

MYCOPHAGOUS LADYBUGS, AN INDICATOR OF POWDERY MILDEW IN VINEYARDS?

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Powdery mildew is a serious pathogen affecting vineyards. Sulfur or other chemicals are applied when the pathogen is first detected or anticipated. Management programs can be initiated based on plant growth stage, environment-climate models, and PCR detection using spore traps. Researchers from UC Davis have been investigating the presence of the mycophagous ladybug, *Psyllobora vigintimaculata*, in vineyards as a low-cost monitoring tool for powdery mildew. This ladybug is a voracious consumer of powdery mildew spores. Based upon results from 2008, *P. vigintimaculata* was commonly captured in a variety of crops in the Mid-Willamette Valley.



Objectives

1. Determine if the presence of mycophagous ladybugs in Mid-Willamette vineyards correlates with the presence of spores on trap rods.
2. Compare the efficiency of white and yellow sticky traps for detecting *P. vigintimaculata*.

Methods

White and yellow sticky traps were paired together and hung within 10 m of a spore trap in nine vineyards starting from 20 April 2009. Sticky traps were monitored in five vineyards from 1 June to 20 August. In vineyards with multiple spore traps, sticky traps were placed in the internal row and were directly compared to the spore trap in the same area.



The presence of powdery mildew spores was detected by PCR. If a sample was positive, a qPCR was conducted to estimate spore load. Since sticky traps were changed weekly and spore traps were changed twice a week, sticky traps were paired with both spore samples taken over the same week for data analysis. A negative and positive spore sample within a week was counted as positive. If two Ct values (PCR cycles to meet threshold) were available within a week, the lowest Ct value (higher spore load) was used for analysis.

Does *P. vigintimaculata* occur when powdery mildew spores are detected?

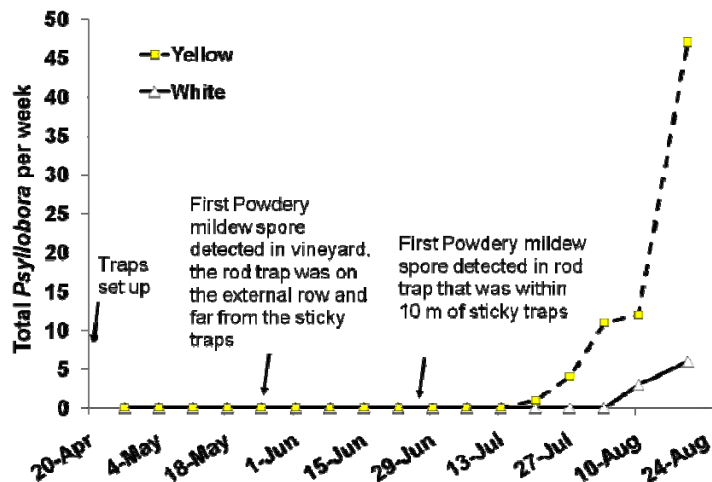
Trap color	Spores present (n,%)		Spores absent	
	Yellow	White	Yellow	White
Ladybug present	8 7.3%	3 2.8%	6 5.5%	3 2.8%
Ladybug absent	3 2.8%	8 7.4%	92 84.4%	95 87.2%
Total	11	11	98	98

Psyllobora vigintimaculata and powdery mildew spores were both present or absent in 91.7% of yellow sticky traps, and 90% of white sticky traps. Specifically, 7.3% of yellow and 2.8% of white sticky traps had detected *P. vigintimaculata* when the nearby spore trap had also detected powdery mildew. Most traps, 84.4% and 87.2%, did not capture *P. vigintimaculata* and likewise no spores were detected.

False negatives where spores were present but no *P. vigintimaculata* appeared accounted for 2.8% of yellow and 7.4% of white sticky traps. False positives where no spores were detected but *P. vigintimaculata* were present accounted for 5.5% of yellow and 2.8% of white traps. These false positives occurred later in the season and may result from powdery mildew being present at a different life stage not detected in the spore trap but could be fed upon by these ladybugs. Alternatively, a false positive may also result from ladybugs feeding on other types of powdery mildew on the ground cover or surrounding vegetation.

Does *P. vigintimaculata* show up early enough with the first spore detection?

The first ladybug appeared four weeks after spores were detected in the nearby spore trap (graph). When spores were detected in another distant rod trap in the vineyard, there was a two month lag before detecting the ladybug.



Which trap color more efficiently detects *P. vigintimaculata*?

Yellow sticky traps collected more *P. vigintimaculata* than white sticky traps when spores are present. Pearson $\chi^2 = 4.5$, $df = 1$, $P = 0.03$.

Overall, yellow sticky traps consistently captured more *P. vigintimaculata* over the season. ANOVA for *P. vigintimaculata*: Yellow vs. white trap $F_{1,176} = 20.9$, $P < 0.001$, vineyard site $F_{8,176} = 1.7$, $P = 0.093$, collection week $F_{16,176} = 12.4$, $P < 0.001$, trap type*week interaction $F_{16,176} = 125$, $P < 0.001$.

Does abundance of *P. vigintimaculata* correlate with spore load?

Data at this point does not point towards a correlation; more samples may be needed to determine the relationship. The Ct value from qPCR indicates the number of PCR cycles needed to reach a threshold. Higher spore loads have lower Ct values. When both spores (y-axis) and *P. vigintimaculata* (x-axis) were present, a regression with 11 data points was not significant. $F = 1.8$, $df = 1, 9$, $P = 0.21$. When spores were present, a regression with 22 data points was not significant. $F = 0.18$, $df = 1, 20$, $P = 0.68$.