

Commercial Grape Downy Mildew Management

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Disease Overview

Downy mildew is a serious disease of grapes caused by the oomycete *Plasmopara viticola*. It can infect all green parts of the vines including leaves and young berries. Downy mildew causes direct losses by damaging fruit and shoots and indirect losses by prematurely defoliating vines, leading to reduced yield and quality and predisposing vines to winter damage. The disease is favored by warm and wet conditions during vegetative growth of the vine. The pathogen overwinters as thick-walled survival spores, called oospores, in fallen leaves and soil.

Downy mildew management is aided by cultural practices that reduce leaf wetness and limit sources of initial inoculum, but fungicides are still required for satisfactory control when susceptible varieties are grown in a favorable climate for disease, such as Tennessee. Of course, there are several other important diseases and pests that can affect grapes grown in the Mid-South and Southeast, which should be factored into a comprehensive integrated pest management program.

Generally, cultural practices described here will aid in the management of other diseases like black rot and botrytis. Additionally, several fungicides recommended for downy mildew management, such as azoxystrobin, captan and mancozeb, have activity against other common diseases like black rot and bitter rot. More information can be found on these and other grape production considerations in the Additional Resources section at the end of this publication.

Diagnosing Downy Mildew

Downy mildew can infect all green, actively growing parts of the vine that have mature, functional stomata that are used for air exchange. Lesions on younger leaves initially appear as slightly dark or yellow, circular and angular, and tissue within lesions quickly becomes necrotic (dies) (Figure 1). On older leaves lesions may appear darker and are typically delimited by veins (angular) (Figure 2).



Figure 1. Lesions on a younger grape leaf caused by downy mildew. Lesions are slightly dark or yellow, circular or angular, and quickly become necrotic.



Figure 2. Angular lesions on top of a grape leaf caused by downy mildew. Lesions are typically dark and delimited by veins (angular).

Affected leaf tissue eventually becomes completely necrotic (Figure 3). Sporulation occurs beneath lesions on the underside of the leaves following humid, damp nights and appears as dense, cottony, white masses (Figures 4 and 5). Sporulation can easily be seen with the naked eye (Figure 4). If left unmanaged, premature defoliation can occur.



Figure 3. Severe leaf necrosis caused by advanced downy mildew infection.



Figure 4. Cottony white spore masses on the underside of grape leaves infected with downy mildew.

Young berries are highly susceptible to downy mildew and can become covered in white, cottony masses of sporulation under humid conditions. As berries mature, they become less susceptible to direct infection, but they can still be infected by the susceptible pedicels (the structure connecting each berry to the inflorescence), leading to a brown rot or leather berry symptom. Infected berries usually fall off (Figure 6).

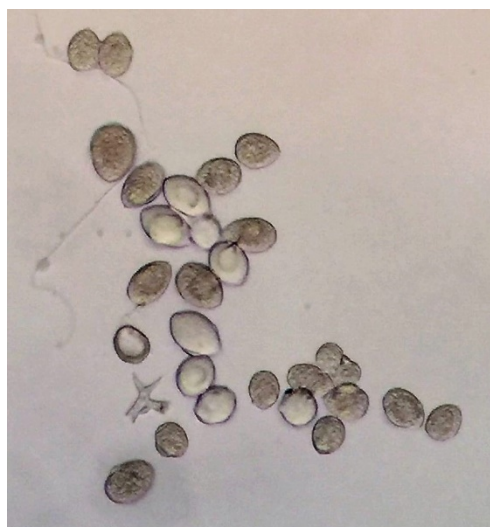


Figure 5. Sporangia of the grape downy mildew pathogen, *Plasmopara viticola*, viewed under a microscope.



Figure 6. Downy mildew damage on bunch grapes.

Management

Cultural Control

Site selection and canopy management practices that promote rapid drying of leaves, inflorescences and berry clusters help limit the potential for infection and disease spread. Locating the vineyard on a site with a higher relative elevation than surrounding land promotes good air flow out of the vineyard. Planting on a mild slope (2-5 percent gradient) will result in better air flow than flat ground.

A slight slope is mild enough that safe operation of equipment is still possible. Vineyards should be planted in areas of full sun, and any

impediments to air flow, such as hedgerows, fencerows or ditches, should be cleaned up to promote better air flow through the vineyard.

Select trellis designs and vine training systems that will promote better air circulation. Proper pruning practices and canopy management techniques will promote sunlight penetration, air movement and spray coverage throughout the canopy. When using divided canopy systems, such as Geneva double curtain or lyre trellis, keep the area between the two areas of foliage cleared through shoot positioning and summer pruning to help promote sunlight, air flow and spray penetration into the canopy. See the University of Tennessee Extension publication, [PB 1475: Grape Growing in Tennessee](#) for more information on site selection.

During the dormant season, leaves should be shredded, removed or buried to reduce overwintering inoculum. Urea can be applied to the canopy and ground at three-fourths defoliation at a rate of 4-5 lb/A to encourage the breakdown of leaf material. In early season, mulches and removal of low-lying foliage can help reduce the spread of primary inoculum onto susceptible tissue as well as promote canopy drying. Destruction and removal of inoculum reservoirs, such as wild or feral grapevines or abandoned vineyards, reduce inoculum potential. Overhead irrigation should be avoided. Proper soil drainage will minimize standing water that promotes the spread of the pathogen.

Chemical Control

Pesticide labels and recommendations are frequently updated and revised. Therefore, the latest Southeast Regional Bunch Grape Integrated Management Guide, available at smallfruits.org/ipm-production-guides, should be checked for the most up-to-date recommendations.

Downy mildew can appear early in the season depending on environmental conditions and inoculum pressure. Protectant sprays may need

to start as early as bud break and new shoot expansion and continue on a seven-to-10-day schedule until prebloom. Mancozeb is a good choice for early-season applications. Prebloom is an important time to begin protecting newly developing berries from downy mildew infection. An additional application may need to be made during bloom if the duration of bloom is long and/or conditions during bloom are especially favorable for disease. Postbloom is also an important time to protect developing fruit from downy mildew infection. A postbloom spray should include mancozeb plus a FRAC group 3 (DMI) or 11 (QoI) fungicide for increased efficacy.

Alternatively, a product containing an active ingredient targeted for oomycetes may be used (Ridomil, Revus, Forum, Zampro). Cover sprays should continue at 10-to-14-day intervals after the postbloom spray, but captan may need to be substituted for mancozeb if the season limit for mancozeb has been reached or to satisfy the preharvest interval (PHI). By this time (approximately 40 days after bloom), fruit should have matured to the point that they are no longer susceptible to downy mildew. However, foliage, rachises and pedicels (the main axis of the berry cluster and the structure connecting each berry to the inflorescence, respectively) are still susceptible, which can lead to premature defoliation and brown rot symptoms on fruit.

Sprays should continue on a 10-to-14-day interval up to preharvest (10 to 14 days before harvest). Postharvest sprays should continue on a 14-to-21-day interval to avoid premature defoliation, which can predispose vines to winter injury. Copper is a good choice for postharvest sprays.

Fungicides recommended for managing downy mildew in grape production.

Product	Active ingredient(s)	FRAC group	Efficacy	Max. consecutive apps.	Max. apps. per season	Re-entry interval (REI)	Preharvest interval (PHI)
Abound	azoxystrobin	11	excellent ^R	1	9	4 hours	14 days
Pristine	boscalid + pyraclostrobin	7+11	excellent ^R	2	5	12 hours	14 days
Various	captan	M4	good	3	6	48 hours	up to harvest
Various	Fixed copper and Bordeaux mixture	N/A	moderate	see label	see label	see label	see label
Ranman	cyazofamid	21	excellent	1	6	12 hours	30 days
Tanos	famoxadone + cymoxanil	11+27	moderate ^R	1	9	12 hours	30 days
Sovran	kresoxim-methyl	11	moderate ^R	2	4	12 hours	14 days
Various	mancozeb	M3	excellent	see label	see label	see label	see label
Revus	mandipropamid	40	excellent ^R	2	4	4 hours	14 days
Forum	dimethomorph	40	excellent	1	4	12 hours	14 days
Zampro*	dimethomorph + ametocradin	40+45	excellent	2	4	12 hours	14 days
Revus Top*	mandipropamid + difenoconazole	40+3	excellent	2	4	12 hours	14 days
Ridomil Gold Copper	mefenoxam + copper	4+M1	excellent	2	4	48 hours	42 days
Ridomil Gold MZ	mefenoxam + mancozeb	4+M	excellent	2	4	48 hours	66 days
Various	phosphonate	N/A	good	see label	see label	see label	see label
Flint	trifloxystrobin	11	moderate	2	6	12 hours	14 days
Ziram	ziram	M3	good	2	7	48 hours	21 days

^RResistance has been reported in southeastern states.

*Check tank mix requirements on product label.

Additional Resources

2020 Southeast Regional Bunch Grape Integrated Management Guide. Ed. Nita, M. 2020. <https://smallfruits.org/ipm-production-guides/>

Lockwood, D.W. and Robinson, D.K. PB 1475: Grape Growing in Tennessee. University of Tennessee Extension.

Diagnostic images available at <https://www.ipmimages.org/search/action.cfm?q=grape+downy+mildew>

Precautionary statement: To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

****Disclaimer**

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

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