PROJECT TITLE

Dynamic measurement of leaf water content of grapevines by ratiometric reflectance NIR imaging.

CONSORTIUM

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SUMMARY OF THE REPORT

Globally, grapevine is a profitable crop (e.g., fresh fruits, wines, juices) but the management of drought stress is pivotal in future climate scenarios (1). Image analysis based tools are emerging (2, 3) and RGB and NIR cameras collecting broad spectrum data across 900-1700 nm have provided a correlation with leaf water potential of 0.44 R^2. This proposal evaluated specific regions of the NIR spectrum for improved HTP evaluation of tissue water content. Remotely detected spectral measurements should provide a proxy for physiological features. Methods include ratiometric measurements in the visible light (standard CMOS sensor providing photochemical reflectance index; assorted vegetation indices; carotenoids; anthocyanins), and in the NIR region (InGaAs sensor) where water signals are particularly strong.

Some NIR cameras on HTP phenotyping platforms are limited by technical factors including low resolution (320 × 256 pixels), single band imaging (“water band”, presumably centred on 1450 nm), and susceptibility to local high temperature. For example, the LemnaTec-installed AlliedVision NIR-300PGE camera had a maximum specified environment temperature of 40 °C, while the provided tungsten-halogen lights raises the local temperature above 60 °C.

An AlliedVision Goldeye G-032 camera was tested using 3 narrow [12 nm bandwidth, OD4] bandpass filters to provide higher resolution (636 × 508 pixels) alongside existing lights providing a continuous spectrum (currently using Cassel P1635FL-CA, 35 W, 230 V, GU10). Some of the other technical barriers (e.g. lighting variations, baseline wavelength corrections, image registration) have or are being evaluated using the image data acquired from the experiment.

Early results indicate that a more robust non-contact technique based on NIR can estimate water content of the leaf surface of vines and follow changes in water content as leaves react to drought. The technique uses reflectance measurements at various NIR frequencies and models water content based on a remote sensing Leaf Water Index (LWI). After appropriate calibration and correction, LWI provides a useful estimate of relative leaf water content.