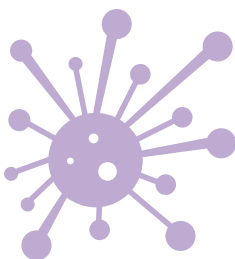
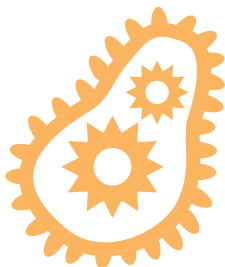
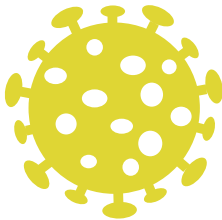




Disease-Tested GRAPEVINE PLANTING STOCK

By Judit Monis, Ph.D.

Pathogen-free vines help avoid problems in the vineyard



Unlike in this case, symptoms of infection are not always easy to spot.

Many disease-causing organisms (pathogens) that infect grapevines have the potential to spread and are difficult to control once established in the vineyard. The most practical way to avoid problems is to plant pathogen-free vines.

Although awareness of diseases caused by viruses and other organisms has increased over the years, many vineyard managers are still not well informed on how to manage these threats. The aim of this article is to provide information that will help vineyard managers and nursery personnel understand disease development and spread. Ultimately, this will ensure that clean planting stock is used for establishing high-quality and productive vineyards.

PATHOGENS AND DISEASE DEVELOPMENT

Grapevines can be affected by different pathogens such as bacteria, fungi, nematodes and viruses. Additionally, environmental and external conditions can negatively affect the vineyard (i.e., freezes, chemicals). Insects and nematodes play an important role in disease development, as they facilitate the transmission and spread of certain pathogens. The most important

AT A GLANCE

- The best way to establish a healthy vineyard is to plant pathogen-free vines.
- Many pathogens have the ability to spread and are difficult to control once established in the vineyard.
- All grapevine disease-causing organisms are propagated by grafting.
- Certification programs aim to establish a foundation of disease-tested grapevines for distribution to nurseries and growers.
- Through the Russell Ranch foundation block at UC Davis Foundation Plant Services, nurseries will be able to supply disease-tested progeny vines to growers as early as 2015.

point to understand is that all pathogens affecting grapevines are propagated by grafting. Consequently, many infected vines can be derived from a single diseased vine.

At least three factors or conditions must be present for a disease to develop: the pathogen, a susceptible host and favorable environmental conditions. This concept is known as the disease triangle principle. It applies pertinently to the vineyard: Planted grapevines are the susceptible host, and disease will develop only when a pathogen (bacterial, fungal and/or viral) and appropriate conditions for disease development (environment) are present. However, the concept is further complicated. Certain grapevine varieties and rootstocks can be more or less susceptible to infection.

Similarly, pathogens are specialized and exist as populations of strains or races that are more or less virulent (i.e., show severe, mild or no symptoms) on different varieties or clones planted in the vineyard. Many other factors allow the establishment, movement and spread of the disease-causing agents. Certain species of grapevine leafroll-associated viruses are transmitted by mealybugs and soft-scale insects. These insects can be translocated a short distance by ants who "nurse" the mealybugs. The insects may be moved longer distances via workers who track insects stuck on shoes and clothing, and on contaminated tools and vineyard equipment. In addition, wind can carry viruliferous mealybugs a great distance.

Freezing temperatures increase susceptibility of grapevines to viral, fungal and bacterial pathogens. For example, crown gall symptoms, caused by pathogenic strains of *Agrobacterium vitis*, appear only after injuries caused by freezing temperatures or mechanical damage. Many fungal pathogens are able to colonize healthy-appearing grapevines without causing disease unless stress conditions (freeze, drought, mechanical damage, overwatering) are present. Likewise, virus-infected vines are more sus-

ceptible to environmental stress conditions or the invasion of other pathogens.

PLANTING DISEASE-TESTED STOCK

The most important step to establishing a healthy vineyard is the planting of pathogen-free material. Countries around the world and many U.S. states have developed certification programs to establish a foundation of disease-tested grapevines. Most are voluntary and open to participants who fulfill and follow all the required rules. Nurseries will further propagate the material from the certification program to create increase blocks (an increase block is a vineyard or vineyard section from which cuttings may be used to propagate certified grapevines) and produce grafted vines and rootstock to distribute to growers.

Most certification programs limit their testing efforts to viruses. Research programs throughout the world are constantly discovering new viruses and developing new detection methods. To keep certification programs current, the mother plants and nursery increase

Because of the improvement of knowledge and detection methods, most certification programs cannot guarantee infection-free plant material because it is impossible to rule out diseases or the presence of pathogens that have not been discovered. For example, a recent study showed the presence of "cryptic" viruses in wild grapevines grown in Mississippi. Of particular interest is grapevine virus Q, isolated from asymptomatic *Vitis rotundifolia*. Grapevine virus Q is nearly identical to grapevine syrah virus-1, characterized by UC Davis researchers as showing syrah-decline symptoms. The finding of this virus in asymptomatic wild grapevines has relevant implications on the sanitary status of planting stock (rootstocks do not show virus symptoms). Another virus that has received increased attention is the syrah strain of *Rupestris* stem-pitting virus. As researchers and commercial diagnostics laboratories are able to detect viruses in planted vineyards, everyone will have a better knowledge and understanding of the effect of newly discovered viruses on grape and wine production.



Fungal pathogens are responsible for the uneven size and color of the berries on this vine.

blocks need to be re-tested routinely. Mother vines that are found to be infected with excluded viruses must be removed from the certification program.

Fungal pathogens are also a threat to planting material, and some are known to affect quality and yield of grapes in the vineyards. Similar to their bacterial and viral

counterparts, fungal pathogens are graft-transmissible. In addition, many fungal pathogens are soil-borne, and produce spores that can be spread long distances by wind, workers, and through soiled or contaminated equipment and pruning tools.

Unfortunately, certification programs throughout the world do not focus on the detection and control of fungal pathogens in mother vines or progeny increase blocks. Researchers are working on the development of strategies to control the spread and incidence of fungal pathogens. When reliable fungal control methods become available, certification programs will have the ability to exclude fungal pathogens from mother blocks and planting stock.

REVISED REGULATIONS

Currently, the California Grapevine Registration & Certification Program is under revision. The drafted regulations will include rules for traceability to original foundation blocks and specific distance of increase blocks (i.e., setback) from fruit-bearing vineyards. The new regulations will include field and laboratory tests to assure that vines released from the program have met higher standards.

Under the new rules, a comprehensive list of viruses and methodologies will be prescribed for mother and progeny vines. If a vine is found to be infected with a virus on the list, the increase block will be disqualified from the program.

The National Clean Plant Network, created to protect U.S. specialty crops from the spread of economically harmful plant pests and diseases, has made \$20 million during a five-year period available for the testing and production of grapevine and other fruit crop clean stock. The funding and guidelines will allow the planting of the Russell Ranch foundation block at UC Davis' Foundation Plant Services (FPS). The new block is expected to be planted in the spring of 2011 with material produced using the "shoot tip" tissue culture tech-

nique – a method that allows the elimination of certain viruses and bacteria. FPS director Deborah Golino announced that nurseries will be able to supply virus-tested progeny material to growers as early as 2015.

ROUTINE TESTING PROGRAMS

It is exciting news that high-quality, disease-tested planting material will become available to vineyards throughout United States in the near future. Even so, growers and nurseries need to develop routine testing programs to assure that disease-free planting stock remains so. The first step to a disease-free vineyard is to plant clean stock material. Many growers still rely on planting "healthy-looking" material from their own or neighboring vineyards. Derived vines should be planted with caution, as many vineyards can harbor pathogens without showing notable signs of infection. To ensure disease-free stock, representative samples should be submitted to a laboratory to test for major disease-causing agents (i.e., viruses, bacteria and fungi). To assure the highest quality, planting material from certified sources should always be tested.

Growers should request from the nursery information about the disease-testing history and age of the increase blocks where plantings are generated. Since new detection methods continue to be implemented, healthier plantings will derive from newer increase blocks. Similarly, the likelihood of infection increases with age (i.e., the older the increase block, the higher probability of infection). Because viruses and other pathogens can spread from adjacent vineyards, it is important to work with a knowledgeable vineyard consultant or plant pathologist to inspect the increase blocks and adjacent vineyards for insect vectors and/or suspicious symptoms.

The time to submit samples for testing of planting material should coincide with the time the grower decides which rootstock-scion combination will be ordered at the

nursery. In most cases, nurseries are able to trace their mother vines and organize cuttings in specific bins. A representative sample should be collected from each bin of rootstock and scion material that will be used for grafting. The correct sample will depend on the diagnostic tests ordered. For sensitive and accurate detection, sampling must be done in the appropriate season. Consequently, samples will need to be submitted at different times to cover the whole spectrum of pathogen detection. The testing laboratory plant pathologist or vineyard consultant can give the best recommendation on timing and sample type.



This field-finished bench graft shows necrosis and dark exudates caused by fungal infection.

Many pathogens originate and spread in the vineyard. Because of the potential for pathogen spread or new infections during plant propagation, it is important to test planting material after field finishing. Visual inspection of vines is important; however, symptoms are not always obvious in young vines. Testing and tracing the cuttings collected for further propagation is imperative to assure the pathogen-free status of planting material (disease could be detected in a vineyard that was planted with virus-tested stock). Other practices that require rigorous testing are top-working and field budding. Both the original vine and the grapevine variety to be grafted should be tested when the grower decides

to change varieties or clones in the vineyard by field budding.

While it may seem easy to obtain vines that are pathogen-free, a challenge voiced by nurseries and growers is that it is difficult to prevent a clean stock from becoming infected by neighboring vineyards. Future voluntary programs that include solely planting vines from reputable certification programs, complemented by internal routine testing programs, will result in vineyards free of disease. ■

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Comments? Please e-mail us at feedback@vwm-online.com.