

Grapevine Trunk Diseases

David Appel, Professor, Plant Pathology and Microbiology¹ Albre Brown, Graduate Student²

Grapevine trunk diseases (GTDs) reduce the lifespan of vineyards and increase the costs of producing winegrapes. A broad category of chronic diseases caused by many fungal pathogens, GTDs occur throughout all winegrape growing regions in the world. *Vitis vinifera* varieties are susceptible to GTDs, as are native American grapes and interspecific (occur between species) hybrids.

Although they may infect vines in different ways, all GTDs cause dieback in the woody cordons (semi-permanent branches) and trunks (Fig. 1). The maturing winegrape industry in Texas is reaching a stage where the prevalence of GTDs and their impact on the health and productivity of vineyards will likely increase.

Symptoms

Symptoms appear when the fungi grow through the wood, plugging xylem vessels (the plant's water-carrying system) and phloem elements (sugar transport system). Water and nutrients to the canes and cordons cease to flow. As a result, buds and shoots are girdled and die, producing an expanding canker with the typical wedge-shaped pattern seen in the cross section of an infected vine (Fig. 2).

As the vine ages (7 to 10 years old), infections can become more numerous and severe, eventually reaching the trunk and killing it. Various random patterns of chlorosis (yellowing) and necrosis (browning and death) become evident while the vines decline, fail to thrive, and die back. With a few exceptions, basing a diagnosis of different GTD pathogens on foliar symptoms is unreliable.



Figure 1. A typical "dead arm" resulting from a grapevine trunk disease. *Source: Albre Brown*



Figure 2. Wedge-shaped discoloration caused by infection by GTD pathogens. *Source: Albre Brown*

¹Texas A&M AgriLife Extension Service, the Texas A&M University System ²University of California-Davis



Specific GTD pathogens

There are several fungal pathogens responsible for GTDs. A single vine can be infected with more than one of these pathogens, further complicating a diagnosis. A definitive diagnosis that identifies the specific GTD pathogen may not be necessary and often depends on submitting samples to a diagnostic lab for clinical testing. Some of the more common GTD pathogens in Texas include Bot dieback, Esca, and Eutypa dieback.

Bot dieback or dead arm

The most common of the GTDs, Bot dieback is caused by several species of related fungi in the Botryosphariaceae family, from which the group is named. Bot dieback is one of the most prevalent diseases of winegrapes worldwide. Typical symptoms include

- dead spurs;
- dieback of canes, cordons, and trunks;
- leaf chlorosis; and
- wedge-shaped staining of necrotic (dead) wood visible in the cross section of the wood (Fig. 2).

In Texas, the two most prevalent fungi from this family are *Diplodia seriata* and *Lasiodiplodia crassisipora*. They produce spores in tiny black structures, or pycnidia, on the surface of infected wood (Fig. 3). The pycnidia, or fruiting bodies, are best observed with a hand lens.

Spores spread from diseased vines to wounds on healthy vines during cool, wet weather. Splashing rain can disperse the spores of the Bot pathogens over relatively short distances. Windblown rain can spread the spores over longer distances, often blowing the pathogen into a nearby vineyard. Most infections probably enter a vineyard on propagation materials that have latent infections, meaning the symptoms are not evident



Figure 3. (left) Pycnidia of Bot pathogen on the surface of a dead, cankered cordon (arrows). Source: Albre Brown

Figure 4. (right) Staining in xylem elements and decay in a vine affected by Petri disease. Source: Albre Brown

on the scions, rootstocks, and cuttings used to establish the vineyard.

Seasonally, Bot canker spores are released in Texas during late winter and spring. For this reason, pruning wounds made when rains prevail are the primary infection courts (locations where the fungus infects). During the dormant season, the increased humidity enhances spore production and the vines are less active and unable to respond to infections. Other infection courts include freeze cankers, insect damage, and any mechanical wounds made during growing and harvesting operations. Wounds are immediately susceptible to infection and become less so over time.

Esca, Petri disease, black measles, apoplexy

Esca is a destructive group of five disease scenarios that involve three different pathogens. First described over 100 years ago, esca occurs worldwide and is known by many different names. Petri disease, or young esca, is a vascular disease caused by two fungi in the genera Phaeomoniella and Phaeoacremonium. This disease impacts young (less than 7 years old) vines in newly planted vineyards. The Petri disease fungi grow systemically throughout the vine in the xylem, leading to distinct internal symptoms (Fig. 4). The disease usually appears in new vineyards through infected rootstocks. Like other GTDs, the pathogens spread by spore production and infection of pruning wounds during the dormant season. Affected vines are stunted with poor quality berries and reduced yields. Both of the vascular pathogens in the esca complex occur in Texas.

Surviving, older vines with Petri disease may become infected with another, very different fungus that causes a type of wood decay called white rot. This fungus, *Fomitiporia*, is also present in Texas (Fig. 5a). This white-rot pathogen leads to wood decay seen in the cross sections of dying cordons and trunks (Fig. 5b).



Figure 5. Signs of symptoms of esca in a diseased grapevine. **A.** Fruiting body of the pathogen *Fomitiporia* growing on the surface of the trunk. *Source: Albre Brown* **B.** Typical white rot of cordons and trunks associated with esca. *Source: David Appel*

The complex caused by simultaneous infections of vascular pathogens and decay organisms is the classic scenario known as esca, or esca "proper." Esca is the only GTD with a typical berry symptom, called "black measles," where the skin exhibits tan to purplish spots (Fig. 6). It is also the only GTD with a distinct pattern of foliar symptoms (Fig. 7). Specific symptoms found in the esca complex include

- black wood streaking of xylem vessels (Petri disease);
- poor growth, low vigor (Petri disease);
- chlorotic interveinal leaf tissues (Petri disease);
- chlorotic tissues that turn red, exhibiting the "tiger striped" symptom associated with esca in red grape varieties (Petri disease and white rot);
- wood decay (white rot);
- spotting of berry skin (black measles); and
- rapid leaf drop, foliar shriveling, and drying of fruit clusters (apoplexy).

Esca symptoms may discontinue from one year to the next, and, in some cases, appear suddenly and extensively through a vine (apoplexy) (Fig. 8) and apparently recover the following year. The disease may resemble the other GTDs when vines die back and grape quality and productivity decrease.

Eutypa dieback, dead arm

A primary fungal pathogen, *Eutypa lata*, causes Eutypa dieback. *E. lata* has a wide host range on dozens of woody plants other than grapes. The pathogen also produces a phytotoxin that helps induce reduced vigor and chlorotic, dwarfed, and cupped foliage on stunted, new shoots (Fig. 9).

In the early stages, the vine outgrows the deformed shoots with new, healthy growth. Over subsequent years, the slowly growing cankers and symptoms eventually dominate so that cordons fail to produce any new shoots and the vine dies. Close inspection of symptomatic shoots reveals cankers on trunks and cordons similar to those seen with other GTDs. Cross sections through cankered cordons and trunks show zones of brown, necrotic wood, some of which have the typical wedge shape of the other cankers. The disease often goes unnoticed until the vines reach maturity.

Little is known about what other hosts, native or cultivated, might harbor this fungus in Texas. *E. lata* produces pycnidia imbedded in the surface of the cankered wood. As with most of the GTD pathogens, spores are discharged following rainfall and can be dispersed over long distances. In the temperate Texas



Figure 6. Black measles symptoms of esca on affected berries. Source: Albre Brown



Figure 7. Tiger stripe symptom of esca in a mature grapevine. Source: Albre Brown



Figure 8. Apoplexy, the rapid collapse of a vine affected by esca. Source: David Appel



Figure 9. Stunted, chlorotic foliage, and dieback of a grapevine infected with *E. lata. Source: David Appel*

climate, spore discharge is greatest in fall and spring. Pruning wounds are most susceptible to infection during the first 2 weeks after they occur.

Management

In a new vineyard, early prevention is the best approach to managing GTDs. As with any grapevine disease, sustained management depends on proper diagnosis. A cursory diagnosis based on symptoms is usually sufficient, but there are circumstances where knowing the pathogen name is useful. If necessary, have affected tissues inspected by an experienced plant diagnostician or state viticulturist. In Texas, submit samples to the Texas A&M AgriLife Extension Service, Texas Plant Disease Diagnostic Lab (see http://plantclinic.tamu.edu) for a clinical diagnosis.

Complete control or eradication of GTDs in a vineyard is virtually impossible. The pathogens are everywhere, the Texas climate is usually conducive to infection, commercial grape varieties are susceptible to one or more of the pathogens, and every wound made on the vines is a potential location for canker development. There are, however, many economically favorable measures that, when applied in a broad and integrated approach, can delay the impact of GTDs and prolong winegrape production. Successful management of GTDs must be a goal from the planting of new vines throughout the duration of the vineyard.

Cultural practices

The pathogens that cause GTDs are more severe on stressed, poorly maintained vines. Practices intended

to keep vines in good health, particularly in young vines, delay the detrimental effects of the GTDs. Using clean, healthy propagation materials, including scion and rootstock, proper planting, avoiding over-cropping when vines are young, and maintaining suitable fertility are cultural practices that contribute to good vine health and will discourage canker development.

In addition to the following recommendations, never prune vines during rainy, wet weather. Regularly scout the vineyard, particularly when growth is new and has not yet obscured the presence of dead spurs and shoots. When you identify infected wood, excise (cut out) it at least 4 inches into healthy, green wood and properly dispose of it by burning or burying it to eliminate spore production.

Modified routine pruning practices

There are two pruning methods recommended for suppressing GTDs: double pruning and delayed pruning. Double pruning consists of a "prepruning" cut of canes to about 10 to 12 inches above the intended spurs, sometimes made with a mechanical pruner. Make this first pruning during the dormant season, in December or January. During the second pruning (in February, just before or at bud break), remove any wounds that have become infected. At this time, the vines are better suited to respond to and resist infections than during the winter.

Wound protection

Paints for use on grapevines protect pruning cuts and other types of wounds from diseases. The ideal pruning paint must be durable and effective in reducing various GTD pathogens for at least 2 to 12 weeks to reduce infection. Manually apply the paint to all wounds. There are several formulations available that contain protectants such as resins, essential oils, or some other carrier. Some formulations contain boric acid or a fungicide to provide added protection from infection beyond simply creating a physical barrier.

Tractor-applied fungicide sprays can also help protect grapevines. In Texas, fungicides are labeled for dormant season sprays to control GTDs caused by *Botryosphaeria, Eutypa, Phaeoacremonium*, and *Phaeomoniella* (refer to the *Grape Pest Management Guide* listed in Other Resources, below).

The effectiveness of sprays depends on the timing of

the pruning and when rains occur, which can wash the fungicide from the cut surface as well as trigger spore production.

Always refer to product labels for specific instructions on the use of dormant sprays to control GTDs.

Surgery and retraining vines

The following practices help prolong production:

- Rehabilitate diseased vines by renewing trunks and retraining new cordons.
- Enhance these efforts in advance by training for multiple trunks. Then periodically replace older, diseased trunks with new ones derived from shoots that grow from basal buds.
- During the dormant season, excise diseased wood a minimum of 4 inches below the discolored wood.
- Identify and train new shoots the year before removing a diseased cordon (Fig. 10).
- Protect all pruning wounds from infection.

When properly done, vine surgery can prolong the life of the vine, but there are drawbacks. Excision is not effective in the case of Petri disease, where the pathogens are systemic infections in the xylem rather than localized cankers. Pruning practices that produce large wounds create new, susceptible infection courts. If unprotected, these new wounds will likely succumb to infection and the incidence and severity of GTDs in the vineyard will persist. Vine surgery to control GTDs is a delaying tactic; anticipate the eventual need to rogue (cull) diseased vines.



Fig. 10. Retrained vine affected by GTD. Note the excision of original, diseased cordons. *Source: David Appel*

Other Resources

For help in diagnosing GTDs and other grapevine diseases, see <u>http://plantclinic.tamu.edu/</u> for instructions on how to submit samples to the Texas Plant Disease Diagnostic Laboratory. The laboratory is a service of the Department of Plant Pathology and Microbiology at Texas A&M University in conjunction with the Texas A&M AgriLife Extension Service. Also, regional viticulture Extension program specialists are available to advise grape producers with grape disorders. See <u>http://winegrapes.tamu.edu/texas-viticulture-and-enology-extension/</u> for contact information.

For specific recommendations about using fungicides and insecticides for pest management of insect and diseases, see the 2016 Grape Pest Management Guide (HT-085), available at the Texas A&M AgriLife Extension Service Bookstore (at <u>http://www.agrilifebookstore.org/Texas-Grape-Pest-Management-Guide-p/ht-085.htm</u>).

To learn more about current research and developments on GTDs, visit the USDA Specialty Crops Research Initiative on GTDs in California website at http://treeandvinetrunkdiseases.org/.

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