EFFECT OF SCION-ROOTSTOCK COMBINATIONS ON THE PERFORMANCE OF A NEAR-INFRARED (NIR) SPECTROSCOPY METHOD FOR DETERMINING VINE WATER STATUS

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Abstract:

Context and purpose of the study - In the context of sustainable viticulture, modern and efficient techniques to determine water status are required to optimize irrigation practices. Proximal techniques such as thermography and spectroscopy have shown promising results. When these techniques are incorporated into mobile systems is possible to evaluate the water status on-the-go, offering the possibility to generate variability maps. However, in most cases, complex protocols of data acquisition and analysis are required. Also, the inherent physiological behaviour of the plants under certain water stress conditions needs to be considered. Therefore, the aim of this study was to evaluate the effect of scion-rootstock combinations on the performance of a predefined plant-based method based on proximal near-infrared (NIR) spectroscopy.

Material and methods – During the growing season 2021-2022, a field experiment was conducted in the 'fit-for-purpose' irrigation block at Stellenbosch University, which was designed to study the long-term effects of water deficit on a variety of different cultivars and rootstock combinations. The irrigation block consists of three cultivars and two rootstock combinations namely Cabernet Sauvignon, Pinotage, and Shiraz grafted on 110-Richter and US-87 rootstocks. These combinations are managed with three different irrigation levels. In this study, a robotic platform was used to navigate through the irrigating block and collect the experimental data. On this platform, a NIR spectrometer with a light source was mounted to acquire spectral signals of the vines. Spectral measurements were taken at ~0.30 m from the canopy, on the sunny side (around 11:00 am local time). Midday stem water potential measurements were acquired simultaneously on the same target vines to be used as reference indicators of plant water status. Partial least squares (PLS) regression was used to build the models and the Root Mean Square Error om the cross-validation (RMSEcv) was used to compare the performance of the technique for each rootstock-scion combination.

Results – Accuracy results of the PLS models show a clear effect of the cultivars. When the scions were analysed independently (both rootstocks), the determination coefficients of the cross-validation (R^2cv) ranged from 0.65 to 0.73. However, when all scions were analysed together the accuracy decreased (R^2cv = 0.441). The effect of the rootstock for the same scion was also analysed. In this case, no clear differences were noticed in the trend lines. The R^2cv was slightly higher for 110-Richter probably because the vines reached higher water stress for the same irrigation conditions, especially in Cabernet Sauvignon and Pinotage. The results of this exploratory study show a clear effect of the cultivar in the spectral response to the water stress. Further experiments, involving a wider range of water status, multiple penological periods and a higher number of samples are needed to confirm and quantify this trend.

Keywords: Stem water potential; Water stress; Cabernet Sauvignon; Pinotage; Shiraz; Partial least square.