

the fruit and foliage staying wet for longer periods. For this reason, most diseases caused by fungi are generally more serious in plantings with poor weed control than in those with good weed control.

Manage the Canopy

Any cultural practice that alters vegetative growth and canopy density has an effect on vine microclimate. Most cultural practices are chosen primarily to enhance yield or fruit quality rather than to influence the microclimate. However, practices, such as shoot thinning, pruning, and positioning, have a direct impact on vine microclimate. Increasing cluster thinning and decreasing pruning stimulates vegetative growth and hence reduces light exposure and ventilation within the canopy.

Shoot thinning, leaf removal, and summer pruning are frequently done specifically to reduce canopy density, so as to increase fruit exposure to light, improve ventilation, and aid spray coverage. Leaf removal in the fruiting zone of the canopy is important for optimal control of Botrytis bunch rot. This is a common practice in California vineyards and has been shown to be effective in Midwestern vineyards as well. Shoot positioning is usually done to ensure canopy separation of divided canopies or to enhance light exposure of the renewal zone of the vine; it also decreases vegetative growth and canopy density and increases light exposure of fruit.

Avoid Winter Injury

Wounding by freeze injury is important in the development of crown gall. If winter injury is reduced, crown gall may not become an important problem. Practices such as hilling or burying vines of cold-sensitive cultivars are beneficial. Proper pruning practices and proper crop loads for maximum vine vigor will result in stronger plants that are less susceptible to winter injury. Controlling other diseases, such as downy and powdery mildew, is also important in preventing winter injury and crown gall.

Practice Sanitation (Removal of Overwintering Inoculum)

Vineyard sanitation is an extremely important part of the disease-management program. Most pathogens overwinter (survive from one season to the next) in old diseased plant material, such as mummified fruit, leaves, and infected canes or trunks, within the

vineyard. Removal of old, infected wood, tendrils, and clusters with mummified berries from the vines and wires greatly reduces overwintering inoculum of several diseases.

Wild grapes in nearby woods and fence rows also are sources of disease inoculum and insects. Removal of these wild hosts is beneficial to the disease-management program. This especially applies to abandoned vineyards adjacent to managed sites with respect to contamination from powdery and downy mildews.

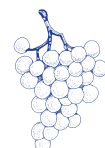
Using Fungicides for Controlling Grape Diseases

Fungicides are an important part of the grape disease-management program. Due to the lack of disease resistance in most of our currently grown cultivars combined with our environmental conditions (abundant moisture) that are highly conducive to disease development, successful commercial grape production in the Midwest is highly unlikely without the use of at least some fungicide. Whereas fungicides are important, growers need to recognize that they are only one part of the overall integrated disease-management program. The effectiveness of the fungicide program is greatly influenced by use of the various cultural practices described previously and the level of disease susceptibility of the cultivars being grown. For example, given a poorly pruned (dense canopy) vineyard of Chancellor grapes (highly susceptible to downy mildew) planted on a poor site (little air circulation) and with poor weed control, the chance of any reasonable fungicide program providing an acceptable level of downy mildew control is highly unlikely.

To use any fungicide effectively, consider these points:

Identify the Disease Correctly

If you do not know what disease or diseases are present in the vineyard, you cannot choose the most effective fungicide or fungicides for their control. Correct disease identification is essential for selecting the proper fungicide or fungicide combinations to use in the vineyard.



Select the Proper Fungicide

Fungicides differ greatly in their spectrum of activity (which fungi they can control). Selection of the wrong fungicide for use on a specific disease can result in financial loss and no control. For example, if a grower misidentified downy mildew for powdery mildew and sprayed Nova or Bayleton to control it, neither of these fungicides would have any effect on the downy mildew, although they would provide excellent control of powdery mildew.

Time the Application Properly

For most diseases it takes at least a week from the time the fungus enters the plant until the symptoms appear. In the case of Phomopsis fruit rot, the fungus enters the fruit during bloom, and symptoms do not appear until the fruit begins to ripen (harvest). Depending upon the weather, it may take two weeks for black rot symptoms to appear. Once symptoms appear, it is too late to control the disease; therefore, proper timing of the application is critical. The fungus must be controlled before or shortly after it enters the plant.

Cover All Susceptible Plant Parts Thoroughly

If the fungicide is not on or in susceptible plant parts, it cannot control the fungus. Cultural practices that open the plant canopy greatly improve fungicide coverage. Proper calibration and use of the sprayer is also critical to good coverage.

Fungicide Use Strategies for Grapes

Unfortunately, there are not many options to choose from when one considers our current fungicide-use strategies. The current options are:

Do Not Use Fungicides

This is always an option, but it is not recommended for commercial plantings. This option should not be confused with organic production. Grape growers in organic production systems will most probably use sulfur or copper to some extent for disease control. Sulfur, lime-sulfur, and copper are fungicides. Growers who choose not to use fungicides must rely completely on cultural practices and disease resistance for disease control.

Use a Protectant Fungicide

In a protectant program, fungicides are used to form a protective barrier on the plant surface. This chemical barrier prevents the fungus from entering the plant. It works much like paint on a piece of wood to keep out water. Protectant fungicides are not systemic and cannot move into plant tissues. Once the fungus penetrates into the plant, protectant fungicides will not control it. As the protective barrier breaks down or new foliage is produced, additional applications are required to maintain the protective barrier.

Protectant fungicide programs have been and still are very effective; however, they generally result in a fairly intensive use of fungicides. Protectant fungicides are usually applied on a seven- to 10-day schedule early in the growing season and on a 10- to 14-day schedule later in the season. Obviously, maintaining a protective barrier on the plant surface throughout the growing season requires many applications.

Use a Post-Infection or Curative Fungicide

The development and introduction of new systemic fungicides allows the use of a post-infection or curative fungicide-use strategy. In a post-infection program, fungicides are applied only after infection periods occur. The systemic properties of the fungicide allow it to move into plant tissues where it stops further development of the fungus after it has penetrated the plant. In the post-infection program, the fungicide is applied after the initiation of an infection period, but before symptoms develop. Thus, the fungicide must be applied within three to four days (72 to 96 hours) after the initiation of an infection period in order to be effective.

The sterol-inhibiting (SI) fungicides (Bayleton and Nova) have excellent post-infection activity against black rot and powdery mildew. Ridomil and Aliette have excellent post-infection activity against downy mildew. In dry growing seasons, with few or no infection periods, a post-infection program should result in reduced fungicide use.

There are several important points to remember about the post-infection program. In order to use a post-infection program, you must:

- Monitor the environment to determine when



infection periods occur. If growers do not have the capability to accurately monitor the environment, they should not use a post-infection program.

- Know what an infection period is for a specific disease. This requires a great deal of knowledge about the biology of the pathogen. At present, we have this information for black rot (Table 5-1 on page 124). There are also predictive capabilities for powdery mildew and downy mildew, and Botrytis bunch rot. Predictive programs are currently being developed and evaluated for these diseases.
- Timing is critical. Post-infection applications must be made as soon as possible, but no later than three to four days (72 to 96 hours) after the initiation of an infection period and before symptom development. In most situations, once symptoms develop, the damage is done.

Fungicides for Controlling Specific Grape Diseases

Specific fungicide recommendations cannot be made in this publication because of constantly changing regulations and recommendations regarding their agricultural use. For specific fungicide recommendations, consult your local Extension service. Most Midwestern states have a small fruit and grape spray guide that is revised annually. General information about fungicides that were available at the time this bulletin was published is presented here.

Fungicides for Controlling Black Rot

Protectants

Mancozeb, **Ferbam**, and **Ziram** are all highly effective against black rot (see Table 5-3 on page 144). Because these fungicides are strictly protectants, they must be applied before the fungus infects or enters the plant. They protect fruit and foliage by preventing spore germination. They will not arrest lesion development after infection has occurred.

Mancozeb provides an excellent foundation for a protectant spray program for grapes in the Midwest.

It is a good protectant fungicide that will provide good to excellent control of downy mildew and Phomopsis cane and leaf spot in addition to black rot. The major problem with Mancozeb is a 66-day preharvest interval (PHI) on grapes. It cannot be applied within 66 days of harvest. Mancozeb is available under many trade names and formulations. Some common trade names are Manzate 200, Penncozeb, Dithane M45, Dithane F45, and Dithane Rainshield DF.

Some food processors may not accept Mancozeb-treated fruit or may have special restrictions on its use. This also applies to Captan. Growers need to know where they will sell their fruit and if the buyer has any restrictions on pesticide use prior to initiating a control program in the spring.

Ziram is similar in efficacy to Ferbam. It is highly effective against black rot and provides moderate control of downy mildew and Phomopsis cane and leaf spot.

Growers of processing grapes who cannot apply Mancozeb past the initiation of bloom could use Ziram during this period. Ziram can be applied up to 21 days before harvest.

Ferbam will provide excellent control of black rot but is not highly effective against the other grape diseases. In addition, there are restrictions on the number of applications that can be used. Always read and understand the label before using or purchasing a pesticide.

Captan and **copper fungicides** (fixed copper or Bordeaux mixture) are only slightly to moderately effective against black rot and will probably not provide adequate control under heavy disease pressure.

Sterol Inhibiting (SI) Fungicides

The locally systemic fungicides, Bayleton, Nova, Elite, and Procure, are also highly effective against black rot and will provide some post-infection (curative) activity of the disease if applied at the higher labeled rates within 72 to 96 hours after the initiation of an infection period. Post-infection or curative control must be achieved prior to symptom development on leaves or fruit. Once the symptoms are present, these fungicides will not eradicate or burn out the fungus. Bayleton, Nova,

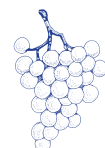


Table 5-3. Effectiveness of Fungicides for the Control of Grape Diseases.

Fungicide	Phomopsis Cane and Leaf Spot	Black Rot	Downy Mildew	Powdery Mildew	Botrytis Rot
Abound	+	+++	+++	+++	++
Bayleton	0	+++	0	+++	0
Captan	+++	+	+++	0	+
Elevate	0	0	0	0	+++
Elite	0	+++	0	+++	0
Endura	0	0	0	+++	++
Ferbam	+	+++	+	0	0
Fixed Copper and Lime	+	+	+++	++	+
Flint	+	+++	+	+++	++
JMS Stylet Oil	0	0	0	+++	?
Mancozeb	+++	+++	+++	0	0
Nova	0	+++	0	+++	0
Phosphorous acid	0	0	+++	0	0
Potassium salts	0	0	0	++	0
Pristine	++	+++	+++	+++	++
Procure	0	+++	0	+++	0
Quintec	0	0	0	+++	0
Ridomil Gold MZ	+	++	+++	0	0
Ridomil Gold Copper	+	+	+++	0	0
Rovral	0	0	0	0	+++
Rubigan	0	++	0	+++	0
Sovran	+	+++	++	+++	++
Sulfur	+	0	0	+++	0
Vanguard	0	0	0	0	+++
Ziram	++	+++	++	0	0

+++ = highly effective, ++ = moderately effective, + = slightly effective, 0 = not effective, ? = activity unknown.

Note: These ratings are intended to provide the reader with an idea of relative effectiveness. They are based on published data and/or field observations from various locations. Ratings could change based on varietal susceptibility and environmental conditions for disease development, or changes in fungal sensitivity to specific fungicides.

Elite, and Procure also appear to provide good protectant activity against black rot if applied at the lower labeled rates in a protectant program. These fungicides also have excellent activity against powdery mildew as well.

Rubigan is another SI fungicide that is registered for use on grapes and will provide moderate control of black rot if applied in a protectant program. This fungicide is in the same general class of fungicides

as Bayleton, Nova, Elite, and Procure; however, it does not provide adequate curative or post-infection control of black rot. Nova, Elite, Procure, or Bayleton are the preferred SI fungicides for black rot control.

Strobilurin Fungicides

Abound, Sovran, Flint, and Pristine are locally systemic fungicides that are all highly effective for control of black rot. They do differ in their efficacy against some of the other important grape diseases.



Note: Flint or Pristine cannot be applied on Concord grapes or phytotoxicity (damage) could occur. Always read the fungicide label carefully.

Fungicides for Powdery Mildew

Protectants

Sulfur is highly effective against powdery mildew if used in a protectant program with a minimum of seven to 14 days between applications (see Table 5-3). There are many formulations of sulfur (wetable powders, dusts, dry flowables, and flowables). The flowable formulations appear to be most effective and result in much less applicator exposure when preparing sprays.

Note: On sulfur-tolerant cultivars that are susceptible to powdery mildew (Table 5-2), sulfur will probably be a major component of the fungicide program. On highly susceptible cultivars, spray intervals shorter than 14 days (7 to 10 days) will probably be required with sulfur. Although sulfur is highly effective for powdery mildew control, it has little or no effect on the other grape diseases (Table 5-3). It is important to remember that sulfur will cause severe injury on some grape cultivars. Sulfur should only be used on cultivars known to be sulfur tolerant (Table 5-2).

Note: Chancellor, Concord, DeChaunac, Foch, and Rougeon grapes are highly sensitive to sulfur. Sulfur injury may occur even on sulfur-tolerant cultivars when temperatures of 80 to 85°F or higher are experienced during or immediately after application.

Copper fungicides (fixed coppers or Bordeaux mixture) have been rated moderately effective against powdery mildew; however, care must be taken when using copper due to the danger of foliage injury (phytotoxicity). Grape cultivars differ in their sensitivity to copper fungicides (Table 5-2). Under heavy disease pressure, copper fungicides may not provide adequate control. Copper is not the preferred fungicide for powdery mildew control. However, if copper is applied for downy mildew control, it will provide some protection against powdery mildew. On less susceptible cultivars, such as Concord, copper fungicides may provide satisfactory control.

Sterol Inhibiting (SI) Fungicides

Nova, Elite, Procure, and Rubigan are locally systemic and highly effective for control of powdery mildew. They will also provide good to excellent control of black rot, but they will not control downy mildew. Bayleton was highly effective against powdery mildew when it was first introduced; however, due to development of fungicide-resistant strains of the powdery mildew fungus, Bayleton is no longer recommended for powdery mildew control.

Strobilurin Fungicides

Abound, Sovran, Flint, and Pristine are locally systemic and all were good to excellent for control of powdery mildew when they were first introduced. Fungicide resistance development in powdery mildew has been observed in the strobilurin fungicides.

Note: Flint or Pristine cannot be applied on Concord grapes or phytotoxicity (damage) can occur. Always read the fungicide label carefully.

Endura 70WG Fungicide is new fungicide chemistry and is highly effective for control of powdery mildew and provides good control of Botrytis bunch rot. It is different chemistry from the sterol-inhibiting and strobilurin fungicides; therefore, it is an excellent material to use in rotation with these materials in a fungicide resistance management program.

JMS Stylet-Oil is a highly refined petroleum distillate that is registered for use on grapes in the United States. It has provided excellent powdery mildew control in fungicide tests in Ohio and New York and is currently being used rather extensively by California grape growers for powdery mildew control. It is registered for use at the rate of 1 to 2 gallons oil per 100 gallons water (1% to 2% concentration). The label states on grapes: "Make first application pre-bloom and continue sprays every two to three weeks depending on level of disease pressure. Use higher rates and shorter spray interval when disease conditions are severe."

Although this fungicide has not been used on grapes extensively in the Midwest or northeastern United States, it appears to have good potential as an alternative fungicide for powdery mildew control on grape.



Note: One potential problem with stilet oil is that it removes the “bloom” or waxy coating from the grape berry. This apparently has no effect on quality of wine or juice grapes, but it does affect the appearance of the berry and probably should not be used for fresh-market table grapes.

Note: DO NOT use CAPTAN or SULFUR within two weeks after applying JMS STYLET- OIL. Mixing Captan or Sulfur with oil could result in severe damage to the vine. In addition, repeated use of oil during the growing season has been shown to be phytotoxic to vines.

Potassium Salts

Armicard 100 (potassium bicarbonate) and Nutrol (manopotassium phosphate) have been reported to provide fair control of powdery mildew on grape but provide no control of the other grape diseases. It is assumed that they provide control through limited eradication and antispore activity. They do not provide protectant activity.

Quintec

Quintec 2.08SC is new fungicide chemistry that is very effective for control of powdery mildew but has no activity against the other grape diseases. It is a protectant fungicide so it must be applied before infection occurs. It does not have curative activity. It is registered for use at the rate of 3 to 4 fluid ounces per acre on a seven- to 14-day schedule. Because it is new chemistry (not related to other fungicides), it will control strains of the powdery mildew fungus that are resistant to the strobilurin fungicides (Abound, Sovran, Flint, and Cabrio) and the sterol-inhibiting fungicides (Nova, Elite, Procure, and Rubigan). Quintec has a 12-hour re-entry interval and a 14-day preharvest interval.

Fungicides for Phomopsis Cane and Leaf Spot

At present, **Mancozeb**, **Captan**, or **Ziram** are the fungicides recommended for control of this disease (Table 5-3). They are ranked as moderately to highly effective.

Fungicide test results indicate that the sterol inhibitors are not effective and the strobilurins only provide moderate control. Copper and sulfur fungicides appear to be ineffective.

Note: Especially where Phomopsis is a problem or a concern, Mancozeb, Captan, or Ziram should be included in the early-season fungicide program.

Fungicides for Downy Mildew

Protectant Fungicides

Mancozeb, Captan, and Copper fungicides

(fixed coppers and Bordeaux mixture) are highly effective for control of downy mildew (Table 5-3). Ziram is moderately effective. All of these fungicides are effective only when used in a protectant spray program. They will not provide post-infection or curative activity and will not eradicate or burn out the fungus after symptoms appear.

Of the protectant fungicides currently available, **Mancozeb** is an excellent choice. Mancozeb is highly effective against downy mildew, black rot, and Phomopsis cane and leaf spot. One problem with Mancozeb is that it cannot be applied within 66 days of harvest. Even with this restriction, Mancozeb is an excellent protectant fungicide for early-season disease control and can also be used on later-maturing cultivars for post-bloom disease control (prior to 66 days of harvest).

Captan is also excellent for downy mildew and Phomopsis cane and leaf spot but is weak for controlling black rot. A good approach to using Mancozeb and Captan for downy mildew control is to use Mancozeb early in the season then switch to Captan within the 66-day preharvest interval for Mancozeb. Currently Captan does not have a preharvest interval for grapes.

Note: Although Captan has no preharvest interval on grapes, it does have a four-day reentry restriction. The following information is taken from the Captan label: “Do not allow persons to enter treated areas within four days following application unless a long-sleeved shirt and long pants or a coverall that covers all parts of the body except the head, hands, and feet, and chemically resistant gloves are worn. Conspicuously post reentry information at site of application.” Remember, always read the label.

Ziram is similar in efficacy to Ferbam. It provides only moderate control of downy mildew, and excellent control of black rot and Phomopsis cane



and leaf spot. Under heavy disease pressure, Ziram may not provide adequate control of downy mildew.

Locally Systemic Fungicides with Curative Properties

Ridomil Gold MZ and Ridomil Gold/Copper are by far the most efficacious fungicides available for control of downy mildew. Ridomil is locally systemic and has good post-infection or curative activity. If used in post-infection control programs, it should be applied as soon as possible, *but within* two to three days after the initiation of an infection period. Ridomil **should not be** applied after symptom development (sporulating lesions). Use of Ridomil in this manner (as an eradicant) will probably lead to a rapid buildup of Ridomil-resistant strains of the downy mildew fungus in your vineyard. If resistance develops in the vineyard, the use of Ridomil as a tool for downy mildew control is lost.

Ridomil also has excellent protectant activity against downy mildew. It should provide at least two weeks of protection, and in some tests in Ohio, it has provided up to three weeks of protection.

As mentioned previously, Ridomil Gold has a strong potential for fungicide resistance development by the downy mildew fungus. For this reason, the manufacturer (Syngenta) has registered its use only as a **Package Mix** with a protectant fungicide. The two formulations available for use on grapes are Ridomil Gold MZ (4% Ridomil and 64% Mancozeb) and Ridomil Gold/Copper (5% Ridomil and 60% Copper hydroxide). The purpose of the package mix (at least in theory) is to delay the development of strains of the downy mildew fungus with resistance to Ridomil. Both formulations are equally effective for controlling downy mildew. The Ridomil Gold MZ formulation should be used on copper sensitive cultivars.

Although Ridomil is very effective, the current label use recommendations restrict the timing of its use on grapes. These materials cannot be applied within 66 days of harvest. Based on the 66-day preharvest interval, Ridomil will be of limited use for late season downy mildew control in the Midwest. In seasons when downy mildew is a problem and on highly susceptible cultivars, pre-bloom and post-bloom applications of Ridomil will aid greatly in disease control. However, additional fungicide protection may be required within the

66-day preharvest interval on late-harvested, highly susceptible cultivars. The alternative fungicides for use during this period are Captan, copper fungicides, phosphorus acid fungicides, or the strobilurin fungicides Abound or Pristine.

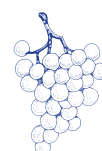
Strobilurin fungicides are also locally systemic, and some have good to excellent activity against downy mildew. Whereas the strobilurins (Abound, Sovran, and Flint) all have good to excellent activity against black rot and powdery mildew, they vary greatly in their efficacy against downy mildew. Abound and Pristine have excellent activity and are the most effective for downy mildew control. Sovran is moderately effective if used at the highest labeled rate, and Flint is registered for “suppression” of downy mildew, not control.

Phosphorous Acid (Agri-Fos, ProPhyt, Phostrol)

Several products containing phosphorous acid (PA, also called phosphite or phosphonate) are sold as nutritional supplements and plant conditioners. Recently several of these materials have been registered in the United States as fungicides for control of downy mildew on grape. In multiple New York trials, PA has provided excellent control of downy mildew but has not controlled any other grape disease. Australian experience suggests that PA provides most control on *foliage* when it is applied within a few days after the start of an infection period, providing only a few days of additional residual (protective) activity. Experience in New York suggests that spray timing is less critical for control of downy mildew on *fruit*, perhaps because this highly mobile chemical (which is exempt from residue tolerances) accumulates in these organs. When applied on a seven to 10-day protectant program, they appear to provide good to excellent control of downy mildew.

Copper fungicides are highly effective against downy mildew and are moderately effective against powdery mildew. Copper fungicides are weak for controlling black rot. A major concern with the use of copper fungicides is the potential they have for phytotoxicity or vine damage. Grape cultivars differ in their sensitivity to copper fungicides (Table 5-2).

Note: Certain food processors, such as the National Grape Cooperative, will not accept grapes treated with Mancozeb past the initiation of bloom, and



the use of Captan is not permitted at any time. If growers cannot use Mancozeb or Captan, Ridomil Gold/Copper, copper fungicides, a phosphorus acid fungicide, or a strobilurin fungicide are the other alternatives for downy mildew control. Thus, copper may be an important fungicide for producers of processing grapes that have these fungicide use restrictions.

Botrytis Bunch Rot

Vangard, Elevate, Endura, and Rovral all have excellent activity against Botrytis bunch rot on grapes and are the fungicides of choice for control of Botrytis bunch rot. The strobilurins are moderately effective against Botrytis. Botrytis bunch rot is most commonly a problem on tight-clustered French hybrids and *Vitis vinifera* cultivars.

Proper timing and thorough spray coverage are essential for good control. Make at least two applications:

- When the disease is first observed or when the first berries reach 5°Brix (5% soluble solids/sugars), whichever comes first.
- Fourteen days after the first application. A third spray may be necessary on late cultivars, e.g., White Riesling, if the interval between the second spray and harvest is greater than four weeks.

Field experience suggests that effectiveness of the fungicide is reduced following a heavy prolonged rainfall. If such conditions occur after the last intended spray has been made, an additional application may be necessary. If only one application can be made, wait until the crop average is 5°Brix. Direct the spray toward the fruit; use a minimum of 100 gallons of water/acre.

The importance of bloom sprays for control of Botrytis bunch rot is not clear; however, during seasons with wet conditions during bloom, fungicide application during bloom is probably beneficial. Research in New York has shown that the strobilurin fungicides have moderate to good efficacy for Botrytis control. The use of a strobilurin fungicide during the bloom period may be beneficial for Botrytis control, especially on highly susceptible cultivars. In addition, a strobilurin fungicide such as Abound or Pristine during bloom will provide excellent control of black rot, powdery mildew, and downy mildew as well.

Note: Growers in Europe and Canada have experienced loss of disease control due to the development of fungicide resistance when more than three sprays per year of Rovral were applied over a period of three to five years. It is, therefore, strongly recommended that the use of Rovral, Endura, Vangard, or Elevate be limited to a maximum of two to three applications per year to reduce the probability of developing strains of *Botrytis* that are resistant to this material. In addition, alternating these fungicides during the growing season or from season to season should be helpful in fungicide-resistance management.

Note: Removal of leaves around clusters on mid- or low-wire cordon-trained vines before bunch closing has been shown to reduce losses caused by Botrytis due to improved air circulation and improved spray penetration and coverage.

Post-Harvest Applications

On cultivars highly susceptible to downy mildew and powdery mildew, some post-harvest application may be required to protect foliage and prevent premature defoliation. This is especially true on early harvested cultivars in southern regions of the Midwest.

Fungicide Resistance Management

The development of strains of the powdery mildew fungus with resistance to the sterol-inhibiting (SI) fungicides (Bayleton, Nova, Procure, and Rubigan) or the strobilurin fungicides (Abound, Sovran, and Flint) is a serious threat to their continued use for powdery mildew control on grapes. There is good evidence that strains of the fungus with resistance to Bayleton and reduced sensitivity to other SI fungicides have developed in several areas.

Other grape diseases (fungi) and fungicides that are at high risk for fungicide resistance development include Botrytis bunch rot (Vangard, Endura, Elevate, Rovral, and Topsin) and downy mildew (Ridomil Gold, Abound, Sovran, and Pristine). In order to prevent or delay the development of fungicide resistance, these fungicides should not be used alone for season-long control and should be used as little as possible. This means another fungicide with good activity against the disease should be incorporated into the spray program at some point during the growing season.



A good strategy for resistance management is to use one or two spray blocks of different fungicides. For example, a grower could start the season with two applications of a sterol-inhibiting fungicide, then switch to a strobilurin fungicide for two sprays. Other materials, such as a protectant fungicide, can be used in an alternating program such as this. The important thing is not to use one material season-long. Check with your local Extension service for the most current fungicide recommendations.

Grape Insects and Their Management

Introduction

The objective of the Integrated Pest Management (IPM) program is to provide a commercially acceptable level of insect and mite control with minimal use of pesticides, applied at the appropriate times. This is accomplished by following an integrated insect management program that integrates the use of insect monitoring devices,

cultural practices, resistant cultivars, a knowledge of insect behavior and biology, and pesticides.

Several species of insects and mites infest or feed on grapes in the Midwest. Damage is direct to the berry clusters or indirect to vines, shoots, roots, or leaves. Many of the pests are found only in certain regions; others only occasionally reach damaging population levels. Periodic vineyard inspections for these grape pests are an important part of the Integrated Pest Management program for grapes (Figure 179). Much of the potential for reducing pesticides used on grapes will be in the area of insect control. IPM methods have been developed for monitoring and controlling insects. These allow the grower more flexibility in making decisions on whether insecticides are needed, what alternative control methods might be applied, which control measures to apply, and when to apply them.

Insect Monitoring Devices

These devices are an important part of any IPM program. They have been developed for the most part to monitor adult activity. The devices themselves

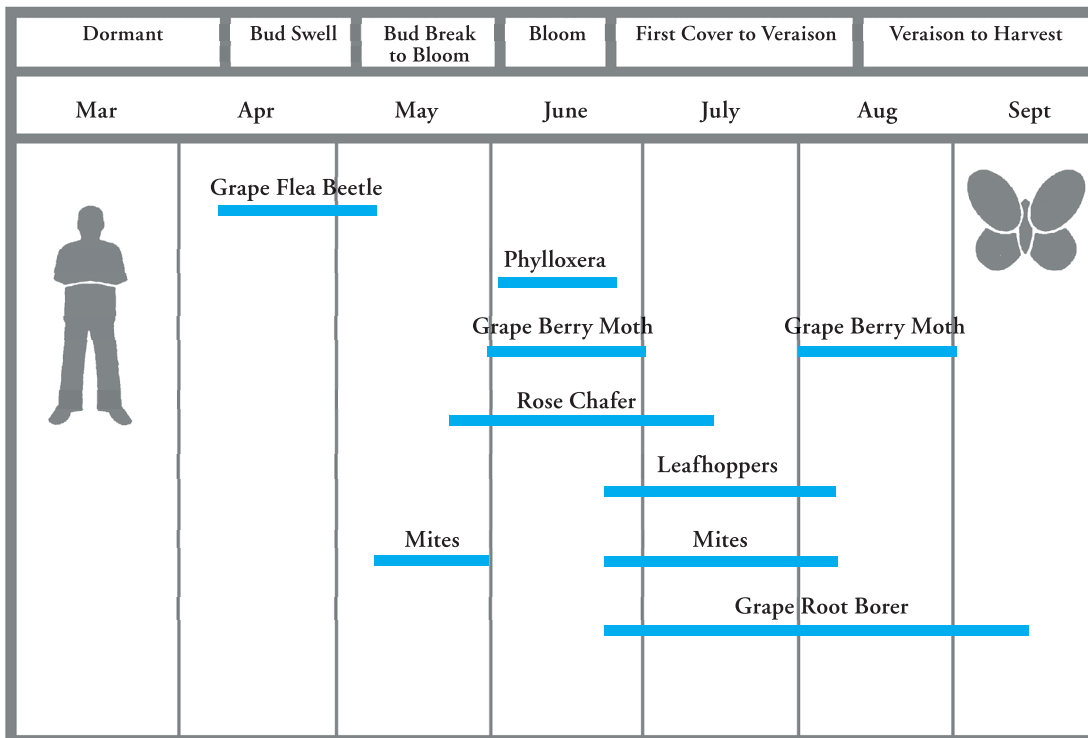


Figure 179. Suggested time to scout a vineyard for damage or presence of specific pests.

