

Grapevine Leafroll Disease – Should You Be Concerned?

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Leafroll is one of the more important virus diseases of grapevines. It occurs in every major grape growing area of the world. The classification of these closteroviruses associated with grapevine leafroll disease is still evolving as molecular identification techniques have better distinguished species differences. Currently there are 10 recognized grapevine leafroll associated viruses (GLRaVs). These single stranded RNA viruses are placed in a family called Closteroviridae. The majority of these are grouped in the genus *Ampelovirus* (GLRaV 1, -3, -4, -5, -6, -9, -Pr and -Car), most of the viruses in this genus have been demonstrated to be vectored by mealybugs and scale insects in vineyards. GLRaV-2 is in the genus *Closterovirus*, and GLRaV-7 is not currently assigned (there is a proposal to place GLRaV-7 in the genus *Velarivirus*), there is no known vector of these two genera.

These viruses can cause similar symptoms in infected grapevines. All the GLRaVs can be transmitted by vegetative propagation and grafting; GLRaVs in *Ampelovirus* can also be transmitted by the mealybugs and soft-scale insects in vineyards. GLRaV-3 is the predominant species found in most vineyards worldwide. Recent surveys in the north coast have shown 80% of symptomatic vines sampled were infected with GLRaV-3.

To further complicate matters there are variants that have been identified for given GLRaV species. For GLRaV-3 there are several distinct variants known to exist. What needs to be better understood is the significance of these GLRaV-3 variants and their interactions with other viruses when multiple infections exist in a vine. For GLRaV-2 the “Red Globe” variant is known to cause graft incompatibility when grafted onto certain rootstocks (5BB, 5C, 3309C and 1103P) resulting in the decline and death of vines.

In the post-phylloxera infestation plantings that have occurred on the central coast during the past 20 years there has been an increased incidence of grapevine leafroll disease. The use of non-certified scion material has been a major contributor to this disease increase. The other issue has been the spread of leafroll (primarily GLRaV-3) from infected vineyards to adjacent vineyards planted with California-certified stock. UC research documented the rapid spread of leafroll into a

certified planting from an adjacent infected block. During the 5 years of observation the annual rate of increase in leafroll symptomatic vines was more than 10% in a Napa Valley site.

Recognizing Leafroll

Leaf symptoms become visually apparent by early summer and generally intensify into midsummer and fall. Physical stresses to the vine may increase symptom severity and there are similar symptoms caused by other abiotic and biotic injuries. On affected vines, the margins of the leaf blades roll downward, starting with the basal leaf on the cane. Areas between the major veins turn yellow or red, depending on whether the cultivar produces white or red fruit. In some cultivars, the area adjacent to the major veins remains green until late fall.

The most important effect of leafroll disease is a reduction in the yield and quality of fruit from infected vines. Yield losses of 10 to 20% are fairly typical. Because leafroll viruses damage the phloem of infected vines, sugar accumulation is delayed and color pigment production is reduced. Fruit from infected vines can be low in sugar, poorly colored, and late in ripening.

It is important to remember that the lack of symptoms in a grapevine does not guarantee freedom from infection by the viruses that are the causal agents of leafroll disease.



Leafroll disease on Pinot noir (left) showing burgundy red between green main leaf veins accompanied by downward rolling of the leaf margins; on Chardonnay (right) leaves show a more generalized chlorosis and downward rolling of the leaf margins in late fall.

Lab Testing

Leafroll viruses may be diagnosed using ELISA and RT-PCR tests. Virus titer levels are variable not only within the year, but also within the vine. Collect petioles in late summer and fall, or shoots/canes for cambium scrapings in fall and winter. PCR and ELISA tests are not available for all GLRaVs. Check with the commercial lab for their preferred sampling method and collection time prior to taking samples.

Mealybug Vectors

The most common mealybug found in California vineyards is the grape mealybug (*Pseudococcus maritimus*). Obscure mealybug (*P. viburni*) is present in central coast vineyards but less common than the grape mealybug. The vine mealybug (*Planococcus ficus*) was introduced into California in 1994 and has now been found in most production area of the state. Less common is the long-tailed mealybug (*P. longispinus*) found primarily in the cooler areas of the south central coast. The Gill's mealybug (*Ferrisia gilli*) is the fifth species found in California but is currently very limited in distribution with populations found in the Sierra foothills, in the northern coast (Lake County) and in the southern San Joaquin Valley.

All the above species are capable of being a vector for leafroll disease. Research has shown that mealybugs can become infective after one hour of feeding on a leafroll virus infected vine and can transmit the virus to a clean host after one hour of feeding. Although all female instars can transmit the virus once infected, the first instar is the most effective vectors of the disease. The first instar or "crawler" moves to find a feeding spot and is considered to be the most common dispersal stage of a mealybug population. Mealybugs can also be moved by wind, equipment, workers and infested nursery stock.



Movement of leafroll disease into a recently planted vineyard of certified planting stock from an infected block on the opposite side of the avenue. Note the vines showing symptoms are nearest the avenue and are not present on vines further down the rows.

Management of Grapevine Leafroll Disease

1. Plant Material. The first management strategy should be to plant certified vines that have been grown and produced by a nursery participating in the California Grapevine Registration and Certification Program. Once virus infected a vine will remain infected, there is no cure. Commercial nurseries that produce certified grapevines and participate in the California

Grapevine R&C Program obtain their clean stock from the Foundation Plant Services at the University of California, Davis. UC Davis has a foundation vineyard for major grape cultivars and clones. Before being planted in the foundation vineyard, all vines are tested across biological indicators, and by ELISA and RT-PCR. The foundation vineyard is monitored by visual inspections in spring and fall, and a portion of it is retested every year by ELISA and RT-PCR for viruses known to spread naturally. This provides the highest level of confidence about the virus status of the selections.

Both the fruiting scion and the rootstock need to come from certified mother plants. A very common spread of leafroll is the use of infected bud wood from commercial vineyards. The lack of symptoms in the source vineyard cannot be relied upon as a guarantee that there is no virus; many of the major grapevine viruses show no symptoms during some or all of the season. Particularly if wood is collected during the dormant season, it is unlikely that the source vines will show distinct symptoms of virus infection. Selected grapevines should also be pre-tested for virus by a competent diagnostic laboratory if this type of material is going to be used. Even with vine testing sourcing bud wood from established vineyards carries a risk of introducing virus into a new planting.

2. Learn to recognize leafroll symptoms. Leafroll symptoms become visually apparent by early summer and generally intensify into midsummer and fall as noted above. Symptoms can vary by leafroll species, multiple virus infections, and by cultivar and rootstock combination. Symptoms are generally more apparent in cultivars producing red or black fruit than in white fruiting cultivars. **Remember that the lack of symptoms in a grapevine does not guarantee freedom from infection by the viruses that are the causal agents of leafroll disease.**

3. Recognize and be aware of potential leafroll vectors. As discussed above mealybugs and scale insects are known vectors of some species of GLRaVs. Monitor and be aware of which insect vectors may be in your vineyards. More information on these insects is available in Grape Pest Management UCANR publication 3343 or in the online UC IPM guideline for grapes, <http://www.ipm.ucdavis.edu>. Know which species of mealybugs are present in your vineyards, their population dynamics are different and will influence the timing of any needed control practices. European fruit lecanium scale (*Parthenolecanium corni*) is a common insect found in California vineyards, it and other scale insects has been shown to transmit some GLRaV species.

4. Be aware of potential spread from leafroll infected blocks. Leafroll infected blocks can be a source for vector and disease spread into adjacent clean plantings. Consider if plant removal is a viable option to reduce further spread. Vector control may be a management decision to consider. Recent research suggests the rate of disease spread of GLRaV-3 is greater when higher mealybug population levels are present. Treatment of virus source blocks should minimize the infective vectors leaving the block; the treatment of clean block should be targeted to kill infective vectors quickly upon entering the block and to reduce secondary spread to adjacent vines.

Grapevine leafroll disease is actively being studied both here in the US and internationally. Improvements in identification techniques and better understanding of disease epidemiology in vineyards will hopefully improve our ability to develop management practices to reduce economic impacts.

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