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## The use of multi-level and multi-scale spectral data approach to evaluate the vineyard status.

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### Abstract

Currently, the main goal of agriculture is to promote the resilience of agricultural systems in a sustainable way through the improvement of use efficiency of farm resources, increasing crop yield and quality, under climate change conditions. This last is expected to drastically modify plant growth, with possible negative effects especially in arid and semi-arid regions of Europe on the viticultural sector. In this context, the monitoring of spatial behavior of grapevine during the growing season represents an opportunity to improve the plant management, winegrowers' incomes, and to preserve the environmental health, but it has additional costs for the farmer. Nowadays UAS equipped with a VIS-NIR multispectral camera (blue, green, red, red-edge, and NIR) represents a good and relatively cheap solution to assess plant status spatial information (by means of a limited set of spectral vegetation indices), representing important support in precision agriculture management during the growing season. While differences between UAS-based multispectral imagery and point-based spectroscopy are well discussed in the literature, their impact on plant status estimation by vegetation indices is not completely investigated in depth. The aim of this study was to assess the performance level of UAS-based multispectral (5 bands across 450-800nm spectral region with a spatial resolution of 5cm) imagery, reconstructed high-resolution satellite (Sentinel-2A) multispectral imagery (13 bands across 400-2500 nm with a spatial resolution of <2 m) through Convolutional Neural Network (CNN) approach, and point-based field spectroscopy (collecting 600 wavelengths across 400-1000 nm spectral region with a surface footprint of 1-2 cm) in a plant status estimation application, and then, using Bayesian regularization artificial neural network for leaf chlorophyll content (LCC) and plant water status (LWP) prediction. The approach was realized within the Italian regional project GREASE, in an experimental vineyard of Greco of Feudi di San Gregorio winery (southern Italy), where detailed and precise records on soil and atmosphere systems, in-vivo plant monitoring of eco-physiological parameters have been conducted.

**Keywords:** precision agriculture, vineyard monitoring, spectral measurements, CNN applied to viticulture, UAS.