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RESEARCH ARTICLE

Assessment of Water Status in Wheat (*Triticum aestivum* L.) Using Ground Based Hyperspectral Reflectance

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Abstract Field experiments were conducted with four levels of irrigation and nitrogen on wheat for 2 years (2009–2010 and 2010–2011) to quantify and predict the crop water status using hyperspectral remote sensing. Hyperspectral reflectance in 350–2500 nm range was recorded at five growth stages. Based on highest correlation between relative leaf water content (RLWC) and reflectance in five water bands, the booting stage was identified as the most suitable stage for water stress evaluation. Ten hyperspectral water indices were calculated using the first year booting stage reflectance data and prediction models for RLWC and equivalent water thickness (EWT) based on these ten indices were developed. The prediction models for RLWC based on moisture stress index (MSI), normalized difference infrared index (NDII), normalized difference water index$_{1640}$ (NDWI$_{1640}$) and normalized multiband drought index (NMDI) were identified as the most precise and accurate models as indicated by different validation statistics. The models developed for EWT based on water band index (WBI), MSI, NDWI$_{1640}$ and NMDI were found to be most suitable and accurate. These indices were found to be insensitive to N stress treatments indicating their ability to detect water deficiency as the cause of plant stress. Thus, the study identified four hyperspectral water indices to assess the wheat crop water status at booting stage and developed their respective predictive models.

Keywords Water stress · Hyperspectral water indices · Relative leaf water content · Equivalent water thickness

Introduction

Water stress in crops is one of the most common limitations which is detrimental to photosynthesis and plant primary productivity. The detection of crop water status is important for monitoring the plant status, assessment of drought and in the irrigation scheduling of crops [1]. Traditional measurement of crop water status is done through the field-based sampling approach that is generally destructive and time-consuming and fails to meet the requirement of real time evaluation [2].

Although field sampling of leaf and shoot provide the most accurate assessment of plant water status but it is not feasible when estimates are required for crops on large areas. Remote sensing technique offers the alternative non-destructive and instantaneous method of assessing the water status of vegetation over large scale [2, 3]. The vegetation water contents can be detected by the spectroradiometer in situ [4] and by aircraft borne [5] and satellite