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STUDY OF THE USE OF SATELLITE SPECTRAL INFORMATION TO ASSESS AND BENCHMARK THE VINE VIGOUR VARIABILITY IN CV. SUGRATHIRTYFIVE (AUTUMNCRISP® BRAND)

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Background

Table grape productivity and quality are affected by various parameters such as spatial and temporal variability, weather conditions and agronomic practices.

Introduction

During the last decade, satellite images in conjunction with digital methods and image processing techniques have been widely used in agriculture to monitor the behaviour of different crops at different spatial scales. In this context, the Sentinel-2 satellites (2A and 2B) provide freely-available images with high spatial, temporal, and spectral resolution covering the visible (VIS), near-infrared (NIR) and shortwave-infrared (SWIR) spectral regions. Monitoring and mapping vine growth and vineyard conditions (vigour) using remote sensing techniques can improve the precision of input deliveries and help predict crop productivity and quality trends. Therefore, the objective of the study was to analyse the possibilities of using Sentinel-2 data to assess vine vigour variability at different stages of development based on ground-truth measurements as reference values.

Method

The study was conducted in five commercial table grape vineyard plots (cultivar sugrathirtyfive - AUTUMNCRISP® brand), located in different areas of the south of Italy, during the growing season of the year 2022. In each plot, sampling areas were defined and geolocated to facilitate field sampling in order to assess several parameters of crop vigour (leaf area index (LAI) and shoot diameter), yield (yield per plant, cluster weight and berry weight), and grape quality (sugar concentration). Sentinel images were downloaded

from the ESA's (European Space Agency) Copernicus project website. Images were filtered and analysed manually in order to obtain cloud-free products in the vineyard plot areas. With the spectral values obtained from the different bands of 13 images, we proceeded to calculate the standard Normalized difference vegetation index (NDVI). All image analysis and statistical comparisons were conducted using the R Statistical language (version 4.2.2; R Core Team, 2022).

Results

The use of Sentinel-2 satellite images implies that the NDVI values are not pure vegetation, they also include soil or other types of surfaces present in vineyards. Therefore, in this case, NDVI is an indicator of vigour per unit area. NDVI heterogeneity expressed as coefficient of variation (CV) was changing over time and was different for each vineyard plot, ranging from 1.0 to 17.6%. The temporal evaluation of NDVI indicated a similar trend on all plots, reaching stable values around veraison. The comparison of NDVI values with ground truth data indicated strong correlations for all variables measured at harvest. Combining all plots, the highest correlation value (r) value was 0.87 for the average berry diameter. In the case of, yield per vine the r value was 0.73. Also, significant a correlation was indicated for shoot diameter and LAI, both measured through the growing season.

Conclusion

The results of the study demonstrate the applicability of spectral information (Sentinel-2 satellite images) for monitoring the spatial and temporal variability of vigour on table grape vineyards at plot scale. The increase in vigour characterized by NDVI implied an increase in yield parameters and a decrease in sugar concentration. Further research is needed to verify the reliability of this technique, considering more sampling points per plot and contrasting conditions (e.g., different cultivars, management practices, soil types, and weather conditions).