The Disease Management Puzzle: Putting the Pieces Together

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Good disease management is among the most important tasks for a grape grower. With five or six major diseases (powdery mildew, downy mildew, black rot, phomopsis, anthacnose, and sometimes botrytis), it can seem like a complicated puzzle. But a few unifying principles can simplify the task, and help you successfully achieve your goal: clean, disease-free fruit and healthy foliage.

Types of fungicides. Many people first think of spray programs and pesticides when it comes to disease management. There are a number of fungicides registered for use in vineyards, but your goal should not be to learn everything about each one. This information can come from a number of spray guides that are published annually for different regions of the US. Instead, become aware of how the fungicides are classified. They can be grouped into two major classes based on how they protect the plant from infection. Systemic fungicides are those that are absorbed or taken up by the plant. All systemic fungicides are not the same and are further classified based on how they move in the plant. The other class of

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Downy mildew infection on underside of leaves (left) and immature fruit (right). Grape berries are nearly resistant to infection by downy mildew by approximately four weeks after bloom, but it's important to apply fungicides from immediately before bloom through a few weeks after bloom to prevent infection.

fungicides is contact fungicides, which adhere to plant surfaces. The important thing to remember about all fungicides is that their efficacy can be affected by a number of different factors.

Both systemic and contact fungicides are affected by plant growth. Systemic fungicides are prone to dilution by grapevine growth, as during the spray interval, the vine grows new shoots, leaves, tendrils, or floral parts, and berry size may increase. Some types of systemic fungicides will move into the new tissue, resulting in an overall dilution of the fungicide in the plant. In the case of contact fungicides, tissue that emerged after the application was made will not be protected. However, contact fungicides can be redistributed and diluted on grape tissue surfaces by dew, rainfall, or overhead irrigation. This redistribution is limited and will not compensate for poor spray coverage nor will it adequately protect newly-emerged tissue. As the number of days between sprays increases, systemic fungicides are further diluted and more and more new tissue is left unprotected by contact fungicides.

Weather and phenology. In integrated pest management, it is often said that you have to know your enemy; in terms of grape pathogens, this is particularly important. For each of the fungi that attack grapes, there are specific circumstances that favor infection of the plant (Table 1). The weather conditions and developmental stage of the plant (phenology) both come into play. For example, powdery mildew is the only one of the six major fungal pathogens which does not require free water for infection and can infect fruit only until four to five weeks after bloom, whereas botrytis does require free water and can infect fruit the entire growing season. A weather station located in the vineyard provides real-time environmental data, which can be coupled with grape disease predictive software models to help determine if an infection period occurred for a specific fungal pathogen.

Ontogenic resistance. Grape berries become more resistant to infection by some fungal pathogens as they age, a phenomenon called ontogenic resistance. Flowers and very small berries are quite susceptible to powdery mildew, downy mildew and black rot. Older berries are more resistant. The critical period for protecting the fruit from these three pathogens is from immediate pre-bloom to four weeks post bloom. If a grower does everything right during the critical period, managing these pathogens will be relatively easy, but if sprays are missed, it can be very difficult to recover. It's also important to remember that the critical period for protecting the crop from pathogens can be prolonged by spring frost events, as they often result in a mix of both primary and secondary buds producing flower clusters. In such instances, the flowering period becomes extended and the onset of ontogenic resistance in the berries will be delayed. Therefore, the crop will need to be adequately protected with fungicides over a longer-than-normal period.

Cultural practices. There are also many cultural practices that can make disease management easier. For example, as most grape fungal pathogens need water for infection to occur, reducing the duration of leaf wetness periods can help control fungal disease. In designing vineyards, select sites that have good air flow and orient rows north south if possible, as this promotes the most rapid drying of the canopy due to maximized sun exposure. Canopy management practices such as shoot thinning, hedging, and leaf pulling can all result in increased air flow and sun exposure leading to faster grape tissue drying. Leaf pulling also allows more thorough spray coverage during application of fungicides.

Scouting. Scouting the vineyard is very important and should be done, at a minimum, on a weekly basis. It is important to familiarize yourself with the common grape pathogens and their symptoms. Scouting early in the season is fairly straight forward since there is very little green tissue, but as the season progresses, be prepared to spend more time scouting. Later in the season, monitor leaves within the canopy and examine fruit clusters. As you "learn" your vineyard, you will likely identify areas where some pathogens appear first, such as a shaded area or a spot with reduced air flow. These areas are noteworthy and you should keep good records that include exactly where you scouted and what you found. This information will be vital, especially if you have

Table 1
The Six Major Grape Fungal Pathogens

Pathogen	Water needed for infection	Berry disease threat period	Foliar disease threat period	Overwintering locations
Anthracnose	Yes	Pre-bloom to veraison	1-5" shoots to harvest	Infected canes
Black rot	Yes	Pre-bloom to 3-4 weeks post-bloom	1-5" shoots to veraison	Canes, spurs, & mummy berries
Botrytis	Yes	Immediate pre-bloom to harvest	Bloom to harvest	Canes & mummy berries
Downy mildew	Yes	Early bloom to 4-5 weeks post-bloom	8-12" shoots to post harvest	Leaf debris & upper layer of soil
Powdery mildew	No	Immediate pre-bloom to 4-5 weeks post-bloom	1-5" shoots to harvest	Fungal fruiting bodies in bark crevices
Phomopsis	Yes	Immediate pre-bloom to bloom	1-5" shoots to harvest	Infected canes and rachises

Table 2
Relative Disease Susceptibility of Selected Cold-Hardy Grape Cultivars[1]

Cultivar	Black rot	Downy mildew	Powdery mildew	Botrytis	Phomopsis	Anthracnose
Frontenac	+++	+	++	++	+	+
Frontenac Gris	++	+	++	++	+	+
La Crescent	++	+++	++	+	+++	+
La Crosse	+++	++	++	+++	++	+
Leon Millot	+	++	+++	+	+	+
Marechal Foch	++	+	++	+	+	++
Marquette	+++	+	+	+++	?	?
St. Croix	?	++	++	++	+++	+

Key to ratings: + = slightly susceptible; ++ = moderately susceptible; +++ = highly susceptible; ? = susceptibility not established

[1] *Information adopted from the 2013 Midwest Small Fruit and Grape Spray Guide.*

to apply a rescue fungicide treatment. The records will allow you to perform follow-up scouting in the same area and determine if the pathogen problem was controlled.

Santiation. Proper sanitation in the vineyard can help reduce fungal inoculum. Dormant pruning and the removal of pruning debris reduces fungal overwintering structures. Remember, many grape fungal pathogens do not overwinter inside the plant, but rather need to reinfect each season. Therefore, removing mummy berries and cane wood from the vineyard reduces black rot and powdery mildew inoculum, respectively.

Genetic resistance. Some cold-climate cultivars are highly susceptible to some pathogens, whereas others are virtually resistant to these same pathogens (Table 2). For example, La

photo: Wayne Wilcox, Cornell Univ.

Black rot lesions on Vignoles canes.

Crescent is highly susceptible to downy mildew, but Frontenac is resistant. This information can be found in most regional spray guides and can be used in planning your disease management program.

Once you understand how the biology of the pathogen, the environment, ontogenic resistance, and vineyard management practices interact, a disease management strategy emerges. Your disease management program should always focus in on the period of immediate pre-bloom to four weeks after bloom, as this is the period when the fruit is highly susceptible to many of the common fungal pathogens. Remember, however, that fruit becomes resistant to some of the common grape fungal pathogens by four weeks post-bloom, but the berries and other tissue remain susceptible to others throughout the growing season. But with diligent scouting and understanding of how environmental conditions affect fungal pathogens, you will be able to adequately protect your crop. Take the time to understand the role each piece of the disease management puzzle and you will end up with quality fruit.

Selected References on Grape Fungal Pathogens

Ellis, M. A. and O. Erincik. 2008. *Anthracnose of grape.* The Ohio State University HYG-3208-08.

Pearson, R. C. 1984. *Botrytis bunch rot and blight.* New York State Agricultural Experiment Station.

Wilcox, W. 2003. *Black rot.* Cornell Cooperative Extension. Disease Identification Sheet No. 102GFSG-D4.

Schwarz, M. R. and R. C. Pearson. 1984. *Downy mildew.* New York State Agricultural Experiment Station.

Wilcox, W. F. 2003. *Grapevine powdery mildew.* Cornell Cooperative Extension. Disease Identification Sheet No. 102GFSG-D2.

Pscheidt, J. W. and R. C. Pearson. 1991. *Phomopsis cane and leaf spot of grape.* Cornell Cooperative Extension. Disease Identification Sheet No. 6 (Revision).