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The following information describes the fungicide options currently available for control of Powdery Mildew, Downy mildew and Botrytis Bunch rot

Note: This information is taken directly from “The Midwest Small Fruit Pest Management Handbook”. For additional information and the tables that accompany this text, obtain a copy of the handbook.

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 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.

There are many formulations of sulfur (wettable powders, dusts, dry flowables, and flowables). The flowable and dry 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, 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. 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.

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. 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. Especially where strobilurins have been used fairly extensively in a vineyard, they should not be relied on for powdery mildew control. If they are used for control of other diseases, they should be combined with a fungicide that has activity against powdery mildew if control of powdery mildew is required.

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 stylet 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

Armocard 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 Downy Mildew

Protectant Fungicides

Mancozeb, Captan, and Copper fungicides (fixed coppers and Bordeaux mixture) are highly effective for control of downy mildew. **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. Ridomil Gold MZ cannot be applied within 66 days of harvest. Ridomil Gold Copper has a 42-day PHI (can be applied up to 42 days of harvest). Based on the 42 and 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 42 and 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.

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

Vanguard, 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.