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Airborne surveys for the detection of Flavescence Dorée in vineyards

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Flavescence Dorée (FD) is one of the most severe diseases affecting the main viticultural areas of Europe primarily due to a vine-specific leafhopper, Scaphoideus titanus, which indirectly transmits the pathogen to the plant's phloem. In infested grapevine areas where the disease is epidemic and is allowed to spread uncontrolled, epidemic flavescence dorée had catastrophic consequences on yield. Once infected, plants are beyond cure; the only options are severe pruning or total removal. This devastating disease compromises plant growth and can damage entire wine-producing regions, causing substantial economic losses. Delayed symptom recognition contributes significantly to the spread of FD, making early detection strategies essential to effectively manage and mitigate the disease's impact on vineyards.

In this context, remote sensing marks a paradigm shift compared to traditional ground-based surveys. The acquisition of high-resolution images from aircrafts or drones enables efficient scanning of large vineyard areas and detecting subtle changes in leaf color or vigor, enabling faster responses and precise interventions.

In this case study the Radgyro, an experimental aircraft designed for environmental monitoring, surveyed during the initial stages of the disease onset a vineyard of Sangiovese grape variety located in the Emilia-Romagna region (Italy), covering collectively approximately 19 ha with a single 17 min-flight. The centimeter-level resolution of the images acquired by the optical sensors mounted on the Radgyro were automatically processed off-line through a tailored software. The analysis pipeline includes the processing of RGB index maps, where carefully tuned index thresholds were adopted to identify the pixel groups with leaf color attributable to FD symptoms. Spatial clustering algorithms are applied to eliminate noise and isolate potentially diseased plants.

The final outputs of the process are the potentially diseased plants, FD density and incidence maps, i.e. prescription maps which provide direct operational guidelines for the FD containment interventions.

On field validation surveys revealed that the process analysis detected 86% of true positive and only 1% of false negative, underscoring an excellent agreement between the remote and ground surveys. Thanks to the high quality of the acquired images and the automatized process analysis, this methodology revealed effective in identifying FD symptoms in the single leaves with a precision comparable to traditional and time-consuming ground-based surveys.

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