Monitoring Grapevine Downy Mildew Epidemics with SkySat and PlanetScope Imagery

Authors: Kathleen KANALEY[1*], Angela PAUL[1], David COMBS[1], Ertai LIU[2] , Yu JIANG[2], Kaitlin M. GOLD[1]

[1] *Plant Pathology and Plant Microbe Biology Section, Cornell Agritech, 15 Castle Creek Drive, Geneva, NY, United States 14456*
[2]*Horticulture Section, Cornell Agritech, 635 W North St, Geneva, NY, United States 14456*

*Corresponding author: *kk697@cornell.edu*

Abstract:

Context and purpose of the study – Grapevine downy mildew (GDM), caused by the oomycete *Plasmopara viticola*, is one of the most destructive diseases of *Vitis vinifera* worldwide. All *V. vinifera* cultivars are susceptible to *P. viticola* infection, and epidemics can spread across an entire vineyard within a matter of weeks. Severe outbreaks cause substantial reductions in yield and fruit quality. Tracking GDM spread by manual scouting is time-consuming and unfeasible over large spatial extents. Satellite remote sensing could be a valuable tool for rapid, scalable disease monitoring but has been challenged by the coarse spatial and temporal resolution of existing spaceborne sensors. We investigated the utility of two new satellite constellations, SkySat (50cm spatial, 4 band spectral resolution) and PlanetScope (3m spatial, 8 band spectral resolution) for mapping GDM epidemics in Geneva, New York. This study aims to assess whether and how these new sources of satellite imagery can be used to monitor GDM in vineyards.

Material and methods - We acquired weekly SkySat images of a pathology research vineyard in Geneva, NY during the months of June-September in 2020, 2021, and 2022. We calculated a series of vegetation health indices (VIs) to assess spatio-temporal changes in health of vines (*Vitis vinifera* cv. Chardonnay) with varying levels of GDM (0-84% disease severity). We coupled this assessment with a time series analysis of higher frequency PlanetScope imagery aligned with SkySat collections over the three year period. Scouts performed weekly disease severity measurements following standard best practices for ground validation.

Results - VIs calculated from SkySat imagery are significantly different for low (<10% symptomatic leaf area) and high (>10% symptomatic leaf area) severity GDM infections. Differences in VIs enable identifying and mapping distinct disease classes once GDM exceeds the 10% severity detection threshold. We were unable to use SkySat VIs to differentiate between healthy vines and those with low severity infections. Additionally, while PlanetScope's 3m resolution was insufficient to track GDM in individual grapevine panels, near-daily revisit time enables more consistent monitoring of broad-scale changes in grapevine health. Our findings suggest that SkySat's enhanced spatial resolution enables mapping of severe GDM outbreaks, while the higher spectral and temporal resolution of PlanetScope's 3m imagery offers near-daily visualization of general plant health trends. Neither of these data streams had sufficient spectral resolution to differentiate between damage caused by GDM and that caused by co-occurring diseases. Our results indicate that SkySat and PlanetScope are promising tools for grapevine disease monitoring.

Keywords: Grapevine downy mildew, *Plasmopara viticola*, SkySat, PlanetScope , Remote sensing, Satellite imagery, Vegetation indices, Digital viticulture.