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Management of Pierce’s Disease in Texas

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The single greatest threat to the production of susceptible grape cultivars in Texas is Pierce’s disease. Since 1990, it has caused millions of dollars in losses to the state’s wine industry and has moved into areas previously unaffected by Pierce’s disease. The problem has escalated in the past 5 years, in part because of a series of warm winters that has accelerated the rate of spread and winter survival of the disease.

Pierce’s disease is caused by a bacterium, *Xylella fastidiosa*, which clogs the water-conducting tissue, or xylem, of susceptible grape cultivars. Although some grape cultivars are tolerant of the bacterium, it eventually kills those vines that are susceptible to it, and it can spread throughout a vineyard.

There is no known, approved method of curing the infection. To prevent losses from the disease, growers need to:

- Know the geographic areas where Pierce’s disease is found
- Identify the grape varieties that are susceptible to the disease
- Understand how the disease is spread
- Understand the biology of the insect that transmits the bacteria that cause the disease
- Be able to recognize symptoms of Pierce’s disease
- Carry out disease-inhibiting management strategies in and around their vineyards.

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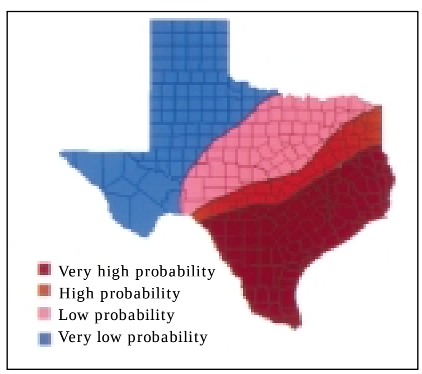
Pierce’s disease probability in Texas

Pierce’s disease is apparently limited to areas that do not experience severe winter temperatures. It has attacked vineyards in every region of Texas except for the South Plains area near Lubbock.

Vineyard survival varies greatly, apparently depending on variety and site selection, cultural practices that reduce the risk of contracting the disease, weather, and probably numerous other factors that influence insect vector behavior and bacterial survival.

The expected presence of Pierce’s disease in Texas was detailed in *A Feasibility Study for Grape Production in Texas*, a bulletin produced in the mid 1970s by the Texas Agricultural Experiment Station.



Expected probability of Pierce’s disease in Texas. Source: Texas Agricultural Experiment Station.

At that time, it was thought that the range of the disease was limited by the natural range of the insect vectors. More recently, cold temperatures have been shown to help plants infected with *Xylella*, but the exact duration and absolute temperatures have not been identified.

The Texas Hill Country, long believed to be a transition zone between high and low probability for Pierce's disease, experienced several warm winters in the mid 1990s, after which several vineyards were completely infected.

Prospective growers should realize that this disease is cyclic (some years with severe Pierce's disease, and some with little or none) and that infections are likely to occur eventually in high-risk areas.

Varietal susceptibility

Some grape species or cultivars are susceptible to Pierce's disease; others are tolerant. Vinifera and most French-American hybrids are highly susceptible to the disease. Some American varieties such as "Champanel," "Black Spanish" ("Lenoir") and "Blanc duBois" are tolerant. "Norton" ("Cynthiana") may also have tolerance.

Tolerant cultivars appear to have internal mechanisms to suppress the bacteria to the point that the vine can live and be productive even when the bacterium is present. But fruit from these varieties have low commercial acceptance because of their reduced wine quality. Some wineries are making high-quality products from them, but the market is somewhat limited. A commercial grower planning to plant tolerant varieties should investigate their market potential with interested wineries to make sure the planting is economically viable.

All native Texas species of *Vitis* are believed to be tolerant of Pierce's disease, which makes them potential carriers of the bacterium.

Survival of infected susceptible varieties

Cultivars also vary in the length of time it takes the pathogen to kill the vines. Although Pierce's disease is ultimately fatal to infected susceptible varieties, some individual vines can survive for extended periods.

For example, "Chardonnay" frequently exhibits symptoms the same year that infection takes place and may completely die within a year. "Cabernet Sauvignon" may not show symptoms for some time after infection and may live and be moderately productive for a few years.

In these cases, some growers choose to manage infected vines until they die, but the assumption is that the block of grapevines will ultimately be lost to the disease. These infected vines can, however, serve as a source of bacteria and accelerate the spread of the disease within the vineyard.

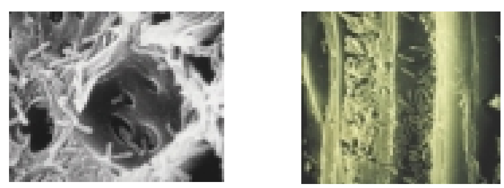
Disease cycle

To spread, Pierce's disease depends on the presence of three organisms: an uninfected susceptible grapevine, a plant already infected that serves as a source of the bacterium, and an insect that feeds on both plants to inoculate the susceptible grapevine.

The bacterium is transmitted, or vectored, by certain kinds of xylem-feeding insects, mainly the leaf-hopper group known as sharpshooters. Sharpshooters acquire the bacteria when the insects feed on an infected grapevine. The bacteria enter and multiply in the insect's foregut, and the insect then passes the bacteria to an uninfected plant as it feeds on the tender tissue.

With each subsequent feeding, the sharpshooter has a high probability of introducing the bacteria into each plant it feeds on. These insect vectors are very efficient at transferring the bacteria during feeding, and infection is likely.

Once they infect the grapevine, the bacteria multiply and form colonies in the xylem, or water-conducting tissue of the plant. The huge bacterial populations clog the vascular tissue and inhibit movement of water through the grapevine.



Electron micrographs of Xylella fastidiosa in xylem vessels of grapevine. Photos by Doug Cook.

The tissue becomes unable to conduct water through the plant, which eventually dies. Infected vines left in the vineyard then serve as a source of the bacteria for additional infection in other vines.

Although the Pierce's disease bacterium is a serious problem to commercial grape growers on the West Coast, it is probably not native to California, but to the U.S. Gulf Coast region. *Xylella fastidiosa* was probably introduced in California through infected grapevines from the Gulf Coast.

The bacterium lives and multiplies in numerous native and introduced plants that do not exhibit visual symptoms. Different strains of the bacterium cause similar diseases in other plants, such as peach, alfalfa, citrus and oleander. However, the strains appear to be host specific: that is, the grape strain apparently does not infect peach, and the peach strain apparently causes no symptoms in grape.

In California, surveys have identified numerous supplemental hosts. Where the disease occurs in Texas, there are probably many more plant species that can support the bacterium.

Sharpshooter biology

It is likely that numerous species of sharpshooters can transmit the bacterium in Texas. Researchers are working to identify these insects, determine their preferred habitat, and understand population dynamics. In areas of rampant infection, it is assumed that many sources of the bacterium are widely available.

Sharpshooters in adult growth stage. Photos by Jim Medley.

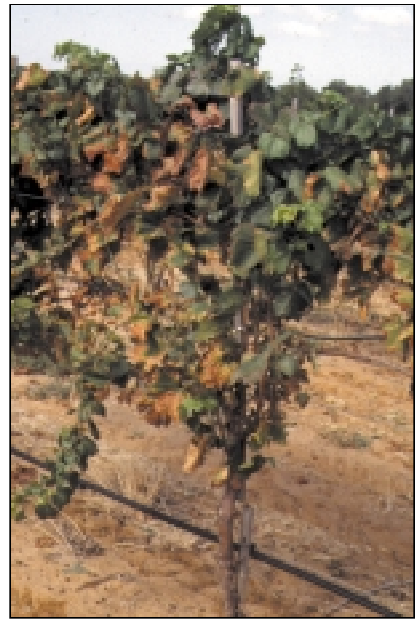
Most if not all sharpshooter species go through five instar (growth) stages in which they apparently lose the ability to transmit the bacterium with each molt. Scientists believe that most infection occurs when sharpshooters become mobile adults.

Sharpshooters prefer certain plants and habitats as food sources or egg-laying sites, including bermudagrass, perennial rye, fescue grass, blackberry, willow and elderberry.

Many riparian plants (those that grow well near water sources) can support sharpshooters.

Symptoms

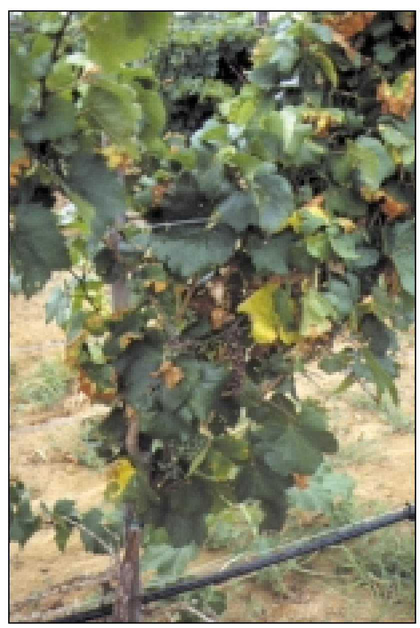
Infected susceptible cultivars can exhibit many symptoms: leaf scorch; cluster collapse; blackened, shriveled fruit; leaf drop; and uneven periderm development. Each of these symptoms can be confused with one or more other nonrelated factors, but the presence of several symptoms offers strong evidence that susceptible grape cultivars are infected.



Leaf scorch caused by Pierce's disease.

The first symptom is that the leaves begin to show marginal scorching. On red-fruited varieties, the edges of the leaves turn red and then brown; on white-fruited varieties, the edges turn yellow and then brown.

Because the bacterium inhibits water movement in the vine, symptoms often appear during heat stress or near veraison (color change) in the grape cluster. Grape clusters on heavily infected vines may actually collapse during this time of high water and carbohydrate movement, resulting in blackened, shriveled fruit.



Cluster collapse at veraison caused by Pierce's disease.

The leaves may also fall off, but the petioles, or leaf stems, remain on the shoots.

As winter approaches, new shoots become woody and develop periderm (brown bark) on 1-year-old shoots. This periderm usually begins forming at the base of a shoot and progresses toward the growing tip.

Retained petioles caused by Pierce's disease.

Green internodes caused by Pierce's disease.

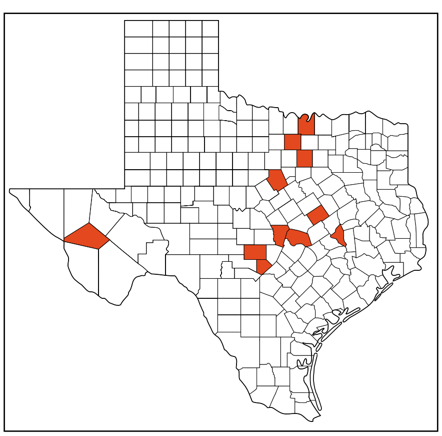
In infected grapevines, periderm does not develop uniformly, usually resulting in green "islands" at the nodal area while the internodal part of the stem turns brown.

Initially, one or a few diseased grapevines appear at different locations in the vineyard. New symptomatic grapevines will soon appear near the initial infections, and the pathogen can spread rapidly to new locations.

In California, symptoms are usually seen at the vineyard edge, but in Texas, the first infected vines have also been found in the center of a vineyard. Flight and feeding habits of the specific vector probably account for these differences.

Laboratory diagnosis

Pathogens may also be identified through laboratory tests. The conventional way to detect the bacterium is with an enzyme-linked immunoassay analysis, also called an ELISA assay.



Texas counties in which ELISA tests were positive for Pierce's disease in 1996.

This technique is widely practiced wherever Pierce's disease occurs and is accomplished by sending proper samples into a diagnostic lab equipped to perform the analysis.

New technologies are being developed and coming into practice to make diagnosis much more reliable. For current information on laboratory diagnosis and the procedures to ship samples, contact your local county Extension office.

Managing Pierce's disease

To prevent and manage Pierce's disease, growers should select favorable sites, remove wild grapevines as well as diseased vines, manage insect vectors, and control weeds on the vineyard floor.

- **Acknowledge risks**

There is no known control for Pierce's disease. Planting susceptible grape cultivars in areas where it is known to exist is inherently risky.

- **Select amenable sites**

Because plants that grow near water sources are essential to sharpshooter populations, choosing vineyard sites away from rivers, creeks or ponds can aid in insect management.

- **Remove wild grapevines**

In Texas, wild hosts of the grape pathogen have not been identified. In other states, grape strains of *Xylella fastidiosa* have been isolated from wild grape, ragweed, alfalfa and almond trees. Numerous perennial riparian weeds are suspected supplemental hosts.

As a precaution, it is recommended that growers remove wild grapes from around the vineyard.

- **Remove diseased vines**

Vines should be destroyed immediately if they have foliage and cane symptoms that are confirmed by laboratory diagnosis to be caused by Pierce's disease. Regardless of varietal longevity, any vine with symptoms of this disease should be pulled up or cut off at the ground and removed from the vineyard.

Because the disease may spread from vine to vine within a vineyard, removing diseased vines reduces the potential sources of bacteria that could be transmitted by insect vectors.

■ **Manage vectors**

Researchers have not identified all the insect species that vector Pierce's disease in Texas. Some species of leafhoppers in Texas vineyards and nearby wild hosts look like sharpshooters but are not known to vector the disease. Sharpshooters tend to be significantly larger than other leafhopper species.

Because all potential vectors within and next to the vineyard cannot be identified, it is difficult to control vectors chemically. Nonetheless, it is thought that vector transmission in northern California is primarily from host plants next to the vineyard, so California growers practice vector control in areas near the vineyards.

In California, the peak transmission of Pierce's disease through sharpshooters is thought to occur shortly after budbreak and to decrease as the season progresses.

The pattern of Pierce's disease spread in Texas more closely parallels that observed in Florida, where significant vine-to-vine spread of the disease occurs. This indicates that insecticides may also be needed to control vectors within the vineyard.

When choosing insecticides, growers should use caution to ensure that specific pesticides are permitted for such use in vegetation next to vineyards.

Based on current information, the following vector control measures are recommended in Texas:

- Establish and maintain a 150-foot buffer (minimum) around the vineyard through mechanical or chemical mowing or cultivation.
- Starting at budbreak and continuing for 6 weeks, sample the vegetation in the area outside and next to the buffer for the presence of sharpshooters. If there is no buffer, sample the vegetation next to the vineyard.
- Use a standard sweep net and take a minimum of eight 25-sweep samples at least twice a week. If on average you find more than one adult sharpshooter per 25-sweep sample, insecticidal treatment may be justified.
- Treat a 65-foot band next to the buffer. If there is no mowed buffer, treat a 130-foot band next to the vineyard. If you cannot treat adjacent vegetation, it might be appropriate to treat the vineyard itself.

  The problem with this approach occurs when there are many supplemental plant hosts for the sharpshooter vectors and the buffer is small or absent. In those cases, treating within the vineyard may not keep out sharpshooters.

  You may need to spray twice a week for 4 to 6 weeks after budbreak, but only if sweep samples indicate that the sharpshooter population is large enough to justify treatments.
- Monitor insect populations, especially after habitat disturbance, such as the cutting of nearby hay fields. The practice will greatly help growers to use insecticides prudently.
- Use insecticides judiciously. Unfortunately, frequent spraying makes outbreaks of secondary pests more likely, especially spider mites. When you apply insecticides often, you also destroy natural insect predators that normally help keep mite populations low.
- Use an insecticide registered for use for the target area. In most cases (and for all sites outside the vineyard), sharpshooters are not listed as a target pest on the insecticide label. The label will list specific restrictions for use on grapes and supplemental hosts.

■ **Manage the vineyard floor**

Vineyards and adjacent areas must be kept free of potential supplemental hosts if Pierce's disease is to be managed long term.

Because little is known about which plant species may serve as a source of Pierce's disease bacteria, many growers are using clean cultivation to eliminate any possible source within the vineyard. Weed growth under the trellis can be controlled with cultivation or herbicides, but researchers have not determined the best management of the vineyard floor between the rows.

Clean cultivation can have serious drawbacks, such as the potential for serious soil loss from erosion. Planting cover crops in vineyard row centers has several advantages over cultivation, including increased equipment mobility, the preservation of soil structure within the vineyard, and erosion control.

We do not yet know which plant species allow the Pierce's disease bacterium to propagate and serve as feeding sites for vectors. Therefore, the plant species that growers should plant or encourage on the vineyard floor are still unknown.

It may be wise to plant (drill or no-till seed) cool-season annual cover crops such as annual rye grass or oats in October and to encourage cover crop growth during the months that grapevines are dormant. These annual plants probably do not contract the bacterium, and they grow when transmission to grapevines is not believed to occur.

Cover crop height can be managed by mowing and is easily controlled during the spring by applying low-rate glyphosate herbicides. This practice keeps cover crop roots in place to support equipment traffic, helps reduce erosion and establishes an organic material layer that inhibits the germination of indigenous weed species.

When annual rye grass is used for this purpose, weed seed germination may also be suppressed because of the allelopathic (repressive or destructive to other plants) properties of rye. Additional applications of glyphosate or glufosinate can be used throughout the growing season to keep developing weed populations in check.

Labeled pre-emergence herbicides can also be incorporated into a vineyard floor management program, but are traditionally used only to control undesirable vegetation under the trellis.

Regardless of the method, immaculate weed control is needed, not only to promote vine vigor, but also to reduce potential supplemental hosts of Pierce's disease and to eliminate feeding and reproductive sites for vectors.

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