

2025

PD/GWSS Board Research Projects At a Glance

cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

CALIFORNIA PD/GWSS BOARD
Partnership for Winegrape Pest Solutions

Introduction

In the face of increasing risks of invasive pests and diseases from around the nation and the world, California's winegrape growers turn to the innovative grower-government partnership created over 25 years ago to protect their vineyard investment. The Pierce's Disease and Glassy-Winged Sharpshooter (PD/GWSS) Board invests in research and outreach to protect vineyards, prevent the spread of pests and diseases and deliver practical and sustainable solutions.

The consistent, reliable funding made possible by the winegrape grower assessment supports leading researchers in finding solutions to PD and other serious grape pests and diseases. Learn more at cdfa.ca.gov/pdcp/PD_GWSS_Board.html.

Research progress reports are compiled annually by the Pierce's Disease Control Program and are available online at cdfa.ca.gov/pdcp/Research.html.

The following is an overview of the 2025 research progress reports.

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Research on Pierce’s Disease and the Glassy-Winged Sharpshooter

Modeling the Bacterial Transmission Process by Integrating New Behavioral Insights into Computational Fluid Dynamics Simulations

Project Leader and Cooperators: *Rodrigo P.P. Almeida and Elizabeth G. Clark, University of California, Berkeley; Saad Bhamla, Georgia Institute of Technology; Andrew J. McElrone, University of California, Davis; Daniele Cornara, Università degli Studi di Bari; Craig R. Brodersen, Yale University and Brandt M. Gibson, University of Toronto, Mississauga*

Understanding how sharpshooters spread *Xylella fastidiosa (Xf)* to host plants is critical to preventing the spread of Pierce's disease (PD). This project focused on developing a physics-based computer model to simulate how bacteria move during insect feeding. This work provides a strong technical foundation for future studies to test how specific insect feeding behaviors and plant vessel characteristics influence bacterial transmission, helping guide strategies to disrupt the spread of PD.

The team developed and verified a sophisticated computational framework that simulates fluid flow inside a sharpshooter-inspired feeding canal, incorporating insect anatomy and electrical feeding signals. They successfully established and tested the modeling infrastructure needed to simulate fluid movement with moving boundaries. Next, the team plans to operate full simulations tracking bacteria-sized particles and biological validation experiments.

Progression of Pierce's Disease Symptoms and *Xylella fastidiosa* Colonization of Grapevines Under Field Conditions

Project Leader and Cooperators: *Rodrigo P.P. Almeida, University of California, Berkeley; Monica Cooper, University of California, Cooperative Extension, Napa County; and Matthew Daugherty, University of California, Riverside*

This project fills a critical gap in understanding how mature grapevines respond to *Xylella fastidiosa (Xf)* infections under field conditions. The team studied Pierce's disease (PD) in a 10-year-old vineyard at a UC research station in Hopland, CA, tracking disease progression across 13 wine grape cultivars. Vines were challenged with two different strains of *Xf*: one native to Mendocino ("cold strain"), and another native to Bakersfield ("hot strain"). Researchers observed new symptoms in some cultivars, including shriveled berries within the first year, and confirmed that winter recovery varies by grape cultivar and bacterial strain. Generally, the "cold strain," native to the study site, resulted in stronger symptoms and more persistent infections over winter than the "hot strain" of the pathogen.

The team also investigated how winter xylem sap collected from the different grape cultivars affects *Xf* survival in potted vines and in the lab. Preliminary results suggest that sap composition during dormancy may affect bacterial persistence, and previously infected vines may be more resistant to reinfection. This highlights both the complexity of PD progression in different environmental conditions and demonstrates that different *Vitis vinifera* cultivars may be able to both tolerate and recover from *Xf* infections due to the chemical makeup of their sap.

Finally, the team continues to collect data to create predictive models to assess how the degree and extent of cold winter temperatures impact bacterial survival in reinfection risk. These findings could lead to significant breakthroughs in disease management, helping growers make informed decisions about cultivar selection and vineyard practices.

Development of Tools for Precise Breeding of Grapevine Cultivars Resistant to Pierce's Disease

Project Leaders and Cooperators: *Dario Cantu, Mirella Zaccheo and M. Andrew Walker, University of California, Davis and Summaira Riaz, USDA Agricultural Research Service*

This project is developing precise breeding tools to create grape varieties resistant to Pierce's disease (PD) while maintaining fruit quality. Researchers refined the PdR1 resistance region from *Vitis arizonica* and identified two leading candidate genes, along with others that may contribute to PD resistance.

Transgenic plants overexpressing two candidate genes have been produced and are being propagated for disease testing. Gene-editing efforts to remove these genes from resistant plants are also underway. Comparative genomic work revealed significant differences among PdR1 versions, suggesting multiple resistance mechanisms.

Next, the team will conduct disease assays to confirm which genes confer resistance and use that information to develop functional markers that identify the gene in newly bred genotypes. This will help breeders build durable PD resistance into new grape varieties more quickly.

Management of the Federal Permits for Multi-Investigator Field-Testing of Transgenic Grapevine Rootstocks in California

Project Leaders and Cooperators: *Abhaya M. Dandekar, Ana M. Ibáñez and Cecilia Aguero, University of California, Davis*

This project manages a federal permit from the Animal Plant Health Inspection Service-Biotechnology Regulatory Service (APHIS-BRS), enabling multi-investigator field testing of transgenic grapevine rootstocks and scions in California. The current and fifth permit, approved in May 2025 and active through May 2027, supports final field data collection, regulated site termination and mandatory post-termination monitoring.

All transgenic plant material at the site was fully removed in August 2025. The focus now is on completing the required monitoring and reporting to formally close out the regulated field site.

Assessing the Effectiveness of Flupyradifurone at Eliminating *Homalodisca vitripennis* Egg Masses on Nursery Stock

Project Leaders and Cooperators: *Matt Daugherty and Bodil Cass, University of California, Riverside and Christopher Shogren, University of California, Cooperative Extension, Los Angeles County*

This project is evaluating whether the insecticide flupyradifurone (Altus™, Bayer CropScience LP) could be added to the Pierce's Disease Control Program's Approved Treatment Protocol used by nurseries to prevent the spread of glassy-winged sharpshooter (GWSS) on shipped plants. Adding another option would provide greater flexibility for nurseries while maintaining strong regulatory safeguards.

Initial trials conducted in late summer and fall 2025 on three common ornamental nursery plants were inconclusive in showing whether flupyradifurone was effective at preventing GWSS egg hatch. Results varied by plant species, and high levels of natural parasitism were observed during the study. Additional trials are planned to increase replication and strengthen conclusions before determining whether flupyradifurone should be included in the treatment protocol.

Development of a Protoplasts-Based Platform to Knock-in Agriculture Relevant Genes into Grapevines

Project Leaders and Cooperators: *Juan Debernardi, Dario Cantu and David Tricoli, University of California, Davis*

Watch the video report: youtube.com/@PD-GWSS-Board

This project is advancing a CRISPR-based gene-editing platform that enables researchers to precisely insert entire genes into grapevines without altering the core genetics of established varieties. So far, the team has successfully inserted a test gene into specific locations in the grape genome using a protoplast regeneration system and confirmed integration in regenerated plants. This demonstrates that targeted gene insertion can be achieved in cultivated grape varieties without relying on traditional transgenic methods.

Next, the team will use this platform to insert Pierce's disease resistance genes identified in *Vitis arizonica* into commercial *Vitis vinifera* cultivars and evaluate the resulting plants. This method could provide a more sustainable way to develop disease-resistant grapevines while preserving the identity and quality of existing wine and table grape varieties.

Optimizing Biopesticide Strategies for Pierce's Disease Management in Recovered Vineyards

Project Leader and Cooperators: *Akif Eskalen and Marcelo I. Bustamante, University of California, Davis; Steven Lindow, University of California, Berkeley; Philippe Rolshausen, University of California, Riverside; and Jean Rodriguez, A&P Inphatec*

This project is evaluating biological treatments to manage Pierce's disease (PD) in vineyards that have previously been infected and partially recovered. This work supports the development of practical, sustainable biopesticide strategies to help growers manage PD and extend vineyard productivity. The team's goal is to optimize the use of beneficial bacteria and a bacteriophage-based product (XylPhi-PD®) applied by trunk injection or foliar spray.

In 2025, field trials were conducted at two sites. At both locations, most biological treatments reduced PD symptom severity compared to untreated vines. Injection treatments containing XylPhi-PD®, alone or in combination with beneficial bacteria, consistently produced the lowest symptom ratings. Molecular testing to quantify *Xylella fastidiosa* levels is underway to link symptom reduction with pathogen suppression. Next, the team will complete qPCR analyses and expand trials to additional naturally infected vineyards to refine application timing and combinations.

Field Evaluation of Cross-Graft Protection Effective Against Pierce's Disease by Dual DNA Constructs Expressed in Transgenic Grape Rootstocks

Project Leader and Cooperators: *David Gilchrist, Abhaya Dandekar, James Lincoln and Bryan Pellissier, University of California, Davis*

This work provided valuable field-based insight into the long-term potential of rootstock-based resistance strategies. This project evaluated whether specially engineered grape rootstocks carrying pairs of disease-suppressing genes could protect non-transgenic Chardonnay scions through cross-graft protection. The transgenic rootstocks were planted in 2019, inoculated with *Xylella fastidiosa* in 2021 and 2022, then managed according to commercial standards. Researchers collected data on PD symptoms and bacterial movement to determine whether stacking pairs of genes with different molecular functions could reduce disease impact across the graft union.

The active field research phase ended, and the project has entered a required post-trial monitoring period under the federal APHIS permit. This agreement supports ongoing field maintenance, regulatory compliance and monitoring of any remaining or volunteer transgenic material through 2027.

Using the Native Grapevine Immune System to Generate Pierce's Disease Resistant Grapevines

Project Leader and Cooperator: *Caroline Roper, University of California, Riverside and David Tricoli, University of California, Davis*

Watch the video report: youtube.com/@PD-GWSS-Board

This research focuses on helping grapevines better defend themselves against Pierce's disease (PD) by strengthening their natural immune system. This work will help determine whether boosting beneficial immune responses or removing harmful ones can improve PD resistance. If successful, these strategies could guide future breeding or biotechnology efforts to provide growers with additional long-term tools to manage PD.

The team is identifying grape genes that improve resistance to *Xylella fastidiosa (Xf)* and testing whether increasing their activity can reduce disease severity. They have identified several genes linked to effective defense responses and introduced five of these into Thompson Seedless vines using transgenic methods. Early results show that stimulating the vine's immune system can reduce PD symptoms and limit the formation of tyloses, which can block water flow and worsen disease damage. At the same time, researchers are developing CRISPR gene-editing tools to remove genes linked to PD susceptibility, particularly those involved in excessive tylose formation.

The team is now propagating the new transgenic grape lines and confirming successful gene insertion before moving them into greenhouse disease trials. Once ready, vines will be exposed to *Xf* and evaluated for PD symptoms, bacterial levels and internal xylem blockage. CRISPR-edited lines are also being developed and will undergo the same testing.

Interactions Between the Spotted Lanternfly and Pierce's Disease of Grapevines

Project Leaders and Cooperators: *Cristina Rosa, Michela Centinari and Julie Urban, The Pennsylvania State University; Caroline Roper, University of California, Riverside and Carmen Gispert, University of California, Cooperative Extension, Riverside Palm Desert Campus*

The spotted lanternfly (SLF) is an invasive insect now established in the eastern United States and moving west, raising concerns about its potential impact on California vineyards. While SLF feeding damage is already a concern, growers also need to know whether this insect can transmit major grapevine diseases, such as Pierce's disease (PD) and grapevine red blotch virus (GRBV). The team's findings suggest that SLF are unlikely to be significant vectors of PD or GRBV under greenhouse conditions, and the risk of disease spread appears to range from none to low.

Over two field seasons, researchers tested whether SLF could acquire these pathogens from infected vines and transmit them to healthy grapevines. Results showed that SLF can ingest *Xylella fastidiosa (Xf)* from infected vines and retain bacterial DNA for a short time. However, despite extensive greenhouse transmission trials, none of the healthy recipient vines became infected with PD or GRBV.

Feeding behavior studies also found that SLF feed on both healthy and PD-infected vines, with no strong preference, although they did not thrive when feeding only on grapevines. Even when large numbers of insects were allowed to feed on healthy vines for extended periods after acquiring the bacteria, no disease transmission was confirmed. Researchers will continue studying how long *Xf* may persist within the insect and where it is in the body to better understand any remaining transmission risk.

Can Spotted Lanternfly Transmit Pierce's Disease? An In-Depth Investigation into Acquisition of *Xylella fastidiosa*

Project Leader and Cooperators: *Julie Urban, Holly Shugart, Cristina Rosa and Micheal Centinari, The Pennsylvania State University*

As the invasive spotted lanternfly (SLF) moves west, growers need clear answers about whether this pest could make Pierce's disease (PD) worse by spreading *Xylella fastidiosa (Xf)*. This project is designed to determine whether SLF is a true disease vector or mainly causes damage through feeding. The results will help growers prepare for the possible arrival of SLF in PD-affected regions and make informed management decisions.

To answer this question, researchers are studying a key first step in transmission: whether SLF can pick up the PD bacterium and how long it remains inside the insect. In this initial phase, the team refined its study methods to improve accuracy and comparability with other research. The main transmission experiments are planned for the upcoming research season.

Blocking the Acquisition and Transmission Cycle of *Xylella fastidiosa* by Glassy-Winged Sharpshooter Using Genetic Control

Project Leaders: *Linda L. Walling, Peter W. Atkinson, Richard A. Redak, Jason E. Stajich, Jun Li, University of California, Riverside and Rodrigo P. P. Almeida, University of California, Berkeley*

This project aims to provide growers with a long-term, environmentally targeted tool to suppress glassy-winged sharpshooter (GWSS) populations and reduce the spread of Pierce's disease. The research team is developing two genetic control strategies. The first, called "anti-adhesion," is designed to create GWSS that cannot efficiently acquire or transmit *Xylella fastidiosa (Xf)* by producing proteins that block the bacterium's attachment within the insect. The second strategy, known as X-chromosome shredding, is intended to reduce GWSS populations by skewing the sex ratio toward males, lowering female numbers over time. Past work by this team has established GWSS as a model organism for research into these genetic tools for disease management.

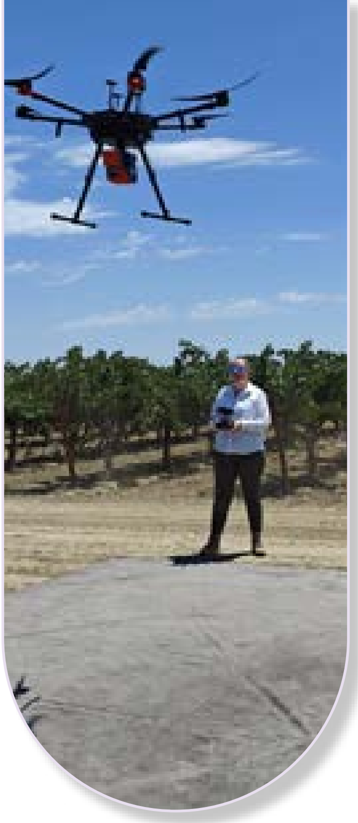
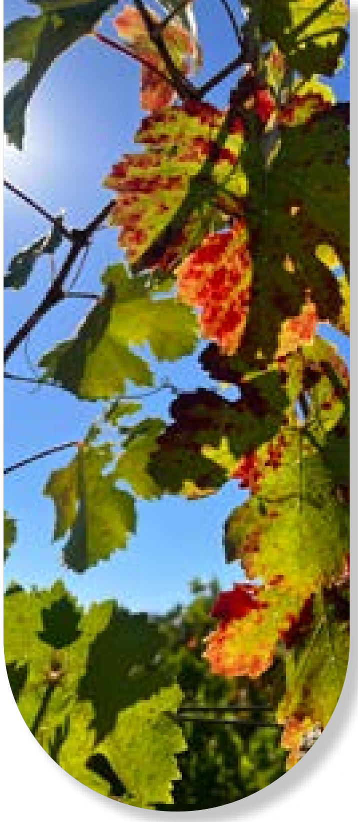
During this reporting period, researchers strengthened the CRISPR-based tools needed to build these strategies. They identified key DNA sequences on the GWSS X chromosome, tested gene promoters that improve gene-editing efficiency, and developed a new strain to enhance precise gene insertion. The team also identified promising genes active in the insect's feeding organs and began optimizing bacterial proteins to function effectively in GWSS. With this groundwork in place, the next phase will focus on assembling and testing these genetic control systems.

Identifying Grapevine and Fungal Compounds to Reduce Sharpshooter Spread of *Xylella fastidiosa*

Project Leader and Cooperators: *Jacob Wenger, California State University, Fresno; Elaine Backus and Christopher Wallis, USDA Agricultural Research Service, San Joaquin Valley Agricultural Sciences Center*

This project examines whether naturally occurring grapevine compounds and beneficial fungal metabolites can change sharpshooter feeding behavior in ways that reduce the spread of *Xylella fastidiosa (Xf).* Rather than relying only on insecticides, the research focuses on influencing feeding behaviors linked to disease inoculation. Replicated artificial-diet studies tested three grapevine phenolic compounds: epicatechin, miquelianin and caftaric acid. Results showed that sharpshooters can detect these compounds and alter their feeding. Epicatechin stimulated prolonged probing behaviors associated with disease spread, while miquelianin and caftaric acid led to shorter searching periods and improved feeding over time.

Next, researchers will use electropenetrography (EPG) to confirm how these compounds affect *Xf* inoculation in live grapevines. The team has also begun sequencing beneficial Trichoderma fungal isolates to identify strains that may produce compounds influencing sharpshooter behavior. If successful, this work could support the development of new tools, such as breeding for favorable compound profiles or using beneficial fungi to help reduce the spread of Pierce's disease.


Research on Other Winegrape Pests and Diseases

Development and Validation of Hiplex Assays for Improved Detection of GLRaVs and GRBV in Grapes

Project Leaders and Cooperators: *Maher Al Rwahnih, Raied Abou Kubaa and Kristian Stevens, Foundation Plant Services, University of California, Davis*

Leafroll and red blotch are two major grapevine diseases that can reduce yield and fruit quality. This project is evaluating a new diagnostic tool, called HiPlex PCR, designed to detect the viruses that cause these diseases. The goal is to provide faster, more reliable testing that can detect viruses even at very low levels. Because the method can process many samples at once, it has the potential to improve efficiency and reduce testing costs for programs that monitor grapevine health.

Results from the first phase of the project show that the HiPlex assay can accurately detect both viruses across a wide range of sample types and virus concentrations. The test showed high sensitivity and reliability, with strong agreement between HiPlex results and existing diagnostic methods. Based on these promising results, the team would like to expand the technology to detect all viruses regulated under the CDFA grapevine certification program, helping prevent the spread of infected planting material and support healthier vineyards.

Propagating the Premier US Grape Collection for Protection in a Foundation Greenhouse

Project Leader: *Maher Al Rwahnih, Foundation Plant Services, University of California, Davis*

Foundation Plant Services (FPS) is the primary source of certified, virus-tested and true-to-variety grapevine plant material distributed to nurseries through the California Department of Agriculture's Grapevine Registration and Certification (R&C) Program. These vines make up most of the grapevines planted in the United States. After the grapevine red blotch virus (GRBV) was found at FPS's Russell Ranch Vineyard, priority grapevines were moved into a greenhouse to protect them from the disease.

Earlier phases of this project, including a large-scale propagation project from 2022–2025, helped lay the groundwork for expanding the protected collection. So far, 40 grape selections have advanced in propagation, with another 40 scheduled for rooting in 2026. All plants are tested for viruses, and when needed, a specialized lab method called microshoot-tip tissue culture is used to grow clean plants from healthy shoot tips.

Next, the team will continue propagation and complete final testing and identification to confirm each selection is healthy and true to type before recertification. This helps ensure growers and nurseries have a reliable, long-term supply of clean planting stock.

Transmission Ecology of Grapevine Red Blotch Virus Genetic Clades

Project Leaders: *Rodrigo P.P. Almeida, University of California, Berkeley and Monica Cooper, University of California, Cooperative Extension, Napa County*

Grapevine red blotch virus (GRBV) can reduce fruit quality and delay ripening, but growers still have limited information about how the virus spreads in vineyards. This project is studying how GRBV is transmitted by the three-cornered alfalfa hopper (TCAH) and whether different genetic types of the virus are spread differently by the insect. Understanding these differences could help explain why red blotch spreads quickly in some vineyards but more slowly in others.

During the first phase of the project, researchers established greenhouse colonies of TCAH and initiated controlled transmission experiments across two GRBV genetic clades and varying feeding periods. Early testing found no infections in recipient vines, and additional insect analyses are underway. The team also examined feeding behavior and found that TCAH survived longest when feeding near the midvein and petiole of grape leaves. Next, researchers will continue testing vines, analyze insect samples and study seasonal patterns of virus transmission to better understand when and how GRBV spreads in vineyards.

Development of Multimodal Lures for Early Detection of Spotted Lanternflies

Project Leader and Cooperators: *Saad Bhamla, Georgia Institute of Technology; Miriam Cooperband, USDA-APHIS Science & Technology; Rodrigo Krugner, USDA Agricultural Research Service; Jacob Harrison and Nami Ha, Georgia Institute of Technology*

Early detection of spotted lanternfly (SLF) is critical because populations are difficult to manage once they become established in vineyards. This project is developing new tools to improve early detection by using signals that SLF naturally produce during feeding and communication. Researchers are studying how the insect releases honeydew and produces vibrations through plant surfaces, signals that may help attract other lanternflies. Understanding these behaviors could help scientists design lures that detect small or newly established populations more effectively than current visual surveys or passive traps.

The team collected more than 2,700 hours of SLF vibration recordings to better understand the signals associated with feeding and honeydew release. They also analyzed the mechanics of honeydew ejection and began developing prototype vibration modules designed to mimic these natural signals. Early field tests integrating these vibration devices into trap systems revealed technical challenges with power supply and durability, providing valuable information for improving future designs. Next, the team will analyze the large vibration dataset to identify key signal patterns and refine trap prototypes that combine vibration and chemical cues to improve early detection of SLF in agricultural settings.

Early and Autonomous Field-Detection of Virus Infections in White and Black Grape Vines

Project Leaders: *Luca Brillante, California State University, Fresno and Marc Fuchs, Cornell University*

Grapevine red blotch virus and grapevine leafroll disease can cause significant damage to vineyards, but early detection for effective management and mitigation remains challenging. This project aims to provide growers with early, accurate, and easy-to-understand maps of infected vines, giving them a powerful tool to manage disease outbreaks more effectively.

The team is using advanced imaging technology and artificial intelligence methods to identify infected plants more accurately. By analyzing the light reflected from grapevines across the spectrum, they found that infected vines show spectral differences before symptoms appear, even in white grape varieties whose symptoms are not visible to the human eye. The team created high-resolution maps of infected areas in commercial vineyards. Testing their accuracy against lab-based PCR tests and growers' field assessments showed the method is reliable and practical. Further research will refine machine learning models, expand datasets to improve disease prediction accuracy, and investigate varietal differences in metabolic responses to infection.

Improved Decision-Making for Grapevine Leafroll and Red Blotch Diseases Using Rapid Identification Tools and a Regional Approach to Monitoring and Management

Project Leaders and Cooperators: *Monica L. Cooper and Jennifer K. Rohrs, University of California, Cooperative Extension, Napa County; Tom Shapland, Tule Technologies; Rodrigo Almeida, University of California, Berkeley; Oakville Neighborhood Grower Group (Chris D'Alo); Nord Vineyard Services; Rutherford Neighborhood Grower Group (Justin Leigon); and Piña Vineyard Management*

This project improved how growers identify and manage grapevine leafroll and red blotch diseases using rapid detection tools and regional collaboration. The team developed and validated two key tools: a handheld AI app to identify symptomatic vines from images, and a point-of-use LAMP assay that allows growers to quickly test for red blotch in the field. The LAMP tool was refined with clear guidelines on timing and tissue sampling, and results were published in peer-reviewed journals.

Across 11 vineyard sites, researchers also monitored insect vectors and disease incidence, analyzed spatial patterns of spread and worked with neighborhood grower groups to support coordinated management. Educational resources, data dashboards and workshops helped increase adoption of these tools.

Next, the team will submit findings on vector and disease trends for publication and continue supporting regional, data-driven decision-making to reduce the economic impact of these diseases.

Evaluating the Impact of dsRNA-induced Silencing of Four C1-protein Interactors on GRBV Activity in Infected Grapevine

Project Leaders: *Laurent Deluc and Satyanarayana Gouthu, Oregon State University*

Watch the video report: youtube.com/@PD-GWSS-Board

This project investigates whether silencing specific grapevine genes can reduce infection by grapevine red blotch virus (GRBV). Researchers previously identified four grapevine proteins that interact with a key GRBV protein and may act as either susceptibility or defense factors. The goal is to determine whether temporarily “turning down” these genes using double-stranded RNA (dsRNA) reduces or increases viral levels.

So far, the team has successfully generated GRBV-infected microvine plants and produced dsRNA molecules targeting two of the four candidate genes, with additional targets in progress. Tissue collection and RNA extractions are underway to measure both gene silencing and changes in viral load.

Next, the team will quantify viral levels in treated plants to determine whether each host factor promotes or restricts infection. Identifying genes that help the virus could guide future development of RNA-based control tools, including spray-induced gene silencing, offering a potential new management strategy.

Foundations to Develop New Grape Cultivars Resistant to Grapevine Fanleaf Decline

Project Leader and Cooperator: *Luis Diaz-Garcia, University of California, Davis and Marc Fuchs, Cornell University*

This project is working to develop new grape cultivars resistant to grapevine fanleaf decline, caused by grapevine fanleaf virus (GFLV) and spread by dagger nematodes. Researchers are testing whether the rgflv1 resistance factor reported in Riesling clone 49 is effective under California conditions.

In 2025, repeated PCR testing of field plantings in high-pressure Lodi vineyards showed that susceptible control varieties were more consistently infected, while most Riesling vines remained negative or had weaker viral signals, supporting possible resistance. The team also refined greenhouse screening approaches, including testing nematode-based infection methods and developing graft-based strategies to create a more reliable, scalable assay.

Two mapping populations derived from Cabernet Sauvignon and Riesling crosses are now established. Once a dependable screening protocol is finalized, the vines will be phenotyped and genotyped to pinpoint the resistance region and support marker-assisted breeding of fanleaf-resistant vinifera cultivars.

Grape Germplasm Evaluation to Identify Potential Host Plant Resistance for Vine Mealybug

Project Leaders and Cooperators: *Luis Diaz-Garcia, University of California, Davis and Summaira Riaz, Mark Sisterson and Zachary Dashner, USDA Agricultural Research Service, San Joaquin Valley Agricultural Sciences Center*

This project is evaluating grape germplasm to identify natural resistance or non-preference to vine mealybug (VMB), a major pest and vector of grapevine leafroll viruses. Current management relies heavily on insecticides, so identifying plant-based resistance could provide a more durable, long-term tool to reduce pest pressure and virus spread.

In 2025, the team screened 117 grape types, including wild species, hybrids and commercial rootstocks, using a standardized laboratory assay. Most of the planned testing has been completed. Early results show meaningful differences among grape types, with some accessions significantly limiting mealybug survival and growth. Leaf samples have also been collected for genome-wide DNA analysis.

Next, the final screening block will be completed, and phenotypic results will be integrated with genetic data to identify genomic regions associated with resistance. This work aims to deliver both promising resistant germplasm and molecular markers to accelerate the development of mealybug-resistant rootstocks and cultivars for California vineyards.

Epidemiology of Grapevine Leafroll-Associated Virus 3 and RNA Interference Against the Virus and its Major Mealybug Vectors

Project Leaders: *Marc Fuchs and Greg Loeb, Cornell University*

Grapevine leafroll disease is one of the most damaging viral diseases affecting vineyards and is spread primarily by grape and vine mealybugs. This project is working to develop new ways to reduce the spread of grapevine leafroll-associated virus 3 (GLRaV-3) by improving understanding of the virus, its insect vectors and how they move within vineyards. The research also explores new resistance strategies using RNA interference (RNAi), a gene-silencing approach that can disrupt key biological processes in both the virus and the insects that spread it.

During this reporting period, researchers analyzed grapevine samples from 20 vineyard blocks in the Lodi region to identify the diversity and distribution of GLRaV-3 strains. They also studied how vine mealybugs disperse within vineyards and how mechanical harvesting may contribute to their movement. In laboratory bioassays, the team engineered double-stranded RNA constructs targeting key gut genes in grape and vine mealybugs and exposed crawler stages to these molecules on treated grape leaves.

The results showed reduced expression of several targeted genes, confirming that RNAi can affect mealybug biology and may help suppress vector populations. Next steps include continuing studies on virus movement across graft unions and refining RNAi strategies that could eventually help limit both the virus and its insect vectors.

Risk Maps and Apps for the Spread of Spotted Lanternfly *(Lycorma delicatula)* in California

Project Leader and Cooperators: *Matthew Helmus, Temple University; Neil McRoberts, University of California, Davis; Donnell Brown, National Grape Research Alliance; and Stephanie Bolton, Lodi Winegrape Commission*

Spotted lanternfly (SLF) has caused significant damage to vineyards in eastern states, raising concern about its potential impact if it reaches California. This project is developing risk maps and decision-support tools to help identify where SLF is most likely to enter the state. By focusing on high-risk locations such as transportation hubs, rail yards, and distribution centers, these tools aim to support early detection and rapid response efforts to help prevent the pest from becoming established in California vineyards.

During this reporting period, the team began compiling data needed to build the risk models and started developing forecasting methods using information from other states where SLF is already present. Initial modeling work has identified potential introduction points based on transportation patterns and invasion data. The team is currently awaiting additional CDFA survey data to refine California-specific risk maps and to complete the development of interactive mapping apps. Once completed, these tools will help agencies and industry partners prioritize monitoring efforts and respond quickly to potential SLF introductions.

Virus-Based Delivery of Interfering RNAs Targeting Grapevine Leafroll-Associated Virus(es)

Project Leader and Cooperator: Yen-Wen Kuo, University of California, Davis and Maher Al Rwahnih, Foundation Plant Services, University of California, Davis

Grapevine leafroll and red blotch diseases reduce vine vigor, delay fruit ripening and lower grape quality, yet growers have few options to suppress these viruses once vines become infected. This project is developing a new strategy that uses grapevine viruses as delivery systems for RNA interference (RNAi), a natural process that can block virus activity inside the plant. By engineering viral vectors based on grapevine geminivirus A (GGVA) and grapevine virus A (GVA), researchers aim to deliver gene-silencing sequences directly into grapevines to target viruses such as grapevine leafroll-associated virus 3 (GLRaV-3) and grapevine red blotch virus (GRBV).

The team developed and optimized a vacuum infiltration method that enables efficient delivery of viral constructs into greenhouse-grown grapevines without tissue culture. Early experiments showed that these viral vectors can trigger gene silencing in plants and reduce virus levels in proof-of-concept tests. Building on this foundation, the team recently expanded the work to target GRBV by creating new GGVA constructs carrying GRBV gene fragments and initiating greenhouse trials in several grapevine cultivars. Next steps include measuring virus levels in treated plants and testing additional RNAi targets to determine whether this approach can suppress virus accumulation and disease symptoms in grapevines.

Preparing for the Arrival of Spotted Lanternfly: Outreach and Grower Engagement About the Value of Coordinated Area-Wide Responses

Project Leaders and Cooperators: *Neil McRoberts and Sandra Olkowski, University of California, Davis; Stephanie Bolton, Lodi Winegrape Commission; Kim Stemler, Monterey County Vintners and Growers Association; Jason Staling, Sonoma County Viticultural Technology Group; Eric Pooler, Napa County Farm Bureau; and Marc Fuchs, Cornell University*

A technical working group assessed the spotted lanternfly's (SLF) potential impact on California and the effectiveness of pest control strategies. The group's findings highlight the economic risks of SLF invasion and the importance of coordinated control efforts among growers to mitigate its impact. This project aims to provide extension support by bringing key insights from these findings to the industry at scale, ultimately setting the stage for immediate, impactful outcomes in managing SLF after it arrives in the state.

Investigating the Impact of Grapevine Red Blotch Virus (GRBV) on Grape Skin Cell Wall Metabolism and Soluble Pathogenesis-Related Proteins in Relation to Phenolic Extractability

Project Leader and Cooperators: *Ben Montpetit, Mysore Sudarshana, Larry Lerno and Cristina Medina Plaza, University of California, Davis*

Grapevine red blotch virus (GRBV) delays ripening and can reduce sugar levels, color development and aroma compounds in grapes, affecting wine quality. This project examines how GRBV changes grape skin cell walls, pathogenesis-related proteins and enzymatic processes that influence how phenolic compounds such as tannins and anthocyanins are extracted during wine making. Because phenolic extractability plays a key role in wine color, flavor and mouthfeel, understanding these changes could help growers and winemakers better manage fruit from infected vines and reduce quality losses.

The team collected grape samples from healthy and GRBV-infected Merlot vines over two growing seasons and analyzed cell wall material, protein levels and phenolic composition at multiple ripening stages. Early results show that GRBV-infected grapes contain higher levels of pectin and soluble proteins in the skin cell walls, compounds known to interact with phenolics during wine making. Small-scale wines produced from the fruit also showed differences in phenolic extractability between healthy and infected grapes, although seasonal conditions such as heat waves influenced some results. Ongoing work will continue to analyze cell wall components, enzyme activity and protein levels to better understand how GRBV alters grape composition and to help identify potential strategies to mitigate its effects on wine quality.

Investigating the Relationship Between Grapevine Red Blotch Virus (GRBV) Titer Levels, Years of Infection and Symptomology

Project Leader and Cooperators: *Ben Montpetit, Mysore Sudarshana, Larry Lerno and Cristina Medina Plaza, University of California, Davis*

Grapevine red blotch virus (GRBV) delays ripening and can reduce sugar accumulation, color development and aroma compounds in grapes, affecting wine quality. However, growers still have questions about why symptoms vary across vineyards and whether virus levels or the number of years a vine has been infected influence disease severity. This project examines how GRBV titer levels, years of infection and ripening stage interact to shape disease symptoms and grape composition. Understanding these relationships could help growers make more informed decisions about managing infected vines, including whether to keep, rogue or replant affected blocks.

Researchers are analyzing grape and leaf samples collected over multiple seasons from a Merlot vineyard in Paso Robles, where GRBV infections have been tracked since 2014. Using a combination of transcriptomics and metabolomics, the team is studying how gene activity, virus levels and berry chemistry change over time in infected vines. Early results show that gene expression patterns vary with the duration of infection, with long-term infections displaying distinct molecular responses compared to recent infections. Ongoing work will integrate virus titer data with gene expression, berry chemistry and volatile compound profiles to better understand how GRBV infection progresses and how it ultimately affects grape development and wine quality.

Biology and Role of Treehoppers in Grapevine Red Blotch Disease with Emphasis on *Tortistilus albidosparsus*

Project Leaders and Cooperators: *Frank Zalom and Mysore Sudarshana, University of California, Davis; Cindy Kron, University of California, Cooperative Extension, Sonoma County and MacKenzie Patton, University of California, Cooperative Extension, Central Sierra*

Understanding whether the treehopper Tortistilus albidosparsus spreads grapevine red blotch virus (GRBV) is important for growers because it could influence how the disease moves within vineyards and how it should be managed. This project studies the insect's biology and behavior to determine whether it can act as a vector and when transmission risk is highest. Early findings show that the insect can acquire GRBV and that the virus can be found in its salivary glands. Experiments to determine virus inoculation into clean grapevines and to confirm virus symptoms are still underway. The team has also confirmed that adult females can lay eggs in grape canes and that the insects can develop on nearby host plants before moving into vineyards.

Field studies in Napa and Sierra Foothill vineyards are helping researchers understand when and where these treehoppers are most active. Monitoring shows that adults typically appear in vineyards from late May through early summer, with timing influenced by elevation and nearby vegetation. Additional studies found that treehoppers can create feeding girdles on grape shoots within a few days,

and some girdles contained GRBV DNA after insects fed on infected vines. The team also identified a previously unknown parasitic wasp that attacks treehopper eggs and may influence populations. Next steps include continuing transmission studies, analyzing collected samples for the presence of the virus and evaluating management tools that may disrupt feeding and reduce virus spread.