Pinpointing Grapevine Virus Diseases: Part II

Knowing what vineyard symptoms to look for and which diagnostic methods are available can help prevent the spread of harmful viruses this spring.

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AN ARTICLE WAS published in the November 2005 issue of *Wine Business Monthly* describing the most common laboratory methods for the detection and diagnostics of grapevine pathogens. The detection and diagnostics of important pathogens affecting grapevines is seasonal (i.e., they are found in larger concentration and therefore are easier to detect during certain time of the year). In this article, important grapevine diseases caused by viruses that are more effectively detected in the spring, using laboratory methods, are reviewed. We describe visual characteristics (or symptoms) to look for in the vineyard and review laboratory methods available for their sensitive diagnostics. Ultimately we hope to convey ways to prevent the spread of these important and harmful viruses in the vineyard.

Growers are aware that there are many factors that need to be considered when establishing a new vineyard. An important factor is the health status of the planting material. The most common way to transmit and perpetrate grapevine diseases caused by viruses is by making multiple cuttings of an infected vine.

In addition, all of the viruses that we will describe in this article are transmitted by nematodes. Therefore, overall sanitation and good cultural practices are needed to maintain a healthy and productive vineyard. Specific features to help visually diagnose virus infection in the field will be presented. We also will describe sampling methodologies that allow obtaining the best sample for testing in the laboratory.

> Laboratory tests conducted in the right season using appropriate sampling methods will help rule out infection, pinpoint the disease causal agent, and avoid the spread of harmful virus-causing diseases.

GRAPEVINE VIRAL DECLINE AND DEGENERATION

Historically, viral diseases have been named to reflect the symptoms observed in diseased plants (e.g., grapevine decline, fanleaf degeneration, yellow vein disease, etc.). With the advent of molecular tools for the characterization of different causal agents, it has been possible to determine that many different viruses (related or unrelated) may cause the same set of symptoms.

In this article we will focus on the description of viruses associated with grapevine decline and degeneration diseases. The reader should be aware that other disease-causing agents such as fungi have also been associated with decline symptoms, and these will not be covered here. The viruses causing decline are closely related and grouped in the genus *Nepovirus* because they are transmitted by nematodes and have a polyhedral (spherical) shape (nematode polyhedral viruses).

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FIG 1. Note the variety of shapes a grapevine leaf can take when infected with *Grapevine fanleaf virus.* GFLV is one the most serious and devastating grapevine virus diseases. Sensitive cultivars show rapid decline, and low quality of fruit and yield. Up to 80 percent yield loss can be expected in severe infections.

The most important viruses are *Grapevine fanleaf, Arabis mosaic, Tobacco ring spot* and *Tomato ring spot*. Other viruses that are less prevalent include *Raspberry ring spot, Peach rosette, Tomato black ring,* and many others. All these viruses can cause significant economic loss in the vineyard operation and should be kept out of propagation and planting material.

Fanleaf disease, caused by *Grapevine fanleaf virus* (GFLV), is one the most serious and devastating grapevine virus diseases. Sensitive cultivars show rapid decline, low quality of fruit and yield. Affected vines are smaller than healthy vines. Up to 80 percent yield loss can be expected in severe infections. The life span of the vineyard is decreased considerably in sensitive varieties. Infected vines show misshapen leaves with the appearance of an open fan (thus the name "fanleaf"). Other visible symptoms include yellowing of the leaves (mosaic), bright yellow bands near veins (vein banding), abnormal branching, and short internodes. Vines affected by fanleaf disease have poor fruit set, and fruit ripens irregularly. Grapevine fanleaf virus is transmitted by the dagger nematode *Xiphinema index*. The disease is found in all areas where *Vitis vinifera* and American hybrid rootstocks are grown.

Yellow vein disease, caused by *Tomato ring spot virus* (TomRSV), is also known as Tomato ring spot decline and Tomato ring spot disease. Symptoms vary but are most drastic in cold climates. Foliar symptoms include distortion, mottling, and reduced leaf size.

Affected vines are stunted, have increased susceptibility to cold damage, and display small grape clusters. Typical yellow vein symptoms are found in infections of TomRSV in California. However, this disease is endemic in the northeastern U.S. and Canada, and is less frequently found in California. *Tomato ring spot virus* is transmitted by several nematode species, *Xiphinema americanum* being the principal vector.

Tobacco Ring Spot Decline, caused by *Tobacco ring spot virus* (TRSV), induces decline in grapevines. Symptoms are similar to those caused by TomRSV. The disease has been reported in New York and Pennsylvania. *Tobacco ring spot virus* is transmitted mainly by *Xiphinema americanum*.

Arabis mosaic virus Symptoms associated with *Arabis mosaic virus* (ArMV) are similar to fanleaf decline and include leaf chlorosis, necrosis, and distortion, shortened internodes, reduced growth, and overall decline. The virus infects many hosts and has worldwide distribution. Although this virus has been reported in different areas in North America, there is no evidence of spread. In the U.S., ArMV has been found in Missouri vineyards. The virus is transmitted by several nematode vectors, but the principal natural vector is *Xiphinema diversicaudatum*.

> Prevention of virus spread in the vineyard is important; once a viral disease is established in the field there is no treatment or cure.

Other Nepoviruses that are related to GFLV and transmitted by nematodes may be found in grapevines. The viruses include *Raspberry ringspot* (RpRSV), *Tomato black ring* (TBRV), *Grapevine chrome mosaic*, *Strawberry latent ring spot* (SLRSV), and *Grapevine Bulgarian latent virus*, among others.

VIRUS DIAGNOSTIC METHODS

The good news about grapevine decline and degeneration diseases is that the viruses that cause these diseases have been well characterized. Nucleic acid sequence is available for most of these viruses and, consequently, sophisticated and reliable disease diagnostic methods are available.

Different methods have been described and are commonly used in the laboratory for the detection of the virus in infected grapevines: ELISA (Enzyme-linked immuno assay) is available for the detection of ArMV, GFLV, TRSV, TomRSV, TBRV, RpRSV. Reverse Transcription PCR (RT-PCR) and nucleic acid hybridization is available for the detection of ArMV, GFLV, TRSV, TomRSV, RRSV, and SLRSV. Sampling methodology is very important for sensitive detection of grapevine viruses. Work in our lab has shown that collection of young tips and leaves in the spring yields the most reliable material for *Nepovirus* detection. (Refer to the *WBM* article published in November 2005 for the description of this and other diagnostic methods.)

FIG 2. Yellow vein banding leaf symptoms vary but are most drastic in cold climates. Foliar symptoms include distortion, mottling, and reduced leaf size. Typical yellow vein symptoms are found in infections of *Tomato ring spot virus* in California.

VIRUS INFECTION CONTROL AND PREVENTION

As mentioned earlier, the principal method of transmission of grapevine viruses is by movement or propagation of infected vines. Virus transmission occurs by grafting a diseased cutting onto a healthy rootstock, or vice-versa. Nematodes are known to transmit certain grapevine-infecting viruses, particularly those that cause grapevine decline and fanleaf diseases. Infected nematodes may be spread on the roots of plants through soil, water, and by routine vineyard cultural practices. Furthermore, many of the viruses that cause grapevine decline diseases are known to infect weeds present in the vineyard. Therefore, pest control should be a routine task used to maintain a healthy vineyard.

Prevention of virus spread in the vineyard is important; once a viral disease is established in the field there is no treatment or cure. The only and most drastic solution is vine removal when the vines are declined and unproductive. Infected vines are a source of infection (i.e., the viruses can be transmitted by nematodes) and can spread the disease to nearby healthy vines. To avoid problems in the vineyard, the grower should use virus-tested vines for new plantings or for "top-work" practices in established vineyards.

Laboratory tests conducted in the right season using appropriate sampling methods will help rule-out infection, pinpoint the disease causal agent, and avoid the spread of harmful virus causing diseases. An integrated pest management system should be devised to control weeds and vectors that harbor and/or transmit the virus to reduce the spread once the disease is established in the vineyard. **wbm**