Poster

Early remote detection of downy mildew on grape vine by fluorescence methods

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Abstract

Pathogenic fungi severely threatens the annual yield of grapes in quantity and quality. Therefore, viticulture requires intensive fungicide applications, compared to other crops. Aimed at a reduction of fungicide input, different techniques and combined strategies are applied in viticulture. To successfully reduce losses in yields, early detection techniques are required. In this work we present premeasurements to remotely detect a pathogenic fungus on the leaves of *Vitis vinifera* (Müller-Thurgau). We were able to detect a leaf infection with *Plasmopara viticola* (causal agent of downy mildew) on potted vines within the first week after inoculation. Our results could be reproduced over multiple samples and different methods. Fluorescence mapping was used to monitor the blue-green fluorescence and chlorophyll fluorescence behaviour over a wide area of excitation wavelengths. Based on this, spectral data of fluorescence emission was recorded via fluorometric measurements with excitation at different wavelengths in the visible and UV range. Furthermore, we used laser-induced fluorescence (LIF) and hyperspectral imaging to verify our results. Additionally, we combined hyperspectral imaging with LIF. The evaluation was based on the ratio of blue fluorescence to far-red fluorescence (BFRR_UV) and normalized difference vegetation index (NDVI), which represent an established method in many agricultural applications. Eventually, we evaluated the scalability of our methods for long term measurements. Our results form a fundamental approach for the design of a laser-based stand-off detection system for the practical application in vineyards. Such a system can serve as a model technology for early detection of pathogenic diseases and opens a window for early countermeasures. As mildew infection is considered the most damaging disease in European viticulture, these early countermeasures could greatly reduce the environmental and economic cost associated with fungicide application.

Keywords: remote detection, fluorescence, LIF, hyperspectral imaging, grapevine, pathogenic fungi, downy mildew