

Field Monitoring for Leafroll Virus and Mealybug in Pacific Northwest Vineyards

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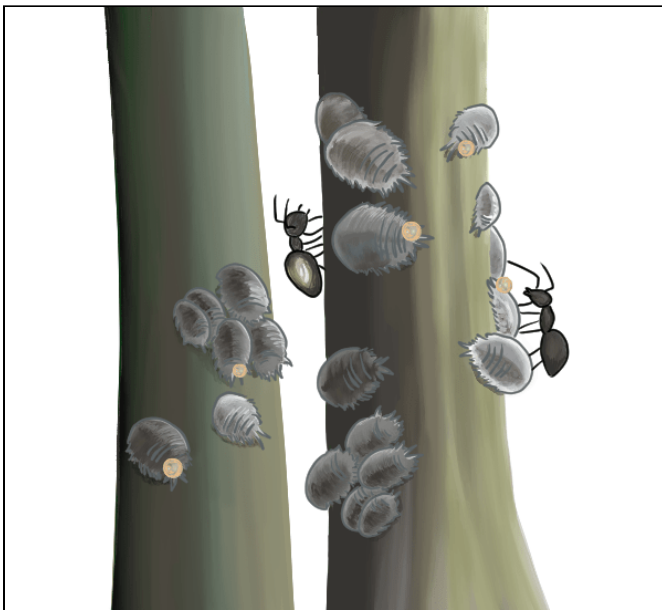


Figure 1. Adult vine mealybugs are oval-shaped and filaments surround their bodies. Their egg sacs are small, ovoid and yellow-orange. Ants feed on the honeydew secreted by mealybugs.

Credit: K.R. Park, © Oregon State University

Introduction

Oregon vineyard managers are increasingly concerned about vineyard viruses. The increasing incidence and spread of viruses and insect vectors (disease transmitters) throughout all key grape industries worldwide has increased these concerns. Vineyards in California, Oregon, Washington and Idaho have battled the spread of grapevine leafroll viruses (GLRaVs). Oregon has been identified with GLRaVs and their key vectors, including several mealybug species. Grapevine viruses can decrease vine health, yield and fruit quality, and these compromise vineyard longevity and sustainability.

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To prevent the movement of GLRaVs and vectors into new vineyards in the area, growers should scout their vineyards to identify GLRaVs symptoms and insect vector infestations. This publication is a field guide to identify vineyard blocks that may have mealybug and GLRaVs.

What are grapevine leafroll viruses?

Grapevine leafroll viruses are members of the Closteroviridae family, which includes 10 distinct viruses. Currently, there is no cure for vines infected by GLRaVs.

Although GLRaVs are generally found in the vascular tissues of wood (phloem), they are also systemic throughout the vine. They are often spread by cuttings, such as grafting of clean scions onto infected rootstocks or infected scions onto healthy rootstocks.

How the viruses spread

Grapevine leafroll viruses are transmitted (vectored) by several species of mealybugs (*Hemiptera: Pseudococcidae*) and soft-scale insects (family Coccoidea). Prominent mealybug vectors include grape mealybug (*Pseudococcus maritimus*), vine mealybug (*Planococcus ficus*), obscure mealybug (*Pseudococcus viburni*) and Gill's mealybug (*Ferrisia gilli*). Soft-scale insects, such as the European fruit lecanium scale, cottony maple scale and wooly vine scale, have been reported as transmitters of GLRaVs. However, these soft-scale insects are less efficient at infecting vines with GLRaVs than mealybugs.

Spread to previously uninfected areas can occur rapidly when a vineyard has GLRaVs-infected vines and an insect vector. When vectors are present, vineyards with less than 10% GLRaVs infection can show greater than 90% infection within just 10 years.

The impact of mealybugs

Mealybugs feed on the vascular tissue of grapevines and expel a thick, sticky, shiny substance known as "honeydew," a byproduct of digestion. Honeydew is basically excess plant sugars (Figure 1). Ants feed on honeydew and are often associated with mealybugs.

Mealybug lifecycle

Female mealybugs undergo incomplete metamorphosis (Figure 2). Adult females are wingless, 2–5 millimeters long, oval-shaped and white with waxy secretions. Some species have thin filaments along the margin of the body. Females lay several hundred eggs in cottony sacs. Nymphs (crawlers) may hatch and emerge after 1–15 days during summer months, depending on temperature. Crawlers closely resemble adult females in body shape.

Adult male mealybugs undergo complete metamorphosis. They are tiny with long antennae and, unlike adult female mealybugs, a single pair of wings. Male mealybugs do not feed during the adult stage. They respond to a sex pheromone, a chemical signal released by mature females. Adult male mealybugs are short-lived and may die within days of emergence, depending on temperature.

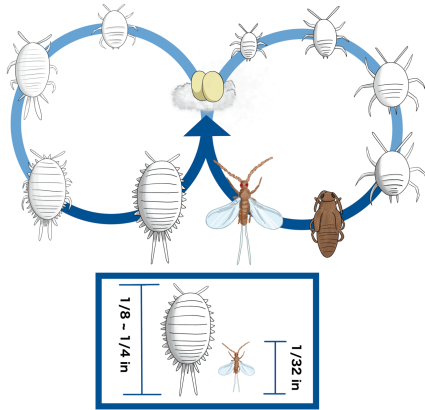


Figure 2. The lifecycle of the mealybug.

Credit: K.R. Park, © Oregon State University

Grape and obscure mealybugs can produce two to three generations each year. When gently probed, grape mealybugs secrete a reddish orange defensive fluid. Vine mealybugs can produce three to nine generations each year, depending on the temperature and environmental conditions. Vine mealybugs produce a clear defensive fluid when probed. Vine mealybugs feed on all parts of the vine, including the roots, making control difficult.

Managing the GLRaVs and mealybugs

Knowing the common signs and symptoms of mealybug GLRaVs in your vineyard will help manage these

pests before they become well-established. Early recognition of vineyard infection with GLRaVs, mealybugs or both is critical to minimizing their spread within your vineyard, into neighboring vineyards and to the industry in your region. Mealybugs are difficult to eradicate once vineyards become infested, and the GLRaVs are impossible to cure. The best defense is to train vineyard crews to identify signs and symptoms and manage these pests.

Mealybug monitoring

Mealybugs are difficult to find at low infestation levels. The most efficient way to monitor for low levels of mealybug is by using pheromone-baited traps (See [Trapping and Identifying Mealybugs in Oregon Vineyards](https://extension.oregonstate.edu/catalog/pub/em-8998-trapping-identifying-mealybugs-oregon-vineyards) (<https://extension.oregonstate.edu/catalog/pub/em-8998-trapping-identifying-mealybugs-oregon-vineyards>), EM 8998).

Commercial pheromone traps are available for grape and vine mealybug and can determine low infestation rates. Vineyard mealybug infestation may go unnoticed for several years. Many symptoms of infestation can be found within vine canopies by peeling the bark on trunks and cordon, digging around the base of the vine trunk and sampling the root zone of the alleyways or cover crop (Figure 3).

Follow mealybug monitoring guidelines for identification and seasonal trends (Table 1, Figure 3).

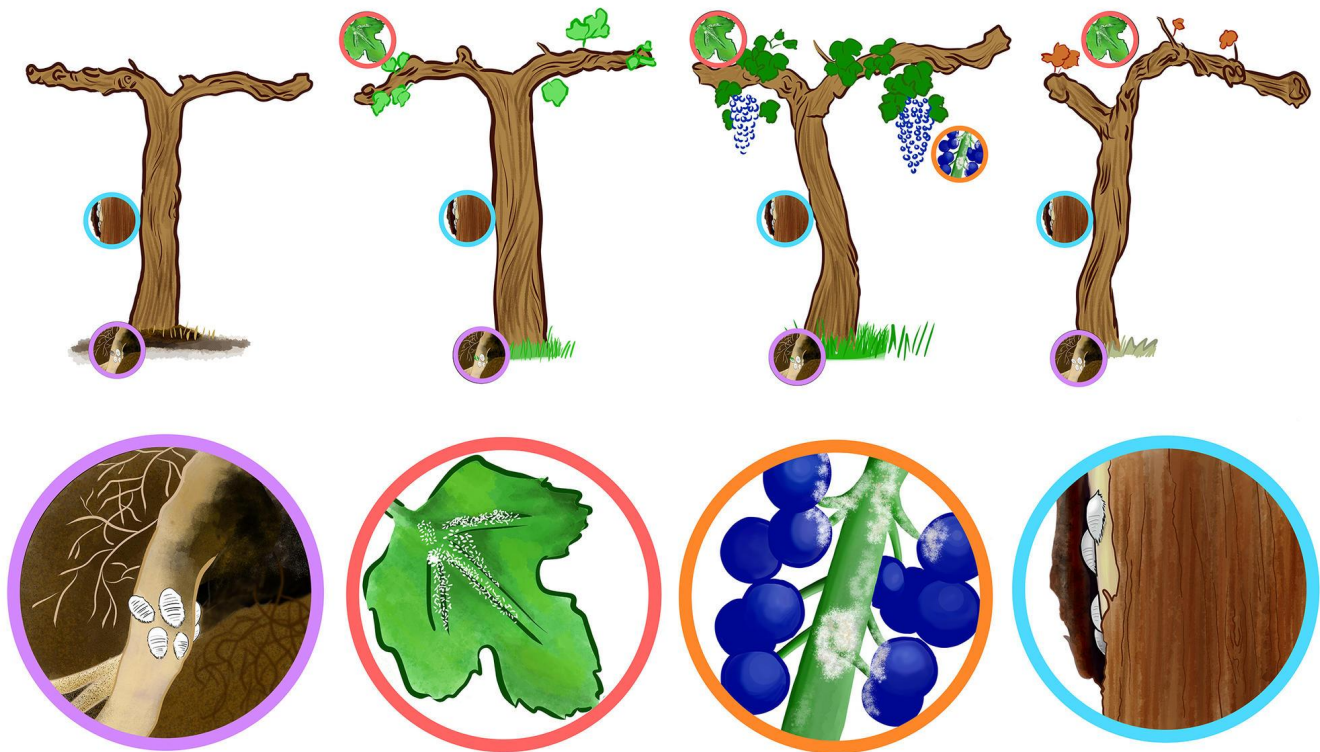


Figure 3. Seasonal occurrence of mealybugs on the grapevine. Mealybug populations typically expand onto developing plant structures such as leaves and clusters and can be found on leaves and clusters touching the cordon area.

Credit: K.R. Park, © Oregon State University

Table 1. Monitoring for mealybugs

Location on plant	Signs	When to scout
Leaves and canopy	Various stages of mealybug development — adults, immature stages and egg sacs (Figure 1).	Midsummer to harvest
Leaves and canopy	Sticky honeydew and sooty mold can be found on the surface and may be associated with ants.	Late summer to harvest
Leaves and canopy	Vines may become weak, and basal-shoot leaves may fall prematurely with heavy mealybug infestations.	Late summer to harvest
Fruit clusters	Sticky clusters on vines before harvest. Look inside clusters for waxy, sticky white residue between berries and on rachis (see Figure 1).	Summer to harvest in vineyard and crush pad as well as during processing
Fruit clusters	Sooty mold development	Late summer to harvest

Location on plant	Signs	When to scout
Trunk or cordon	Wet or shiny appearance of bark caused by honeydew. This may be accompanied by sooty mold (see Figure 1).	Summer to harvest
Trunk (under bark)	The majority of the mealybug populations may be found under the bark.	Year-round
Base of trunk and roots (below soil surface 0–6"	Adult mealybugs and immature crawlers. Waxy, fuzzy, white and cotton-like appearance.	Winter to early spring
Cover crop or weeds	Look for mealybugs at the shoot-root-soil interface under cover crops or weeds (Figure 3).	Late summer to fall
Vine debris (pruning wood, leaves, thinned fruit)	Leaves, canes and fruit may contain various stages of mealybugs as well as egg sacs.	Year-round

Crawlers are difficult to find once they leave the egg sac. Mealybug eggs can be observed within egg sacs by using a hand lens. In the Pacific Northwest, the best time to sample for the presence of mealybugs is mid-July through October (Figure 3), when populations are actively growing. They are found in higher numbers in their preferred feeding spots during this period. Mealybugs tend to shelter under bark and in pruning wounds and crevices. Other key areas to sample include exposed plant parts: trunk, cordon, canes, shoots, leaves and clusters. Be sure to sample roots in sandy soils. Honeydew, ants and sooty mold are common signs of mealybug infestation and can be found on any part of vines. Peel bark away to look for egg sacs.

If you identify symptoms of mealybug infestation, record your observations, noting where in the vineyard they were found. To confirm the species of mealybug, collect and submit samples to the [Oregon State University Insect ID Clinic](https://bpp.oregonstate.edu/insect-id-clinic) (<https://bpp.oregonstate.edu/insect-id-clinic>). Contact your Extension horticulture agent before resorting to chemical control.

Monitoring vines for viruses

Symptoms of GLRaVs resemble general stress responses in grapevine (Table 2). Vine disease symptoms can be mistaken for other factors, such as water stress, nutrient deficiency, crown gall, vertebrate damage or mechanical injury. Symptoms vary between years and may go unnoticed. Symptoms expressed also vary with grape cultivar, age of the vineyard, stage of infection, viticulture practices, environmental conditions and the strain of the GLRaVs. Vines stressed by other biotic or abiotic factors may exhibit symptoms more readily and consistently than healthier, unstressed vines. GLRaVs-impacted vines may express symptoms or combinations of symptoms.

Laboratory tests of tissue samples are required to diagnose virus infection; visual symptoms alone are inadequate. If you suspect you may have the virus in your vineyards, note your seasonal observations. Record the block information, observation date, phenology and what you saw. Collect and submit samples for GLRaVs analysis to verify whether the symptoms are related to the virus.

The best analyses for the GLRaVs are enzyme-linked immunosorbent assays (ELISA) and polymerase chain reaction (PCR) tests. Before submitting samples, call the lab and ask which tests they offer. Autumn, during ripening through

harvest or even post-harvest, is the best time to sample. Ask the testing lab to verify the appropriate tissue type, timing of sample collection and handling before analysis. Collect leaf samples (blade and petiole). Place leaves in a clear plastic zip bag with a dry paper towel and ship them overnight or drop them off at a virus testing lab. If test results are negative for GLRaVs, consider your vineyard management practices; soil or leaf tissue analysis for macro and micronutrients may be indicated, as nutrient deficiencies may cause similar symptoms.

Table 2. Preliminary scouting and identification for grapevine leafroll virus

Location on plant	Symptoms	When to scout
Leaves	Discoloration, generally between veins, but may vary.	August until leaf fall
Leaves	Red cultivars—red to reddish purple (Figure 4)	August until leaf fall
Leaves	White cultivars—yellowing or chlorotic mottling (Figure 5).	August until leaf fall
Leaves	Leaf margins may curl downward (see Figure 4).	August until leaf fall
Fruit clusters*	Loose and smaller clusters. Poor fruit set and lower cluster weights and vine yield.	Fruit-set until harvest
Fruit clusters*	Poor color development in red cultivars.	Veraison until harvest
Fruit clusters*	Low °Brix (soluble solids).	Veraison until harvest
Fruit clusters*	Fruit never ripens to desirable soluble solids (°Brix) or titratable acidity.	Harvest
Vine growth	Decreasing vine growth and yield.	Year-round
Vine growth	Delayed bud break and shorter shoots in spring.	Early spring
Vine growth	Infection increases vine susceptibility to winter injury and pathogens.	Veraison until harvest
Vine growth	Problems with graft union establishment.	Vineyard establishment

*These symptoms are subtle, may not always be observed, or may be caused by other factors, such as nutrition, disease or vineyard management problems.



Figure 4. Vine mealybugs are seen at the base of the trunk and the upper regions of the roots.

Credit: Vaughn Walton, © Oregon State University



Figure 5. Cupping and discoloration of a Pinot Noir leaf infected with grapevine leafroll virus in early September (left). Symptoms become more evident by late September (right).

Credit: R. Martin, © Oregon State University

Contact information

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[Laboratories and Consultants Serving Agriculture in the Pacific Northwest \(http://wsprs.wsu.edu/AnalyticalLabsEB1578E.pdf\)](http://wsprs.wsu.edu/AnalyticalLabsEB1578E.pdf)

Additional information

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California Cooperative Extension: [Mealybugs in California Vineyards \(https://calag.ucanr.edu/Archive/?article=ca.v062n04p156\)](https://calag.ucanr.edu/Archive/?article=ca.v062n04p156)

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Figure 6. Leaf curling can be observed on this Chardonnay vine infected with grapevine leafroll viruses in Idaho.

Credit: R. Martin, © Oregon State University

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