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Detection of crop water status in mature olive orchards using vegetation spectral measurements

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Leaf/stem water potentials are generally considered the most accurate indicators of crop water status (CWS) and they are quite often used for irrigation scheduling, even if costly and time-consuming. For this reason, in the last decade vegetation spectral measurements have been proposed, not only for environmental monitoring, but also in precision agriculture, to evaluate crop parameters and consequently for irrigation scheduling.
Objective of the study was to assess the potential of hyperspectral reflectance (450-2400 nm) data to predict the crop water status (CWS) of a Mediterranean olive orchard.
Different approaches were tested and particularly, (i) several standard broad- and narrow-band vegetation indices (VIs), (ii) specific VIs computed on the basis of some key wavelengths, predetermined by simple correlations and finally, (iii) using partial least squares (PLS) regression technique.
To this aim, an intensive experimental campaign was carried out in 2010 and a total of 201 reflectance spectra, at leaf and canopy level, were collected with an ASD FieldSpec Pro (Analytical Spectral Devices, Inc.) handheld field spectroradiometer. CWS was contemporarily determined by measuring leaf and stem water potentials with the Scholander chamber.
The results indicated that the considered standard vegetation indices were weakly correlated with CWS. On the other side, the prediction of CWS can be improved using VIs pointed to key-specific wavelengths, predetermined with a correlation analysis. The best prediction accuracy, however, can be achieved with models based on PLS regressions.
The results confirmed the dependence of leaf/canopy optical features from CWS so that, for the examined crop, the proposed methodology can be considered a promising tool that could also be extended for operational applications using multispectral aerial sensors.