

Developing an Effective Fungicide Spray Program for Wine Grapes in Ohio 2015

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The following information is intended to be "food for thought" in relation to developing a fungicide spray program for wine grapes in Ohio. This spray schedule presents various fungicide options that can be considered by growers. It is important to note that the schedule is intended to provide simultaneous control of black rot, powdery mildew, downy mildew, anthracnose and Phomopsis cane and leaf spot. The schedule is also intended to provide some level fungicide resistance management, primarily against the powdery mildew and downy mildew pathogens. Note that at any specific application timing, there are usually several fungicide options that can be selected. This schedule does not contain all of the fungicides currently registered for use on grapes. Remember, these are only "**Suggested Guidelines**" for use in developing a fungicide program. The final program that you develop will depend upon the diseases present in your vineyard as well as economic considerations.

Please pay special attention to the notes and special comments.

IMPORTANT NOTE on POWDERY and DOWNY MILDEW FUNGICIDE RESISTANCE

Powdery Mildew

In some locations the powdery mildew fungus has developed resistance to the sterol-inhibiting fungicides (Rally, Mettle, Inspire Super, Tebuzole (Generic Elite)) and the strobilurin fungicides (Abound, Sovran and Flint). All of these materials were highly effective for control of powdery mildew when they were first introduced. In vineyards where these materials have been used for several years, reduced sensitivity or resistance may be present. In some vineyards, all of these materials may still be effective; however, at present there is no way to know the level of resistance that is in your vineyard. Having a control failure and crop loss due to fungicide resistance is a hard way to discover you have resistance. Reports from Virginia suggest that resistance may develop after as few as 10 applications of the material over the life of the vineyard. If these materials have been used in a vineyard on a regular basis for several years, growers should consider not using these materials alone for powdery mildew control. If resistance is a concern, they should be replaced or mixed with a sulfur fungicide, JMS Stylet Oil, Quintec, Endura, Torino, Vivando, or potassium salts (table 1). Pristine is a combination of a strobilurin fungicide plus Endura; therefore, it should be safe to use alone for powdery mildew control. Sulfur fungicides are very effective for control of powdery mildew, relatively inexpensive, and are not at risk for resistance development. On sulfur tolerant varieties, the use of sulfur should be considered.

Downy Mildew

The strobilurin fungicides (Abound, Sovran and Pristine) provided good to excellent control of downy mildew when they were first introduced. Several reports from various areas in Europe and, most recently from Virginia indicate that the downy mildew pathogen has developed resistance, or is at least less sensitive, to the strobilurin fungicides.

Growers that have used strobilurin fungicides for several years and have made several applications per year need to consider the possibility of not using strobilurin fungicides for downy mildew control. If resistance to downy mildew is present in your vineyard and you are using strobilurins to control other diseases, they should be tank mixed with another fungicide with activity against downy mildew. Alternative downy mildew fungicides include: Mancozeb, Captan, Ridomil Gold MZ, Ridomil Gold

Copper, Revus, Presidio, Ranman, Forum, a copper fungicide or a phosphorous acid (phosphite) fungicide. Pristine still provides good control of powdery mildew when used alone and was the only material that would control almost all of our major disease when used alone. Unfortunately, if resistance to downy mildew is present, it should be combined with an effective downy mildew fungicide.

How Do I Know If I Have Fungicide Resistance In My Vineyard?

As mentioned above, if you have been using a fungicide in your vineyard that is at high risk for fungicide resistance development (see Tables 1 and 2) for several years and you make several applications of that fungicide per season, there is a good chance that you have fungicide resistant pathogens, or at least reduced sensitivity in your vineyard. The powdery mildew, downy mildew and Botrytis bunch rot fungi are the most problematic in relation to fungicide resistance problems on grapes. At present there is no place to send the pathogen to have it checked for resistance. Usually, the first sign of resistance is when the fungicide does not appear to be providing the level of control you have gotten in the past. The worst case scenario is if the material does not work at all and you get a control failure in the vineyard. Under the right circumstances, this can be very costly. If the materials continue to provide a good level of control in your vineyard, you evidently do not have a resistance problem. In some vineyards where materials have not been used extensively, they are still very effective. An example of this would be the use of Abound in many 'Concord' vineyards. Abound is fairly expensive and the relatively low value of 'Concord' grapes prevents its extensive use in most 'Concord' vineyards. Often it is used only once and rarely more than twice per season. Therefore, Abound is still very effective in most Concord vineyards compared to some wine grape vineyards where it has been used 2 to 4 times per season for several years. If you have recently planted a new vineyard in an area where there are no other vineyards in close proximity, you probably do not have resistance problem and it may take many years to develop, if ever. This is especially true if you develop a fungicide spray program that will aid in reducing or delaying the development of resistance. If you establish a new vineyard next to older vineyards that have fungicide resistance present, you can expect it to be a problem in the new vineyard as well. About the only thing that I can recommend is that you use fungicides wisely with fungicide resistance management as a part of your overall fungicide program. In addition, it is important to continually monitor (scout) your vineyards for signs of reduced disease control and the possible presence of fungicide resistance.

To Aid in Resistance Management

Do not apply more than two sequential sprays of any material that is at risk for resistance development, before alternating to a fungicide with a different mode of action (see table 2). In addition, the less a specific fungicide or class of fungicide is used in a vineyard, the less likely for resistance to develop to it. Most of the fungicides that are at risk for resistance development have a limited number of applications that can be made per season listed on the label (table 2). **Always read the label.**

SUGGESTED GUIDELINES FOR DEVELOPING A FUNGICIDE SPRAY PROGRAM

FOR WINE GRAPES IN OHIO

This program is intended to provide simultaneous control of Black Rot, Powdery Mildew, Downy Mildew, anthracnose and Phomopsis Cane and Leaf Spot, as well as Fungicide Resistance Management

Application Timing

Material (and rate/A)

Dormant

NOTE: The dormant spray is primarily for control of Anthracnose. If Anthracnose is a problem in the vineyard, the dormant spray is very important for controlling it.

Lime-Sulfur (10 gallons/A)

1 inch shoot

Mancozeb (3 lb/A)

NOTE: Mancozeb alone for Phomopsis only. If Powdery Mildew is a concern this early in the growing season, use:

Mancozeb (3 lb/A)

PLUS a powdery mildew material

A sterol-inhibiting fungicide

[Tebuzol {generic Elite} (4 oz/A), or Rally (4 oz/A) or
Insire Super (16-20 fl oz/A) or Mettle (3-5 fl oz/A)]

or

Endura 70WG (4.5 oz)

or

Vivando 2.5 F (10.3-15.4 fl oz)

or

Torino 0.85 F (3.4 fl oz)

or

Quintec 2.08F (3-4 fl oz)

or

Flowable Sulfur 6F (3-4 qt/A)

or

Wettable Sulfur (6-10 lb/A)

or

JMS Stylet Oil (1% concentration)

or

Potassium salts (see comments below)

Note: These early sprays are the most critical for control of Phomopsis.

NOTE ON POTASSIUM SALTS: Several potassium salt materials are currently registered as fungicides for control of powdery mildew on grape. These include Nutrol (monopotassium phosphate), Kaligreen and Amicarb 100 (potassium bicarbonate). They provide moderate to good control of powdery mildew when applied to developing powdery mildew colonies. They do not provide protectant activity, and they are not effective against the other grape diseases caused by fungi. See label of each material for usage rates and other recommendations.

NOTE: Do not combine JMS Stylet Oil with sulfur fungicides or Captan or serious vine injury can occur. The products should not be sprayed on vines within 14 days of each other.

NOTE: Do not apply sulfur to sulfur sensitive varieties.

**3-5 inch shoot
or 7- 10 days after
last spray**

**Mancozeb (3 lb/A)
PLUS a powdery mildew material**

**A sterol-inhibiting fungicide
[Tebuzol {generic Elite} (4 oz/A) or Rally (4 oz/A) or Inspire
Super (16-20 fl oz/A) or Mettle (3-5 fl oz/A)]**

**or
Endura 70WG (4.5 oz)
or
Vivando 2.5 F (10.3-15 fl oz)
or
Torino 0.85 F (3.4 fl oz)
or
Quintec 2.08F (3-4 fl oz)
or
Flowable Sulfur 6F (3-4 qt/A)
or
Wettable Sulfur (6-10 lbs/A)
or
Potassium salts
or
JMS Stylet Oil (1% concentration)**

NOTE: If Powdery Mildew is a concern, an effective fungicide for powdery mildew control should be used at this time. If fungicide resistance is not a problem, the sterol-inhibiting fungicides (Rally, Mettle, Inspire Super, Mettle and Tebuzol [generic Elite]) and the Strobilurin fungicides (Abound, Sovran and Flint) are excellent for powdery mildew control. In some vineyards, reduced sensitivity or resistance to the sterol-inhibiting and strobilurin fungicides has been reported in the powdery mildew fungus. If resistance to these materials is present in your vineyard, alternative materials must be used. Alternatives for powdery mildew control include sulfur fungicides, Endura, Vivando, Torino, Quintec, Potassium salts and JMS Stylet Oil. Sulfur fungicides are very effective for powdery mildew control, relatively inexpensive and are not at risk for resistance development. The use of sulfur for powdery mildew control should be considered on sulfur tolerant varieties.

Note: If Powdery Mildew is not a problem, Mancozeb alone can be used. It is important to use mancozeb in all sprays where it is recommended. Mancozeb will provide excellent control of Phomopsis cane and leaf spot, black rot, and downy mildew. It will not control powdery mildew. For this reason it is recommended for use in a tank mix with a powdery mildew fungicide.

I consider Mancozeb to be the backbone of the fungicide program for wine grapes in Ohio.

NOTE: Do not combine JMS Stylet Oil with sulfur fungicides or Captan or serious vine injury can occur. The products should not be sprayed on vines within 14 days of each other.

NOTE: Do not apply sulfur to sulfur sensitive varieties

NOTE: Always check the price (cost per acre per application) of each fungicide. At the rates recommended, fungicides vary considerably in cost.

10-12 inch shoot
or 7- 10 days after
last spray

Same fungicides
as 3-5 inch shoot

Immediate pre bloom to early bloom
or 7- 10 days after
last spray

Mancozeb (3-4 lb/A)
See note below on Downy Mildew

PLUS a powdery mildew material

A sterol-inhibiting fungicide
[Tebuzol {generic Elite} (4 oz/A) or Rally (4 oz/A) or
Insire Super (16-20 fl oz/A) or Mettle (3-5 fl oz/A

or

Endura 70WG (4.5 oz)

or

Vivando 2.5 F (10.3-15.4 fl oz)

or

Torino 0.85 F (3.4 fl oz)

or

Quintec 2.08F (3-4 fl oz)

or

Flowable Sulfur 6F (3 qt/A)

or

Wettable Sulfur (8-10 lb/A)

or

JMS Stylet Oil (1% concentration)

or

Potassium salts

OR

*Pristine 38WG (8-12.5 oz/A) used alone

OR

Abound 2.08 F (11-15.4 fl oz /A) used alone

OR

Revus Top 2.08 F (7 oz /A) used alone

*Pristine is a package mix combination of a strobilurin fungicide (pyraclostrobin) and the fungicide, Endura (boscalid). Therefore it should be effective for controlling all of the major grape diseases except downy mildew if strobilurin resistant strains of the downy mildew pathogen are present in the vineyard. This also applies to Abound, which is also a strobilurin fungicide. If downy mildew is a concern and resistance is present, Pristine or Abound should probably not be used alone. Do not make more than 2 sequential applications of Pristine without switching to another fungicide in a different class of chemistry, and do not make more than 6 applications per season. Revus Top has a different Chemistry for Downy Mildew control and can be used alone.

Note on Revus top:

Do not apply Revus Top to "Concord" grapes. In 2010, severe phytotoxicity (leaf burning) was observed on Concord grapes at several locations. Do not apply Revus Top to other American Type grapes (*labrusca*, *labrusca* hybrids, and other non *vinifera* hybrids) where sensitivity is unknown. Phytotoxicity appears to be worse when Revus Top is tank mixed with foliar fertilizers or adjuvant that increases the rapid uptake of chemicals by leaves. Thus far, *vinifera* grapes and French-American hybrids (Seyval, Vidal and others) do not appear to be sensitive to Revus Top.

NOTE: If conditions are highly conducive for Downy Mildew development, Ridomil Gold MZ or Ridomil Gold Copper should be considered

Note: Rally, Tebuzole (generic Elite), Mettle and Inspire Super provide excellent control of black rot and have excellent curative activity (3 to 4 days) against black rot. If powdery mildew is resistant to the sterol-inhibiting fungicides in your vineyard, an alternative material for powdery mildew control should be used. Also, if two sequential sprays of a sterol -inhibitor have been made, switch to a powdery mildew fungicide with a different mode of action.

NOTE: Do not combine JMS Stylet Oil with sulfur fungicides or Captan or serious vine injury can occur. The products should not be sprayed on vines within 14 days of each other.

Important note on disease control

The period from immediate pre bloom through 4 to 5 weeks after bloom is the **MOST CRITICAL PERIOD** for controlling fruit infection by black rot, powdery mildew and downy mildew. After bloom, the threat of *Phomopsis* infection is greatly reduced. However, fruit remain highly susceptible to black rot, powdery mildew and downy mildew until about 4-5 weeks after bloom. It is critical to maintain a fungicide program that controls all three of these diseases until about 4-5 weeks after bloom. Failure to control fruit and cluster infection during this period could result in loss of the crop. At 4-5 weeks after bloom, the fruit become resistant to black rot, powdery mildew and downy mildew; however, the leaves and rachises (cluster stems) remain susceptible to both powdery and downy mildew for the rest of the season. Therefore fungicide protection against both downy and powdery mildew may be required through harvest.

First post bloom spray
no longer than 10 days after
last spray

Same fungicides as
Immediate pre bloom to early bloom

Second post bloom spray
no later than 10 days after
last spray

Same fungicides as
Immediate pre bloom to early bloom

**** NOTE on Phosphorous Acid:**

Several products containing phosphorous acid (phosphonates, phosphites) are sold as nutritional supplements and "plant conditioners", but a few products (ProPhyt, Phostrol, Agri-Fos, Rampart, Topaz and many others) are registered for use as fungicides for downy mildew control on grape. Phosphorous acid is a good fungicide for control of downy mildew. Usage rate recommendations vary among different products. The products mentioned here have a 4-hour re-entry interval and a 0 day pre harvest interval. Obtain and read the label of each product prior to use.

NOTE: The second post bloom spray should be near the end of the **CRITICAL PERIOD** for controlling fruit infection by black rot, powdery and downy mildew (immediate pre bloom through 3 to 4 weeks after bloom). By this time, the fruit of most varieties should be resistant to infection. It is very important to maintain excellent fungicide coverage (protection) during this period until the fruit become resistant. Failure to provide adequate fungicide protection can result in the development of "diffuse infections" of powdery mildew on fruit. It is difficult to see these infections with the naked eye and they can result in increased problems with various fruit rots later in the season, especially sour rot and Botrytis. The importance of protecting the fruit during this critical period cannot be overemphasized.

Remember that cluster stems (rachis) and leaves will remain susceptible to powdery and downy mildew throughout the growing season; therefore, a good fungicide program needs to be maintained throughout the season.

NOTE on Downy Mildew: If conditions are highly conducive for Downy Mildew development during this period, Ridomil Gold MZ or Ridomil Gold Copper should be considered at this time. I do not think any material is more effective than Ridomil for downy mildew control. The PHI for Ridomil Gold MZ is 66 days and for Ridomil Gold Copper it is 42 days. Revus, Presidio, RANMAN and Forum are four new fungicides that are reported to be highly effective against downy mildew. The PHI for Revus is 14 days, for Presidio it is 21 days, for RANMAN it is 30 days and for Forum it is 28 days. The 14 day PHI for Revus makes it an attractive option if downy mildew control is required close to harvest. Zampro is a relatively new fungicide that is reported to provide excellent control of Downy Mildew and it has a 14 day PHI. It is very important to remember that these materials will need to be tank mixed with other fungicides because they will not provide adequate control of powdery mildew or black rot (Table 1).

Later Season Summer Sprays Should Not Exceed a 14-Day Interval

Third post bloom spray

10-14 days after the last spray

If conditions are wet, maintain

A 10-day schedule

Mancozeb (3-4 lb/A) or Captan 50W (3-4 lb/A) or Phosphorous Acid
or Revus (8 fl oz /A) or Presidio (3-4 fl oz /A)
or RANMAN (2.1-2.75 fl oz/A) or Forum (6 oz/A) or
Zampro (11 to 14 fl oz /A)

See note below on Downy Mildew

PLUS a powdery mildew material

A sterol-inhibiting fungicide
 [Tebuzol {generic Elite} (4 oz/A) or Rally (4 oz/A) or
 Insire Super (16-20 fl oz/A) or Mettle (3-5 fl oz/A)
 or
 Endura 70WG (4.5 oz)
 or
 Vivando 2.5 F (10.3-15.4 fl oz)
 or
 Torino 0.85F (3.4)
 or
 Quintec 2.08F (3-4 fl oz)
 or
 Flowable Sulfur 6F (3 qt/A)
 or
 Wettable Sulfur (8-10 lb/A)
 or
 Potassium salts
OR
 Pristine 38WG (8-12.5 oz/A) used alone
OR
 Abound 2.08 F (11-15.4 fl oz/A) used alone
OR
 Revus Top 2.08 F (7 fl oz/A) used alone

Under heavy disease pressure use a shorter interval

NOTE: Watch the 66 days PHI on Mancozeb. On late maturing varieties, mancozeb can be used later in the season as long as it is not applied within 66 days of harvest. I recommend keeping it in the spray program as long as it is legal to use.

If you get within 66 days of harvest, Captan, a phosphite fungicide, Ridomil Gold Copper, Revus, Presidio, RANMNA, Forum or a copper fungicide can be used in place of Mancozeb for downy mildew control. If you have more than 66 days to harvest, Mancozeb would be the fungicide of choice. If weather is dry and downy mildew is not a problem, these downy mildew fungicides are not required. However, you will need to maintain a good program for powdery mildew control, even if weather is dry. The danger of black rot infection should be over by this time. Berries should be resistant to black rot.

Fourth post bloom spray
 10-14 days after
 Last spray

Captan 50W (3-4 lb/A) or Phosphorous Acid
 or Revus (8 fl oz /A) or Presidio (3-4 fl oz /A)
 or RANMAN (2.1-2.75 fl oz/A) or Forum (6 oz/A) or
 Zampro (11 to 14 fl oz /A)

PLUS a powdery mildew material

A sterol-inhibiting fungicide
 [Tebuzole {generic Elite} (4 oz/A) or Rally (4 oz/A) or

Maintain a 10-14 day
spray schedule
through harvest
**These fungicides
will be used through
harvest**

Insire Super (16-20 fl oz/A) or Mettle (3-5 fl oz/A)

or

Endura 70WG (4.5 oz)

or

Vivando 2.5 F (10.3-15.4 fl oz)

or

Torino 0.85 F (3.4 fl oz)

or

Quintec 2.08F (4 fl oz)

or

Wettable Sulfur (8-10 lb/A)

or

Flowable Sulfur 6F (3 qt)

or

Potassium salts

OR

Fixed Copper Fungicide used alone

OR

Pristine 38WG (8-12.5 oz) used alone

OR

About 2.08 F (11-15.4 fl oz/A) used alone

OR

Revus Top 2.08 F (7 fl oz/A) used alone

NOTE: If dry weather persists and the risk of Downy Mildew is low, a downy mildew fungicide may not be required and Sulfur can be used alone for powdery mildew control. If weather is wet and Downy is a problem, a Downy Mildew material should be included. A Fixed Copper Fungicide will give good control of both Downy and Powdery Mildew. Especially on susceptible varieties, powdery mildew will need to be controlled throughout the growing season.

NOTE: Do not apply Captan, sulfur or copper fungicides within 30 days of harvest or fermentation may be affected and **DO NOT** combine Captan or Sulfur with any form of oil.

Note: Under heavy disease pressure use a shorter spray interval

For Botrytis bunch rot control, the following fungicides are available:

Rovral 4F (1.5 to 2 pints/A)

PLUS

Latron B1956(6 fl oz/100 gal)

OR

Vangard 75 WG (10 oz/A) used alone

OR

Elevate 50 WG (1 lb/A) used alone

OR

Scala 5 SC (18 fl oz/A used alone)

OR
 Endura 70 WG (8 oz/A) used alone
OR
 Pristine 38 WG (18.5 to 23 oz/A) used alone
OR
 Switch 62.5 WG (11 to 14 oz/A)

These fungicides should be used in special (additional) sprays for control of Botrytis bunch rot only on tight-clustered, bunch rot susceptible cultivars. The first spray should be made when disease is first observed or at veraison (or shortly thereafter). Then wait until a combination of threatening weather (wet conditions) and/or disease develops and make a second spray (at least 2 weeks after the first spray). On late maturing varieties a third spray may be required.

Importance of Bloom sprays for Botrytis bunch rot control.

Botrytis can enter fruit on dead flower parts or other plant debris in the cluster during bloom. Therefore, bloom applications of fungicide may be beneficial in control. In some years, bloom sprays seem to be very effective and in others, they appear to have no or little effect. Some growers make a Botrytis spray during bloom every year and many do not. On Bunch rot- susceptible and high value wine grapes, a bloom application may be a good form of insurance against botrytis bunch rot. One practical approach to providing protection against bunch rot infections during bloom is to use a fungicide such as Pristine during bloom which would be a standard application within the critical period for fruit infection by black rot, powdery mildew and downy mildew. Pristine at the higher rate listed above should provide excellent control of Botrytis in addition to the other diseases that need to be controlled at this time.

NOTE: Some tests in New York have indicated that Rovral at 1 pint/A plus Vanguard at 5 oz/A may have an additive effect and provides good bunch rot control.

Pristine applied at Normal Harvest for Ice wine: Grapes for Ice wine production must hang for long periods past normal harvest prior to picking. An application of Pristine at normal harvest time may aid in controlling some fruit rots of ripe grapes, especially during falls and early winters when temperatures remain high.

Table 1. Effectiveness of Fungicides for the Control of Grape Diseases

Fungicide	Phomopsis cane and leaf spot	Black rot	Downy mildew	Powdery mildew	Botrytis rot	Bitter rot
Abound	+	+++	+++ (FRP)	+++ (FRP)	++ (FRP)	?
Adament	+	+++	+ (FRP)	+++ (FRP)	0	0
Bayleton	0	+++	0	+++ (FRP)	0	0
Captan	+++	+	+++	0	+	++
Elevate	0	0	0	0	+++ (FRP)	0
Elite (Tebuzol)	0	+++	0	+++ (FRP)	0	0

Endura	0	0	0	+++ (FRP)	++ (FRP)	0
Ferbam	+	+++	+	0	0	++
Fixed copper and Lime	+	+	+++	++	+	+
Flint	+	+++	++ (FRP)	+++ (FRP)	++ (FRP)	0
Forum	0	0	+++	0	0	0
Inspire Super	0	+++	0	+++ (FRP)	0	0
JMS Stylet Oil	0	0	0	+++	0	0
Mancozeb	+++	+++	+++	0	0	++
Mettie	0	+++	0	+++ (FRP)	0	0
Nova	0	+++	0	+++ (FRP)	0	0
Potassium salts	0	0	0	++	0	0
Phosphorous acid	0	0	+++	0	0	0
Presidio	0	0	+++ (FRP)	0	0	0
Pristine	++	+++	+++ (FRP)	+++	++	?
Procure	0	++	0	+++ (FRP)	0	0
Quadris Top	+	+++	+++ (FRP)	+++ (FRP)	+	++
Quintec	0	0	0	+++ (FRP)	0	0
RANMAN	0	0	+++	0	0	0
Revis	0	0	+++	0	0	0
Revis Top	0	+++	+++	+++ (FRP)	0	0
Ridomil Gold MZ	+	++	+++	0	0	++
Ridomil Gold Copper	+	+	+++	++	+	+
Rovral	0	0	0	0	+++	0
Scala	0	0	0	0	+++ (FRP)	0
Sovran	+	+++	++ (FRP)	+++ (FRP)	++ (FRP)	0
Sulfur	+	0	0	+++	0	0
Switch					+++ (FRP)	
Topsin M ¹	++	+	0	+++ (FRP)	++ (FRP)	++
Torino	0	0	0	+++ (FRP)	0	0

Vangard	0	0	0	0	+++ (FRP)	0
Vivando	0	0	0	+++ (FRP)	0	0
Ziram	++	+++	++	0	0	0

Key to ratings: +++=highly effective; ++=moderately effective; +=slightly effective; 0=not effective;

? =effectiveness unknown or not established;

FRP=Fungicide Resistance or Reduced Sensitivity is Possible, especially if the material has been used in the vineyard for several years. Generally, if they have not been used extensively, resistance may not be a problem.

¹ Where Topsin M-resistant strains of the powdery mildew and Botrytis fungi have been detected, Topsin M will be ineffective and should not be used.

Table 2. Resistance-prone Fungicides and Risk of Resistance by Chemical Class

Fungicide class		Common (chemical) name(s)	Trade name(s)
Benzimidazole (Group 1)	High	Thiophanate-methyl	Topsin-M
Phenylamide (Group 4)	High	Mefenoxam Mefenoxam (+ copper) Mefenoxam (+ mancozeb)	Ridomil Gold Ridomil Gold/Copper Ridomil Gold MZ
Strobilurin (Qol) (Group 11)	High	Azoxystrobin Kresoxim-methyl Pyraclostrobin (+ boscalid) Trifloxystrobin	Abound Sovran Pristine Flint
Dicarboximide (Group 2)	Medium to High	Iprodione	Rovral
Sterol Inhibitors (Group 3)	Medium	Fenarimol Myclobutanil Tebuconazole Triflumizole Difenoconazole (+Cyprodinil) tetraconazole	Rubigan (Vintage) Nova Elite (Tebuzol) Procure Inspire Super Mettle
Carboximide (anilide) (Group 7)	Medium	Boscalid Boscalid (+ pyraclostrobin)	Endura Pristine
Anilinopyrimidine (Group 9)	Medium	Cyprodinil Pyrimethanil	Vangard Scala
Quinolines (Group 13)	Medium	Quinoxifen	Quintec
Hydroxyanilid (Group 17)	Medium	Fenhexamid Fenhexamid + captan	Elevate CaptEstate
(Group 40)	Medium	Mandipropamid	Revus
(Group 43)	Medium	Fluopicolide	Presidio

Resistance ratings to all members of a class of fungicides. All fungicide classes with a medium or high risk of resistance development must be used in accordance with resistance management guidelines listed on the label. Tactics for avoiding or slowing resistance development include:

- 1.) Rotating among fungicides from different classes. Make no more than 2 consecutive applications of a resistance-prone fungicide (or fungicides from the same class) before switching to a fungicide from a different class (has a different mode of action).
- 2.) Use high risk fungicides as little as possible. The fewer time a fungicide is applied in a vineyard, the less likely that resistance will develop. Always use fungicides only when needed and at the proper

time to obtain the disease control that is required. Always use fungicides as one integral part of an integrated disease management program.

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