

SUMMARY FINAL REPORT

ECOLOGY OF GRAPEVINE RED BLOTCH VIRUS

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Background

Red blotch disease is a recently recognized new threat to the grape and wine industry in the United States. Grapevine red blotch virus (GRBV), the causal agent of red blotch disease, is documented in all major grape-growing and its economic impact on vineyard profitability can be substantial. The three-cornered alfalfa treehopper (TCAH, *Spissistilus festinus* [Say]) has been shown to transmit GRBV from infected to healthy vines under greenhouse conditions but limited infection is available on the ecology of red blotch disease, stressing the need for studies in diseased vineyards. The overarching goal of our research is to advance our understanding of the ecology of red blotch disease with a major emphasis on attributes of GRBV spread, the potential epidemiological role of vineyard cover crops, the experimental host range of GRBV, and the dissemination of science-based information to the grape industry.

Research objectives

1. Characterize attributes of the spread of grapevine red blotch virus by *Spissistilus festinus*
 - a. Describe the transmission mode of GRBaV by *Spissistilus festinus*
 - b. Test sentinel vines established in a diseased vineyard where spread is documented for the presence of GRBaV
 - c. Investigate the seasonal diversity and distribution of vector candidate populations in a diseased vineyard for which there is no evidence of spread
2. Determine if vineyard cover crops can host GRBaV and/or *S. festinus*
 - a. Survey cover crops in Napa Valley vineyards for *S. festinus*
 - b. Survey cover crops in Napa Valley vineyards for GRBaV
3. Determine the experimental host range of grapevine red blotch virus and *S. festinus*
 - a. Agroinoculate commonly used vineyard cover crop species with infectious GRBaV clones and assess virus infection
 - b. Examine the reproductive potential of *S. festinus* on commonly used vineyard cover crop species
4. Disseminate research results to the grape and wine industry, and to farm advisors

Highlights of the work performed

- Analyzing the spatiotemporal incidence of grapevine red blotch virus (GRBV) over a five-year period (2014–2018) documented a 2.5%, 0.5% and 0% annual increase in a 5-acre Cabernet franc vineyard in California, an adjacent 4-acre Cabernet Sauvignon vineyard in California, and a 2-acre Merlot vineyard in New York, respectively

- An assessment of co-occurrence and covariation between the spatial distribution of GRBV-infected vines and viruliferous insects identified a significant association with viruliferous *Spissistilus festinus*
- Viruliferous *S. festinus* culminated in late-June to early July in diseased vineyards in California
- A possible association between virus spread and relative abundance of *S. festinus* populations was identified in California vineyards
- No *S. festinus* and no vector candidates were identified in the diseased Merlot vineyard in New York
- A single sentinel vine established in the area of the Cabernet franc vineyard where virus spread is readily occurring tested positive for GRBV by PCR three years post-planting. This vine was asymptomatic in 2018
- The transmission mode of GRBV by *S. festinus* is circulative, non-propagative
- None of the vineyard middle-row cover crop samples, including legumes, i.e. bell beans, field peas, vetch, clover, etc., from diseased California vineyards tested positive for GRBV in spring 2014-2018, suggesting that vineyard cover crops are unlikely serving as GRBV reservoirs
- No *S. festinus* was caught by sweep netting of cover crops in vineyard middle-rows in Spring 2017-2018
- *S. festinus* completes its reproductive cycle on alfalfa and snap bean but not on *Vitis vinifera*
- Tomato, snap bean, and *Nicotiana benthamiana* are experimental, herbaceous hosts of GRBV
- Knowledge of the ecology of red blotch disease is guiding the development of disease management strategies
- Information on the ecology of red blotch disease was disseminated to the wine and grape industry during winter meetings

Accomplishments

- Provided insights into the spread of GRBV and population dynamics of *S. festinus* in vineyards informed epidemiological features of red blotch disease
- Documented a differential spread of GRBV in California and New York vineyards
- Determined that grape is not a reproductive host of *S. festinus*
- Identified an association between the dynamics of GRBV spread and the relative abundance of *S. festinus* populations
- Learned that it takes three years for a vine of clean status to become infected with GRBV, likely via *S. festinus*-mediated transmission, when established in a section of a vineyard where disease incidence is high and virus spread is readily occurring
- Disseminated research progress on the ecology of red blotch disease to the industry
- Recommended red blotch disease management tactics based on the eliminating of virus inoculum sources in vineyards through roguing or block removal, depending on the level of disease incidence
- Recommended red blotch disease management tactics to ignore actions against *S. festinus*
- Many growers in California have adopted the recommended red blotch disease management strategies