaneous collection of several hundred narrow spectral bands resulting in more detailed hyperspectral data. The availability of hyperspectral data has led to the identification of several spectral indices that have been shown to be useful in identifying plant stress. Such studies have revealed strong linear relationships between plant pigment concentration and the visible (VIS) and near-infrared (NIR) reflectance, while plant water content has been linked to specific bands in the short-wave infrared (SWIR) region of the spectrum. Ground-truthing is essential to identifying useful reflectance information for detecting plant water stress, and four commonly used ground-based methods *viz*. predawn leaf water potential, leaf chlorophyll fluorescence, leaf pigment concentrations and leaf water content are reviewed for their, usefulness and practical application.

Keywords: leaf chlorophyll fluorescence, leaf-water content, plant pigment concentrations, plant water stress, predawn leaf water potential, remote sensing