Investigating water stress-related seasonal and spatial patterns and the possible links with juice and wine compositional parameters

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Abstract

The mapping of spatial variability in vineyards offers the potential to implement zonal management strategies with the aim to optimize economic benefits and increase sustainability by managing natural resources, such as water used for irrigation, more optimally. This study characterized the (natural) variability in plant water status in a commercial Cabernet Sauvignon block, using remote sensing techniques, and identified the impact of this variability on the yield, and juice and wine composition. From the field data collected over two growing seasons, we demonstrated that remote sensing techniques are a practical and powerful tool for mapping spatial variability within vineyard blocks. The results of this study show the presence of consistent spatial patterns over seasons and highlight the potential of using monitoring techniques to categorize distinct zones within the vineyard with a clear impact on quality parameters, especially in the most water stressed vines, exhibiting higher levels of anthocyanins, tannins, polymeric pigments, total phenolic index, and colour density compared to low water stress vines. Correlation analysis demonstrated significant and complex relationships between water stress and various parameters. Notably, canopy parameters determined by remote sensing techniques emerged as a key influencer, showing correlations with vinicultural parameters like pruning weight, number of bunches, and yield.

Keywords: Spatial variability, Precision viticulture, Remote sensing, water stress, juice and wine composition.