

## Implementation of hyperspectral image analysis for evaluating table grape quality on bunch and berry level

Talitha Venter<sup>1\*</sup>, Rodrigo Oliva-Mancilla<sup>1,2</sup>, Fikile Wolela<sup>1</sup>, Eunice Avenant<sup>1,3</sup>, Carlos Poblete-Echeverría<sup>1\*</sup>

<sup>1</sup> South African Grape and Wine Research Institute, Stellenbosch University, Private Bag X1, Stellenbosch, South Africa, 7602

<sup>2</sup>Global technical consultancies, 05 Barn Road, Bergvliet, Cape Town, South Africa, 7945.

<sup>3</sup>South African Table Grape Industry, PO Box 2932, Paarl, South Africa, 7620

\*Corresponding author: [cpe@sun.ac.za](mailto:cpe@sun.ac.za)\*

### Abstract (250 words)

Typically, subjective, and visual methods are used by grape growers to assess harvest maturity. These methods may not accurately represent the maturity of an entire vineyard – especially if extensive and representative sampling was not used. New technologies have been investigated for improved harvest management decisions. Spectroscopy methods utilizing the near-infrared region of the light spectrum is one such technology investigated as an alternative to classic methods and particularly the application of hyperspectral imaging (HSI) has recently gained attention in research. HIS is a spectroscopic technique that obtains hundreds of images at different wavelengths collecting spectral data for each pixel in the sample i.e., providing both spectral and spatial data.

In this study HSI in the visible-near infrared (VNIR) and short-wave infrared (SWIR) regions was tested for determining total soluble solids (TSS), pH and total acidity (TA) of table grapes under laboratory conditions. Imaging of whole bunches as well as individual berries selected from top, middle and bottom positions of bunches was done. The bunches and berries were collected over multiple samples sessions throughout the 2022-23 and 2023-24 seasons allowing for fruit of various maturity levels (unripe though to harvest maturity) to be included. Spectral data was extracted from the images using MATLAB codes developed for this purpose using different analysis approaches. The resulting data is spatial and numerical yielding mean reflectance per pixel across points for entire bunches, and entire berries. Models for determining grape chemical composition were developed using ground-truthing data collected from the sampled fruit. Initial results indicate that this method could be suitable for determining grape ripeness on a bunch or berry level.

**Keywords:** table grapes, hyperspectral imaging, ripeness, quality, spectroscopy.