More than 70 viruses infect grapevines worldwide. Grapevine virus diseases can ruin crops and inflict great costs to winegrape producers because of the detrimental impact on vine health, productivity, the quantity and quality of berries, and the quality of the finished wines.

Viruses are unique among plant pathogens because of how they infect their hosts, spread throughout a plant, and are transmitted from diseased to healthy plants. Virus diseases can be difficult to diagnose, and the damage they cause can be unpredictable. Some viruses cause vines to decline, while others have little economic impact. Some severely damage grapevines and are well understood, while others are poorly described or do little or no damage.

Symptoms depend on the virus, the season, the cultivar (both scion—a shoot or bud grafted to a rootstock—and rootstock), and cultural factors affecting vine health and performance. Specific symptoms of virus infections can be misleading because they can mimic nutritional disorders, herbicide damage, or other non-viral diseases. In some cases, a virus can be latent, meaning the vine is infected but has no apparent symptoms.

**Specific Viral Pathogens**

Virus diseases are usually introduced into a vineyard by planting infected cuttings, scions, and rootstocks. Depending on the particular virus, further spread within the vineyard can occur by way of various plant-feeding arthropods or nematodes. Within a vine, viruses spread through the phloem from the point of infection, often colonizing the entire plant. Once diseased, infection causes chronic debilitation and may persist throughout the remaining life of the vine.

Some prevalent grapevine virus diseases in Texas include:

**Grapevine Leafroll Disease**

Grapevine leafroll disease (GLD) is the most widespread virus disease that affects grapes. Several virus species and their strains cause GLD. Symptoms of the various species are mostly indistinguishable from each other and evident only during and after the onset of berry ripening (véraison).

The extent of damage varies with the scion cultivar and rootstock, climate, soil, and cultural practices, making symptoms-based field diagnosis more challenging. Mixed infections of different leafroll-associated viruses or even other types of grapevine-infecting viruses may occur, further
Leaf rolling

Interveinal reddening, green veins

Infected Healthy

Fig. 1. Vine infected with GLRaV-3 with decline.
Source: Naidu Rayapati, Washington State University-Irrigated Agriculture Research and Extension Center

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obscuring a successful diagnosis. In some cases, the infections cause delayed bud break, reduced growth, diminished yields, increased acidity, and poor-quality grapes (Fig. 1). As with many viruses, GLD-affected vines may have poor pigmentation and reduced sugar accumulation in the berries.

GLD symptoms are often apparent in dark-fruited varieties, but much less so in light-fruited ones. On dark-fruited grapevine cultivars, GLD symptoms consist of a striking interveinal, reddish-purple discoloration of the foliage while the veins remain green (Fig. 2). In advanced stages of the disease, leaf margins of affected foliage may have a pronounced downward curl.

Symptoms in light-fruited varieties are mainly a more subtle and inconsistent chlorosis of the interveinal tissue (Fig. 3). The symptoms may also resemble those caused by nutrient deficiency.
There are nine described species and strains of GLD-associated viruses, each with a designated number. These viruses are collectively called grapevine leafroll-associated viruses (GLRaVs). Of the nine GLRaVs, the best known and most widespread is GLRaV-3 (grapevine leafroll-associated virus 3), which has been confirmed at several vineyards in Texas. All of the GLRaVs have probably been disseminated for centuries through the distribution of propagated plant materials, including European varieties as well as American rootstocks.

Several species of mealybugs and scale insects are vectors of GLRaVs; different species vary in how efficiently they spread the pathogen. They spread the virus from diseased vines and vineyards to healthy ones—sometimes traveling to adjacent vineyards, being blown by the wind to distant vineyards, or even by infesting farm equipment and being transported from one location to another.

**Red Blotch Disease**

Grapevine red blotch is a relatively new disease, and its impact on the winegrape industry is still unknown. Surveys throughout the United States document an unexpectedly widespread distribution of the grapevine red blotch virus (GRBV), probably through planting material infected before the discovery of the disease. The impact of red blotch on grape production is significant and mimics leafroll disease in that infected vines also yield fruit with relatively lower total soluble solids and increased acidity.

Diagnostic symptoms of red blotch first appear as irregular, red blotches on leaf blades at the basal portions of the canes (Fig. 4). Unlike the interveinal, reddish-purple discoloration of leaves and green veins with GLD, veins also turn red with red blotch disease, giving a diagnostic clue that distinguishes these two easily confused diseases. In the same manner as GLD, symptoms on light-fruited varieties are less conspicuous than those found on dark-fruited varieties. The long-term effects of GRBV on vine health and vigor have yet to be determined. In addition to the distribution of infected plant material, the three-cornered alfalfa treehopper is a vector of grapevine red blotch virus. Research is ongoing to identify additional vectors of GRBV and their roles in short- and long-distance disease spread.

**Rugose Wood Disease Complex**

Some viruses of the Rugose wood (RW) complex affect the wood beneath the bark at the bud union. Rugose refers to stem pitting and grooves in the wood surface that are evident when the bark is peeled back in the vicinity of the graft union. Externally, on affected vines, a swollen scion will occur relative to the much-reduced diameter of the rootstock. In some cases, the bark in the same vicinity will be exceedingly rough and corky (Fig. 5). Vines may not show apparent foliar symptoms of virus infection, but will appear less vigorous and have delayed bud break in the spring, eventually leading to decline and death in the vine over a few years. Because of this characteristic, RW complex viruses are known as “silent killers of the vine.”

RW complex viruses currently in Texas vineyards are grapevine virus A (GVA) and grapevine rupestris stem pitting-associated virus (GRSPaV). As with other viruses, the GVA and GRSPaV are primarily transmitted via infected propagation materials. However, while GVA is also transmitted by mealybugs and scale insects, GRSPaV has no known insect vector.
Fanleaf Degeneration and Decline

Nepoviruses, a unique group of viruses that are transmitted among roots by soil-inhabiting nematodes, cause grapevine fanleaf degeneration and decline. The most common among these viruses are grapevine fanleaf virus (GFLV), tobacco ringspot virus (TRSV), and tomato ringspot virus (ToRSV). TRSV is present in Texas vineyards and has a broad host range, including both annual and perennial plants in addition to grapevines.

Typical symptoms include chlorotic specks, vein banding, shortened internodes, distorted leaves, stunting, uneven berry size, and reduced yields (Fig. 6). TRSV may make grapevines predisposed to winter kill. However, as is common with grapevine viruses, the presence of other agents in vines with mixed infection symptoms can mask TRSV.

MANAGING VIRAL DISEASES

Researchers and winegrape producers are learning more about the impacts of viruses on vine health and grape quality, resulting in better recommendations for managing grapevine viruses.
Start with Clean Planting Materials

The most important practice for preventing grapevine virus diseases is to restrict the movement of infected planting material by not planting them in new vineyards or using them as replacements in existing vineyards. Since some infections have no virus symptoms, and symptoms are often not apparent in dormant canes, test the sources of planting stock with reliable PCR-based and indexing assays to certify that the materials are virus-free. For new vineyards, buy “clean” planting materials from certified nurseries.

Diagnosis

Diagnosis is the first step in successfully managing virus diseases. Their symptoms are sometimes extremely subtle, may not appear soon after infection, and may resemble other common problems such as nutrient deficiencies, chemical toxicities, and environmental extremes. Virus symptoms may not be apparent on dormant grapevine canes even though the source vine is infected.

Viruses rarely kill grapevines; but, over time, they can degenerate vines enough that they succumb to other problems. Enhanced winter kill is a good example of such an effect. Virus infection can reduce return on investment because of decreased fruit yield and quality, as well as shorten the productive lifespan of the vineyard.

The intensities of virus-induced symptoms depend on the virus species or strain, scion cultivar, vine age at the time of infection, and growing conditions. Symptoms can vary from one growing season to the next. Many of the virus-induced symptoms do not appear until the crop approaches véraison. Careful observations made in the vineyard over time, combined with consultation with a reliable plant diagnostic clinic are crucial for confidently diagnosing grapevine virus diseases.

Definitive viral identification may require serological (Enzyme-Linked Immunosorbent Assay or ELISA) or molecular (conventional or reverse transcription polymerase chain reaction [RT-PCR]) methods, which are accessible through plant disease diagnostic laboratories. (See Additional Resources below.) The success and reliability of test results depend on taking the right type of tissue samples and shipping them to the laboratory in excellent condition. Consult with the diagnostic laboratory on instructions for how to collect tissue samples for virus detection.

Remove Infected Vines

Roguing or removing confirmed infected vines can be part of the overall virus disease management strategy. This method is particularly useful when the vineyard infection level is low and the vineyard is young. Removing infected vines reduces the risk of virus spread to other vines within and outside of the vineyard block. When deciding whether to remove infected vines, factor in the risk of virus spread to other uninfected vines and the cost-benefit considerations of replanting.

Vector Management – Insect and Nematode Control

Controlling potential virus vectors such as mealybugs, scale insects, nematodes, and treehoppers is also part of the integrated management strategy for virus diseases. Using chemical agents for vector control works best through chemigation (applying chemicals via irrigation water), using pesticides registered for use on grapevines. Maintaining lower pest thresholds for virus vectors is essential due to the risk of pathogen spread. Apply pesticides judiciously by following recommended rates and label instructions.

Plants resistant to some grapevine viruses are available. For example, scion cultivars or rootstocks derived from Vitis labrusca and V. riparia are resistant to nepoviruses (such as TRSV), based on their nematode tolerance.

Nutrient Supplements

Applying nutritional supplements to the foliage or through the soil to manage virus disease is not effective. While the treatment may mask disease symptoms, it does not cure the vine of
the virus infection, and infected vines may still serve as a source of virus spread to other vines. There is no science-based evidence that such treatment reverses the detrimental impacts of virus infection.

**OTHER RESOURCES**


Texas Plant Disease Diagnostic Laboratory, http://plantclinic.tamu.edu/


Texas A&M AgriLife Extension Service

*AgriLifeExtension.tamu.edu*

More Extension publications can be found at *AgriLifeBookstore.org*

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