

Downy Mildew (*Plasmopara viticola*) in Grapes

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Downy mildew represents one of the most common fungal diseases of wine grapes in the Texas Gulf Coast where it causes crop loss every year. This disease can also be a serious challenge for vineyards in the Texas Hill Country and North Texas wine regions, particularly in wet growing seasons. Downy mildew can infect all green parts of a grapevine, including the shoots, leaves, clusters, and green berries. It is one of few diseases that can cause serious damage all season long (Figs. 1 to 4). Initial infections often go unnoticed, but due to downy mildew's life cycle, a small infection can explode into an outbreak in just several days. Fortunately, downy mildew can be prevented or controlled through targeted cultural practices and the timely use of plant protectant products.

Disease Cycle

Downy mildew is a fungal disease that thrives under warm, wet conditions such as those commonly experienced in spring and early summer in eastern areas of Texas. The fungus overwinters in leaf litter on the vineyard floor and in the surface layers of soil where infected leaves have decomposed. Primary infections can occur with as little as 0.1 inch of rainfall at temperatures of 50 degrees Fahrenheit or above when spores are rain-splashed onto susceptible tissue. Once the primary infection site is capable of producing spores, at least 4 hours of darkness at temperatures above 55 degrees Fahrenheit and a relative humidity of 95 to 100 percent is required for the induction of sporulation. The entire process from induction to the actual release of spores can occur in as little as 4 hours at optimal temperatures (64 to 72 degrees Fahrenheit). Spores may then be blown by the wind to new tissues, where secondary infections can occur if moisture from rainfall or heavy dew is present. The length of wetting

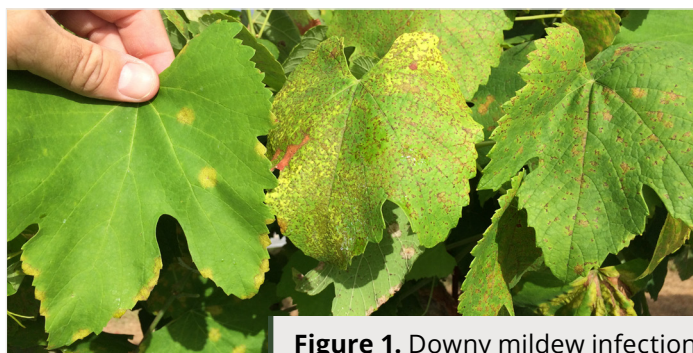


Figure 1. Downy mildew infection on Black Spanish grape leaves.



Figure 2. Grape inflorescences with downy mildew infection.



Figure 3. Downy mildew infection on green berries.

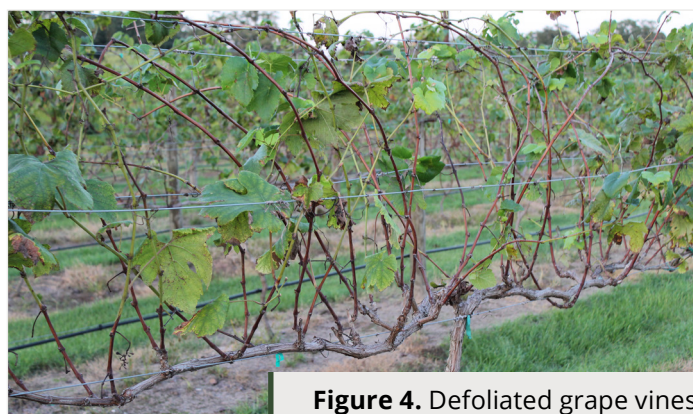


Figure 4. Defoliated grape vines from downy mildew after harvest.

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required for secondary infections can be as little as 1.5 to 2 hours at 59 to 77 degrees Fahrenheit. The first primary infections often occur 2 to 3 weeks before bloom to 2 weeks post-bloom, making this a critical period for preventing the start of an epidemic. As a favorable environment often exists across much of the state for prolonged periods during the growing season, the pathogen is ubiquitous in both young and old vineyards. Multiple generations can exist, perpetuating infection. Downy mildew is one of the greatest fungal pathogen threats for vineyards located in hot, humid, and wet conditions. This is further compounded on high-vigor sites where large and dense canopies exist, which will require both judicious canopy management as well as proper chemical control.

Symptomology

With the exception of very few grape varieties such as Norton and the muscadines, all commercial wine grapes are susceptible to downy mildew. However, their relative susceptibility does vary (Fig. 5). For example, the grape variety Black Spanish/Lenoir is extremely susceptible to downy mildew, more so than Blanc Du Bois. However, downy mildew can be very damaging to Blanc Du Bois as well if not properly controlled.



Figure 5. The grape variety Lomanto (left) next to Black Spanish (right). Black Spanish has visible downy mildew symptoms, while Lomanto does not.

Downy mildew symptoms can vary widely depending on the tissue infected, age of the tissue, stage of infection, and grape variety (Figs. 6 to 12). As a result, downy mildew is often confused with other diseases or disorders, leading to uncontrolled spread. The easiest tissue to use to positively identify a downy mildew infection is leaf tissue. While symptoms can vary by

variety and leaf age, a close inspection of the top and underside of leaves can often lead to a definitive identification.



Figure 6.



Figure 7.



Figure 8.



Figure 9.



Figure 10.



Figure 11.



Figure 12.

Leaf infections first begin as lightly discolored, shiny areas on the upper surface of leaves. These spots may be round or irregularly shaped. More succulent, younger leaves, especially on highly susceptible varieties like Black Spanish, are more likely to have round lesions. Older leaves and those of less susceptible varieties tend to have more irregularly shaped and smaller lesions, which often track along leaf veins. In a short period, lesions become yellowish, taking on an “oil spot” appearance. Over time, lesions progress from yellow to brown and necrotic. Severely infected leaves will typically die and eventually abscise to the ground (Figs. 13 to 18).

The spore produces reproductive structures called *sporangiophores* which may be visible on the undersides of leaves, opposite of the lesions on the upper surface (Figs. 19 to 21). This is more likely to occur after a damp night and is a key feature for positively identifying an ongoing downy mildew infection. Depending on recent weather conditions and severity of infection, no sporangiophores may be visible, or they may be easy to spot with the naked eye. A magnifying glass can be helpful in spotting the “downy” appearance of the sporangiophores on the undersides of leaves (Figs. 22 to 25).



Figure 13.



Figure 14.



Figure 19.

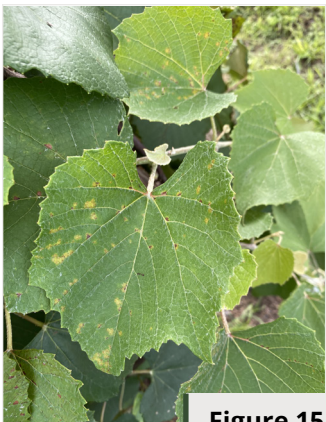


Figure 15.



Figure 16.



Figure 20.



Figure 17.



Figure 18.



Figure 21.



Figure 22.

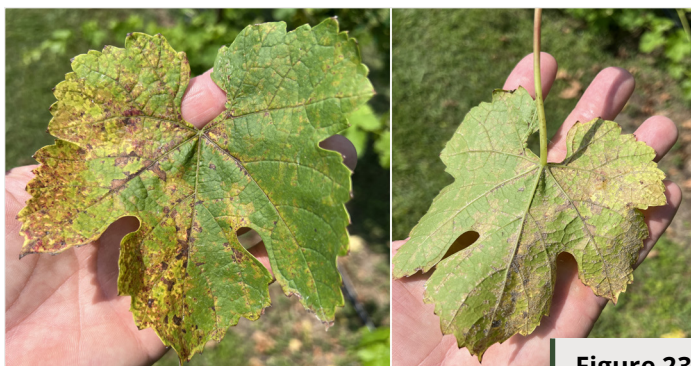


Figure 23.



Figure 24.



Figure 25.

Downy mildew lesions on shoots, clusters, and shoot tips can be more difficult to diagnose due to similarities with other plant disorders. However, inflorescence and berry infections may have sporangioophores that are visible (Figs. 26 to 27). This may be confused with powdery mildew infections which can have a similar appearance. However, powdery mildew infections of leaves will not have symptoms on the bottom of the leaves that correspond to the upper surface. Powdery mildew is usually more prominent on the upper surface of leaves as whitish or grayish discoloration. Additionally, while powdery mildew is found across all parts of the state, including the Texas High Plains, downy mildew is almost exclusively restricted to Texas North, Central, East, and Gulf Coast regions.



Figure 26.



Figure 27.

Flower clusters, or inflorescences, that become infected with downy mildew become brown and necrotic, killing the infected areas or the cluster (Fig. 28). This is sometimes confused with bunch stem necrosis, a physiological disorder with an undetermined cause. Early downy mildew infections of inflorescences are commonly observed later in the growing season as clusters with dead areas, particularly the tail of the clusters (Figs. 29 to 30).



Figure 28.



Figure 29.



Figure 30.

Young berries that are infected by downy mildew typically shrivel and become raisins. However, infections later in the season may result in the skins of berries scarring. This can cause cracking with berry expansion, leading to infections from bacteria and other rotting organisms (Fig. 31).

Proper identification is necessary to guide integrated pest management strategies. If a grower is not confident in their diagnosis, contacting their regional viticulturist with the Texas A&M AgriLife Extension Service is recommended. Microscopic analysis can also be conducted at a certified plant disease laboratory to make a definitive diagnosis.



Figure 31.

Controls

Because downy mildew overwinters in leaf litter, mowing can be helpful in reducing the incidence of primary infections. Shallow tilling may offer benefits as well, but care should be taken to avoid damaging vine roots.

Cultural practices that improve airflow and light penetration into the canopy can reduce the incidence of many fungal diseases, including downy mildew, by reducing humidity in the canopy and drying time after dew and rain events. Another important aspect of maintaining an open canopy is spray penetration.

Poor spray coverage is the number one reason for product failure when controlling disease. Although some products are systemic in their activity, many only travel locally and do not make up for poor spray coverage.

There are quite a few fungicide products with good activity against downy mildew, but it is important to use them properly. Some products have protectant activity and work best when applied before an infection begins. Others have better postinfection activity and control disease best after an infection has started, but BEFORE symptoms are visible. Very few fungicides have curative activity and can kill visible infections. Therefore, prevention is extremely important.

Note that the fungicide product Rally® (active ingredient myclobutanil) is very effective against black rot and powdery mildew, but has no activity against downy mildew. Observations in the Texas Gulf Coast suggest that strobilurins are not always an effective means to control downy mildew. Other states have reported populations of downy mildew that are resistant to strobilurin fungicides, and this is likely the case in Texas. Rotate fungicide groups accordingly to prevent fungicide resistance. For more information, see the [2023 Texas Grape Pest and Weed Management Guide](#).

All photos courtesy of Justin Scheiner.