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Detection of unique electromagnetic signatures from GLRaV-3 infected grapevine leaves at different stages of virus development.

Abstract: Grapevine leafroll associated virus 3 (GLRaV-3) is one of the most common viruses that adversely affect grape production quality around the world. Grapevine virus is usually detected by polymerase chain reaction (PCR) tests, but the main diagnostic challenges with the PCR are uneven distribution of symptoms, low virus titers in early stage, and the tests are time consuming and expensive. In the absence of effective control and treatment for grapevine virus, the recommendation is to remove infected vines before they become a source of transmission and a rapid and early detection method for viruses is urgently needed. This study investigated how GLRaV-3 infection affects spectral behavior of grapevine leaves and the use of remote sensing tools to identify changes caused by the biotic stress. A Real-Time RT-qPCR test was performed to select representative vines with healthy and GLRaV-3 infection, and changes in electromagnetic (EM) spectrum of leaves were observed with a portable hyperspectral spectrometer and a multispectral sensor on a remotely piloted aircraft system (RPAS). The results of this study suggest that foliar EM reflectance may differ depending on the presence or absence of visible symptoms of infected leaves and different stages of virus infection progress could be indicated by changes in the relative rate of reflectance around 700 nm. This research also confirmed that the development of a narrow-band hyperspectral index for the detection of grapevine virus is feasible, further research is recommended in a much more comprehensive investigation including a combination of hyperspectral sensor and chlorophyll fluorescence sensors, interpolation of suspect wavebands into ratios or indices.

Keywords: crop stress sensing, early virus detection, portable spectrometer, hyperspectral sensor, multispectral sensor, remotely piloted aircraft system (RPAS)

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Biography: I earned a PhD in Plant Science, specialized in 'Remote Sensing of Plant Stress' from Brock University, Niagara, Canada. I have been involved in developing research methods for site-specific crop management using remote sensing technologies as well as providing recommendations of innovative technologies for growers at Brock University. Currently, I lead a team developing methods for incorporating spatial variability in agriculture into digital farming decision-making including site-specific nutrition and water management, and integrated pest management with early detection of biotic stress from fungus, bacteria, and viruses.

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