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FACT Sheet

FACT SHEET 848

Guidelines for Developing an Effective Fungicide Spray Program for Wine Grapes in Maryland, 2012

The purpose of this fact sheet is to help wine grape growers in Maryland develop effective fungicide spray programs to manage a complex of five major fungal diseases affecting vines and fruit: powdery mildew, downy mildew, black rot, Botrytis bunch rot, and Phomopsis cane and leaf spot. The spray schedules below suggest several options for each spray but do not include all fungicides registered in Maryland for control of these diseases. Three supplemental tables are provided to further assist growers in choosing fungicides. Table 1 rates the effectiveness of all fungicides mentioned in the fact sheet against these diseases. Information on effectiveness is intended as general guidance only. Results in a given vineyard will depend on weather, disease pressure (level of inoculum present), canopy management, age of vines, fungicide formulation and rate, and spray intervals and coverage. Table 2 lists resistance-prone fungicides by chemical class (mode of action) to help growers choose rotational partners with different modes of action within a spray program to manage resistance. Table 3 lists the labeled reentry interval (REI), preharvest interval (PHI), and seasonal limits and restrictions for brands and formulations of the fungicides mentioned in this guide.

Treat the information in this publication as a general recommendation. Your final program will depend on the characteristics of your vineyard site, the varieties of grapes grown, the complex of diseases you typically see in the vineyard, weather conditions, and economic considerations. The fungicides listed in the schedule vary in price, so check the cost per acre per application as you plan your program. Finally, *always* read the fungicide label for allowable rates, cautions and restrictions on use, and resistance management requirements. Remember, the label is the law

Spray Programs for Young (Non-Bearing) Vineyards and Plantings

In Maryland's warm, humid climate, newly planted grapevines need immediate protection from fungal diseases. A spray program is *strongly* recommended from the first season onward to keep vines healthy and protect their fruit-bearing potential. Powdery mildew and downy mildew, left uncontrolled, can defoliate young vines and either kill them outright or sap their vigor, resulting in winter injury or poor fruit set the following year. Without protectant sprays, black rot and Phomopsis can infect the wood of young vines, making it harder to prevent fruit infection in later years.

Pages 12-14 offer guidance on developing a simplified spray program for non-bearing vineyards (first and second years) to control powdery mildew, downy mildew, black rot, and Phomopsis. For most varieties, growers can rely on contact fungicides in generic formulations that are at low risk for resistance development and typically less expensive than newer fungicides that are still under patent.

New Fungicides

Vivando. Vivando (BASF) is a newly registered

fungicide for powdery mildew that has given excellent control in trials in New York, Pennsylvania, and Virginia. Vivando is a protectant and must be applied before infection occurs. The active ingredient is metrafenone (Group U8), whose mode of action is unknown. Because of its novel chemistry, Vivando should be a valuable rotational partner for other powdery mildew fungicides. It is estimated to be at medium to high risk of resistance, and the label limits applications to three per season.

Difenoconazole pre-mixes. Three pre-packaged mixtures from Syngenta containing difenoconazole, a new sterol-inhibiting (SI) fungicide (Group 3), offer broad-spectrum disease control. According to lab studies in New York, difenoconazole is far more active than other SIs. For example, it takes about 96% less difenoconazole than myclobutanil (Rally) to curb fungal growth in culture to the same degree. Because difenoconazole is applied at rates similar to other SIs, it is effective against strains of powdery mildew that have lost sensitivity to Rally and Elite. Difenoconazole-containing fungicides may be most valuable during the critical period from just before bloom to three or four weeks after bloom, when developing fruit are susceptible to multiple diseases.

Each pre-mix contains a different "partner" fungicide and the amount of difenoconazole varies, so they are not interchangeable.

- *Revus Top* contains mandipropamid (Group 40) and difenoconazole. Mandipropamid, the active ingredient in Revus, is effective *only* against downy mildew. Difenoconazole is active against powdery mildew, black rot, and Phomopsis. Revus Top is currently available under a supplemental label in Maryland, though a full label may be in effect for the 2012 growing season. As of this writing, growers must have a copy of the supplemental label in their possession to apply Revus Top. (Download the supplemental label here: www.syngentacropprotection.com/pdf/special/SCP1278AS41210.pdf.)

- *Inspire Super* contains cyprodinil and difenoconazole. Cyprodinil (Group 9) is effective *only* against Botrytis bunch rot. It is the active ingredient in Vangard and Scala, and one component of the pre-mix Switch (cyprodinil + fludioxonil). Inspire Super is labeled for control of powdery mildew, black rot, Phomopsis, and Botrytis (but not downy mildew).

- *Quadris Top*, the newest addition, is a combination of azoxystrobin (Group 11) and difenoconazole. Resistance has made azoxystrobin, the active ingredient in Abound, ineffective against powdery and downy mildew in many mid-Atlantic vineyards. The difenoconazole in Quadris Top can control strobilurin-resistant strains of powdery mildew but has no activity against strobilurin-resistant *downy mildew*. Quadris Top is labeled for control of downy mildew as well as powdery mildew, black rot and Phomopsis—but tank-mix it with another downy mildew-specific fungicide as insurance against resistant strains.

Observe these guidelines for the effective use of difenoconazole-containing fungicides:

- *Avoid use on sensitive varieties*. On non-*vinifera* grapes, especially *V. lambrusca* and *V. lambrusca* hybrids, difenoconazole may cause leaf burning or other injury. Adding difenoconazole to tank mixtures with materials that increase uptake (adjuvants, foliar fertilizers) may increase the risk of injury. **Do not use difenoconazole on Concord, Concord Seedless, or Thomcord grapes**. Consult product labels for a full list of sensitive varieties.

- *Use effective rates*. Revus Top at the supplemental label rate (7 fl oz/A), Inspire Super at the high rate (20 fl oz/A), and Quadris Top at the high rate (14 fl oz/A) provide equivalent amounts of difenoconazole per acre, about one-quarter of the seasonal limit.

- *Adjust your spray program for the pre-mix*. When applying Revus Top, omit other downy mildew materials such as mancozeb and captan from those sprays. For Inspire Super, omit or reduce the amount of any other botryticide from those sprays. Remember to count the amount of the "partner" fungicide against the seasonal limit for that material. Inspire Super at the 20 fl oz/A rate provides the same amount of cyprodinil as 7 oz/A of Vangard. Quadris Top at the 14 fl oz/A rate provides the same amount of azoxystrobin as 11 fl oz/A of Abound.

- *Practice resistance management*. Limit your applications of SIs, including difenoconazole, to two per year when possible. Rotate to another class of fungicide after each SI application.

  - If you apply Revus Top twice at bloom

or fruit set, do not use Revus for later-season downy mildew control to avoid overusing mandipropamid. See Table 1 for other options.

- If you apply Inspire Super twice at bloom or fruit set, make no more than one additional spray of Vangard, Scala, or Switch, all of which contain cyprodinil. Pristine, Elevate, and iprodione are options for later-season Botrytis sprays.
- Plan ahead when using Quadris Top. Consider whether you may want to apply another Group 11 fungicide later in the season for protection against downy mildew, Botrytis, or other bunch rots.

Fungicides for Later-Season Downy Mildew Management: 2012 Update

Downy mildew is a season-long management challenge in Maryland vineyards, as the late-season storms of 2011 taught us again. Vineyards that avoid primary infections from overwintering inoculum (oospores in the soil) may still suffer secondary foliar infections from sporangia (fruiting bodies) blown in from a distance, particularly during tropical storms. Downy mildew epidemics are driven by moisture—in the air and soil, and on the vine. When conditions favor the spread and development of downy mildew, growers need to maintain a consistent, high level of canopy protection right through harvest.

The spray schedules for bearing and non-bearing vineyards list basic options for downy mildew control throughout the season: the contact fungicides mancozeb and captan, which function only as protectants; and the phosphorous acid fungicides such as Phostrol, ProPhyt, and Topaz, which also act systemically as eradicants on active infections. In wet seasons, growers may want to consider newer, "synthetic" protectant fungicides, particularly in the 66-day interval between the last allowable use of mancozeb and harvest. These materials are absorbed into the waxy, outer layer of the plant, which means they resist wash-off in the rain and may move locally within leaves. They typically have shorter preharvest intervals (PHIs) and do not affect fermentation and wine quality, which makes them suitable for use after veraison. On the other hand, they are usually more expensive and require careful attention to resistance management.

In the past few years, some excellent downy mildew fungicides have been lost to resistance or reformulated to deter it. The appearance of strobilurin-resistant downy mildew strains in Maryland and nearby states means that growers can no longer rely on fungicides like Abound and Pristine *alone* to control downy mildew. They must be tank-mixed with a fungicide with a different chemistry to ensure adequate protection (see the note on fungicide resistance below). Ridomil Gold (mefenoxam) is an outstanding downy mildew fungicide that is very resistance-prone. It is now available only in two pre-mixes: Ridomil Gold MZ (+ mancozeb), with a 66-day PHI; and Ridomil Gold Copper, a restricted-use fungicide with a 42-day PHI.

Fortunately, a number of new fungicides with novel chemistries and shorter PHIs have been registered recently. Presidio, Revus, and Tanos which were available in 2010, have been joined by Forum, Ranman, and Reason. *All of these materials are at medium to high risk of resistance development, so read and observe the resistance management restrictions on the labels.* In order of decreasing PHI, growers now have these additional choices for later-season protection against downy mildew:

- *Ranman* (FMC) is a newly registered fungicide that contains cyazofamid (Group 21), a novel chemistry on grapes, with a 30-day PHI. Cyazofamid is a protectant that is effective only against downy mildew. The Ranman label specifies that it be applied in 100 gal/A of spray solution and prohibits use of a surfactant. In recent New York trials, Ranman offered good to very good control on its own. Tank-mixing it with a phosphorous acid to add post-infection activity improved control.
- *Reason* (Bayer) is another new fungicide with a 30-day PHI. Reason contains fenamidone (Group 11), a novel material similar to a strobilurin that is active only against downy mildew. Like other Group 11 fungicides, Reason has protectant and anti-sporulant effects, but should not be applied to active (sporulating) downy mildew infections. Reason provided excellent control in a single New York trial. Its main drawback is that it will not control strobilurin-resistant strains of downy mildew, though it is similar in effectiveness to other Group 11 fungicides on susceptible strains. It

is *not* a rotational partner for other Group 11 fungicides for downy mildew (Abound, Pristine, Sovran, Tanos).

- *Tanos* (DuPont) is a pre-mix of famoxadone, another strobilurin-like material (Group 11), and cymoxanil, a new chemistry (Group 27), with a 30-day PHI. It is active only against downy mildew. Tanos has protectant and anti-sporulant effects, but should not be applied to active (sporulating) downy mildew infections. The Tanos label *requires* that it be tank-mixed with a protectant-only (contact) fungicide such as mancozeb, captan, or copper. Like Reason, it will not control strobilurin-resistant strains of downy mildew, though it is similar in effectiveness to other Group 11 fungicides on susceptible strains. It is *not* a rotational partner for other Group 11 fungicides for downy mildew (Abound, Pristine, Reason, Sovran).
- *Forum* (BASF) is now available for use on grapes under a supplemental label, with a 28-day PHI. Forum contains dimethomorph (Group 40), which is active only against downy mildew. Growers who apply Forum must have a copy of the supplemental label in their possession. (Download it here: www.cdms.net/LDat/ld79H008.pdf.) Forum offers protectant activity only and must be applied before infection is present. The label prohibits the use of spreading/penetrating adjuvants. Forum is *not* a rotational partner for Revus.
- *Presidio* (Valent) contains fluopicolide, a new chemistry (Group 43) active only against downy mildew on grapes, with a 21-day PHI. It has protectant and anti-sporulant activity. Because it is absorbed after application, it may offer some post-infection activity as well. Avoid applying it when active downy mildew infections are present so as not to stimulate possible resistance. Like Tanos, the Presidio label *requires* a "tank-mix partner," though it does not specify a protectant-only fungicide.
- *Revus* (Syngenta) contains mandipropamid (Group 40), which is active only against downy mildew on grapes. It has the shortest PHI of any of the new materials: 14 days. Mandipropamid has protectant and anti-sporulant activity. It is absorbed after application and may offer some post-infection activity. (The label recommends use of an adjuvant to increase penetration.) Avoid applying Revus when active downy mildew infections are present so as not to stimulate possible resistance. The Revus label does not require a tank-mix partner. It is *not* a rotational partner for Forum.

What if you find active, sporulating downy mildew on your vines? Or if conditions favor a downy mildew outbreak within 14 days of harvest? Apply a phosphorous acid (PA) fungicide (e.g., Phostrol, ProPhyt, Topaz) as soon as possible, and repeat at weekly intervals until sporulation stops and lesions become inactive. PA fungicides have post-infection, anti-sporulant, and eradicant activity and may be used until the day of harvest (0-day PHI). Their protectant activity lasts a week or less, however, depending on rainfall. Monitor your canopy carefully, as repeated use of PAs can result in injury to foliage, especially at high rates and short intervals. Leaf injury symptoms include marginal burning and bleaching of leaf blades that may resemble early downy mildew lesions.

Once downy mildew becomes inactive, rotate or tank-mix a PA with a fungicide that offers a longer window of protectant activity. Early in the season, a contact fungicide (mancozeb, captan, or copper) would be the best choice for a tank-mix partner. Use the more resistance-prone fungicides discussed above later in the season. If the time to harvest is less than 14 days, continue to apply a PA weekly as long as downy mildew is active to keep the canopy functioning and reduce the amount of inoculum left to overwinter in the vineyard soil.

A Primer on Copper Fungicides

Growers have asked why copper fungicides and Bordeaux mixture have not been included among the basic options for various sprays. The reason is safety, for vines and novice growers. Copper fungicides are a mainstay in organic disease management programs, but they need to be applied with caution, as they have the potential to cause serious vine or fruit injury. They are also corrosive (alkaline) and can cause serious injury to applicators if mishandled. The active ingredients in fixed-copper fungicides are copper (II) oxides, including copper hydroxide, copper oxychloride sulfate, and copper sulfate. Bordeaux mixture is copper sulfate with hydrated spray lime added to reduce possible plant injury. Depending on the formulation and amount of metallic copper

in the active ingredient, many copper fungicides are labeled as restricted-use pesticides. Those with the mildest profile (signal word “Caution” on the label) include Champ Formula 2 Flowable, Cuprofix Ultra 40 Disperss, and Kocide 3000.

Copper fungicides are rated as good against downy mildew, fair against powdery mildew, and poor against black rot and Phomopsis (see Table 1). Copper compounds act as protectants and must be applied before any fungal spores arrive, though they may have slight post-infection activity against powdery mildew (but not downy mildew). They wash off easily and must be reapplied after an inch or more of rain. As always, effectiveness will vary according to the susceptibility of the grape variety to the disease, the disease pressure, weather conditions, and thoroughness of coverage.

Avoid using copper fungicides or Bordeaux mixture in any of the following situations:

- *Copper-sensitive grapevines.* Many American varieties (Concord, Delaware, Niagara) can be injured by copper, as can some French-American hybrids. Chancellor is especially sensitive.
- *Weather during application that will slow drying.* Applying copper under cool or very humid conditions, when the spray is slow to dry, may cause injury even on copper-tolerant varieties.
- *When using an acidic material in a tank mix.* Copper is highly alkaline. Addition of an acidic material (for example, a phosphorous acid) may increase the risk of plant injury.
- *When using captan, ferbam, or the insecticides Imidan and Sevin in a tank mix.* Lime is incompatible with these materials, and may either reduce their activity or cause phytotoxicity. Bordeaux mixture contains lime, and lime is often added to fixed-copper fungicides to reduce the chance of plant injury.

A Reminder: Fungicide-Resistant Powdery Mildew and Downy Mildew

Strains of both powdery mildew and downy mildew that are resistant to strobilurin and strobilurin-like fungicides (Group 11: Abound, Sovran, Flint, Reason, and one component each of Pristine, Quadris Top, and Tanos) have been present in Maryland vineyards since at least 2006. Strobilurin resistance may appear without warning and result in a control failure and crop loss. Once resistant fungi become dominant, *all* Group 11 fungicides may be useless against that pathogen.

Strobilurin-resistant strains of powdery mildew are also losing sensitivity to sterol-inhibiting (SI) fungicides, particularly Rally and Elite (including generic formulations of tebuconazole). SI resistance occurs more slowly, and growers may able to compensate for a few seasons by increasing the application rate (up to the label rate), spraying at shorter intervals, or switching to a different SI. The more frequently any SI material is used, however, the higher the level of resistance that is likely to develop.

Powdery Mildew. If you have ever applied strobilurins for powdery mildew control in your vineyard, or if other vineyards nearby have used them, be aware that resistance may appear suddenly. Consider replacing Abound, Flint, or Sovran in your rotation with another material (see Table 1 for other fungicides effective against powdery mildew). Pristine is a combination of a strobilurin and Endura, and should therefore be safe to use alone for powdery mildew control in rotation with other materials. Limit applications of any strobilurin, including Pristine, to two per year at critical times like the bloom period, and rotate to another class of fungicide after each application.

If you have been relying on the SIs Rally or Elite (tebuconazole) for powdery mildew control, you may want to switch to a pre-mix containing the newest SI, difenoconazole (Inspire Super or Revus Top). Another option would be to mix your SI with 2–5 lb/A of sulfur (on sulfur-tolerant grape varieties) to deal with any resistant strains of powdery mildew and slow further resistance development. Again, limit applications of SIs to two per year and rotate to another class of fungicide after each SI application.

Downy Mildew. If you use a strobilurin, including Pristine, to control other diseases and need downy mildew control, add another fungicide to the tank mix. Good choices include captan, mancozeb, or a phosphorous acid (phosphite). Pristine alone will *not* control strobilurin-resistant downy mildew because its other component, Endura, is not active against the downy mildew pathogen. You may also want to consider switching to one of the newer fungicides discussed above under later-season downy mildew management.

GUIDELINES FOR BEARING VINEYARDS

Growth stage or timing	*Material and rate/acre*	*Comments*
½- to 1-inch shoot	Mancozeb @ 4 lb/A or flowable mancozeb at 3.2 qt/A **PLUS one of the following for PM:** Wettable sulfur @ 5–10 lb/A or liquid sulfur @ 3–4 qt/A or JMS Stylet-Oil or Purespray Green @ 1.5-2% concentration or a sterol-inhibiting (SI) fungicide [Elite 45 WP* @ 4 oz/A **or** Rally 40WSP @ 4 oz/A] or Quintec @ 4 fl oz/A or Endura @ 4.5 oz/A or Vivando @ 10.3-15.4 fl oz/A	Apply mancozeb to protect against early Phomopsis (Ph) and black rot (BR) infection. Choose **one** of the materials listed to protect against powdery mildew (PM) infections on the rachis that will give rise to later infections on clusters. Sulfur and spray oils (Stylet-Oil, Purespray) are inexpensive but require **thorough** coverage to be effective. **To avoid vine injury:** **Do not** use sulfur on Concords, red-fruited French-American hybrids, or any sulfur-sensitive variety. Use oil, an SI, Quintec, Endura, or Vivando. **Do not** combine sulfur with oil or spray them within 14 days of one another. **Do not** apply sulfur when the temperature exceeds 85°F at the time of spraying. ****Note***: *Tebuconazole, the active ingredient in Elite, is available in several generic formulations.*
3- to 5-inch shoot or 7–10 days after the last spray	Same options as ½- to 1-inch shoot spray	Use a 7-day interval if: you are applying sulfur or spray oil there has been a lot of rain since the last spray, **or** it is unusually warm, and shoots are growing rapidly. If rain is predicted between 7 and 10 days after your last spray, make another application **before** the rain. Most of these fungicides act only as protectants. They must be on the shoot before fungal spores arrive to be effective, and they do not move through the shoot to new growth. New growth must be protected by sprays at regular intervals.
6- to 10-inch shoot or 7–10 days after the last spray	Same options as ½- to 1-inch shoot spray	**If you are using an SI fungicide, Quintec, Endura, or Vivando,** rotate to one with a different mode of action after **each** spray to deter resistance. See Table 2 for classes of fungicides. Read the label for seasonal limits on applications and amounts of fungicide. In general, make no more than 2 sprays of any resistance-prone fungicide per season.

GUIDELINES FOR BEARING VINEYARDS (continued from page 6)

Growth stage or timing	*Material and rate/acre*	*Comments*
12- to 17-inch shoot or 7–10 days after the last spray (if necessary)	Same options as ½- to 1-inch shoot spray	**If you have been spraying at 10-day intervals** and your vines are approaching bloom, go to the pre-bloom spray guidelines. **If you have been spraying every 7 days,** you may need to make one more spray using these materials. **If you have been using spray oil**, switch to another fungicide after this spray. Later in the season, oil can slow growth and retard fruit ripening. Remember to increase spray volume as the canopy fills out to ensure thorough coverage!
Pre-bloom to early bloom or 10 days after the last spray	**<u>For BR, Ph, DM, and PM</u>** **A.** Mancozeb @ 4 lb/A or flowable mancozeb @ 3.2 qt/A, **or** captan @ 3 lb/A **PLUS one of the following:** Wettable sulfur @ 5 lb/A or liquid sulfur @ 3 qt/A or a sterol-inhibiting (SI) fungicide [Elite 45 WP @ 4 oz/A **or** Rally 40WSP @ 4 oz/A] or Quintec @ 4 fl oz/A or Endura @ 4.5 oz/A or Vivando @ 15.4 fl oz/A or Inspire Super @ 20 fl oz/A **OR** **B.** Revus Top @ 7 fl oz/A **OR** **C.** Pristine @ 10.5 oz/A (see Comments on DM control)	The period from just before bloom to 3 or 4 weeks after bloom is **critical** for protecting fruit from BR, Ph, downy mildew (DM), and PM infection. Early Botrytis control may also be advisable in wet years, especially on varieties with tight fruit clusters. **For BR, Ph, DM, and PM :** Mancozeb plus sulfur is an inexpensive, effective option recommended for sulfur-tolerant grape varieties. Captan is less toxic to predator mites than mancozeb but also less effective against BR. **Do not** combine captan and oil or spray them within 14 days of each other to avoid vine injury. The difenoconazole pre-mixes, especially Revus Top and Inspire Super, are new choices at this stage (see the new fungicides discussion in the introductory section of this guide). Inspire Super *must be combined with a DM fungicide* (mancozeb or captan). Revus Top contains a DM fungicide, mandipropamid. **Do not** use difenoconazole on Concord, Concord Seedless, or Thomcord grapes. **If DM is a problem, do not use Pristine alone.** Add 3 lb/A mancozeb, 2.4 qt/A flowable mancozeb, 3 lb/A captan, or a phosphorous acid (see label for low rate) to the tank mix for DM control. **Do not** use Pristine on Concord or Noiret grapes.

Growth stage or timing	*Material and rate/acre*	*Comments*
Pre-bloom to early bloom or 10 days after the last spray *continued*	**For early Botrytis control** Use either Endura @ 8 oz/A or Inspire Super @ 20 fl oz/A as part of Option A above **OR** Use Pristine @ 18.5–23 oz/A as Option C (see Comments on DM control for this spray) **OR** Add **one** of the following to Option A: Elevate @ 0.5–1 lb/A or Scala @ 18 fl oz/A or Vangard @ 10 oz/A or Switch @ 14 fl oz/A or Iprodione @ 2 pt/A	**For Botrytis:** Endura at 8 oz/A will control Botrytis and PM. Tank-mix with mancozeb or captan for protection against BR, Ph, and DM. Inspire Super at 20 fl oz/A will control Botrytis, BR, and Ph (but not DM). Add up to 3 oz Vangard for maximum Botrytis protection. Pristine at 18.5–23 oz/A will control Botrytis, PM, BR, and Ph—but not DM if resistant strains are present. Switch is a pre-mix of cyprodinil—the active ingredient in Scala and Vangard—and fludioxonil, a "botryticide" from a different class. Rotate Switch with Elevate, Pristine, Endura, or iprodione, but not Vangard or Scala. Iprodione (Iprodione 4L, Rovral) is an older fungicide that lost effectiveness due to overuse but can "recover." Make one spray per season if it has not been used in your vineyard in at least three years. Elevate, Scala, Vangard, Switch, and iprodione are effective *only* against Botrytis. At bloom, scout for primary PM infections on rachises. If you see actively sporulating colonies, apply an eradicant such as a potassium salt (Armicarb 100, Kaligreen, or Nutrol) or spray oil. Spray oil is an excellent eradicant of active infections and provides several days of protection against new infections. Potassium salts provide moderate to good control of developing powdery mildew colonies **if coverage is thorough** but no protection against future infections. Nutrol may be cheaper than Armicarb or Kaligreen but is comparable in effectiveness, according to research in New York. Consult the labels for usage rates and other recommendations.

GUIDELINES FOR BEARING VINEYARDS (continued from page 8)

Growth stage or timing	*Material and rate/acre*	*Comments*
Post-bloom or 10–14 days after the last spray	**For BR, Ph, DM, and PM** Same options as pre-bloom/bloom sprays **For Botrytis control** Same options as for early Botrytis control under pre-bloom/bloom sprays	The first post-bloom spray is also critical for protecting fruit from BR, Ph, DM, and PM infection. Begin Botrytis control if you did not do so at pre-bloom. See Comments on Botrytis materials under the pre-bloom spray. Be aware of the seasonal limit on the amount of mancozeb you can apply (6 sprays at the full rate) as well as the 66-day preharvest interval. Captan plus an SI is a good alternate (see pre-bloom comments on captan). If the weather is warm and wet during bloom, use a shorter spray interval (10 days), especially on PM-susceptible varieties. If PM colonies appear on leaves or fruit clusters, apply an eradicant (see note on PM under pre-bloom/bloom sprays above). Use a high enough spray volume to ensure thorough coverage of foliage and clusters. **Never** spray an SI or SI pre-mix, Quintec, Endura, Vivando, or a strobilurin (Pristine, Abound, Flint, Sovran) on actively sporulating PM colonies as this will accelerate resistance development.
1st cover spray (2nd post-bloom spray) or 10–14 days after the last spray	**A.** Captan @ 3–4 lb/A **or** a phosphorous acid (PA) product at the labeled rate **PLUS one of the following:** Wettable sulfur @ 5 lb/A or liquid sulfur @ 3 qt/A or a sterol-inhibiting (SI) fungicide [Elite 45 WP @ 4 oz/A **or** Rally 40WSP @ 4 oz/A] or Quintec @ 4 fl oz/A or Endura @ 4.5 oz/A or Vivando @ 15.4 fl oz/A **OR** **B.** Pristine @ 10.5 oz/A (but see Comments on DM control under pre-bloom/bloom sprays)	The risks of BR and Ph are decreasing, and DM and PM will be the main threats for the rest of the season. The second postbloom spray should be made near the end of the **critical period** for controlling fruit infection by BR, PM, and DM (immediate prebloom through 3 to 4 weeks after bloom). By this time, the fruit of most varieties should be resistant to infection, though sensitive varieties such as Chardonnay may not be fully immune to BR infection until 7 weeks after bloom. Maintain excellent fungicide coverage (protection) until fruit become resistant. Failure to provide adequate PM protection can result in **"**diffuse infections**"** on fruit. It is difficult to see these infections with the naked eye, and they can lead to fruit rots later in the season. Remember that the rachis and leaves remain susceptible to PM and DM throughout the growing season.

GUIDELINES FOR BEARING VINEYARDS (continued from page 9)

Growth stage or timing	*Material and rate/acre*	*Comments*
1st cover spray (2nd post-bloom spray) or 10–14 days after the last spray *continued*		Use captan in this spray, especially in wet weather or if BR or Ph have been problems in your vineyard. Otherwise, phosphorous acid (PA) products may provide adequate DM control. Choose a product that is registered as a fungicide, such as Phostrol, ProPhyt, or Topaz, not a nutritional supplement or "plant conditioner." Consult the label for the correct rate. PAs may cause foliar injury, especially with repeated use at high rates. Remember to rotate among resistance-prone fungicides (SIs and SI pre-mixes, Quintec, Endura, Vivando, Pristine) from different classes after **each** spray and observe seasonal limits on applications (see Table 3).
2nd cover spray or 10–14 days after the last spray	Captan @ 3–4 lb/A **or** a phosphorous acid (PA) product at the labeled rate **PLUS one of the following:** Wettable sulfur @ 5 lb/A or liquid sulfur @ 3 qt/A or Quintec @ 4 fl oz/A or Endura @ 4.5 oz/A or Vivando @ 15.4 fl oz/A or a potassium salt (Armicarb 100, Kaligreen, or Nutrol) at the labeled rate	Continue DM and PM control. See general comments under 1st cover spray. The need for DM control will vary with weather conditions. Captan offers protection against late-season fruit rots as well as DM and may be the best choice for this spray in warmer parts of the state. For **active** foliar DM, apply a PA **as soon as possible** to prevent defoliation that could threaten vine survival. PAs have post-infection and antisporulant activity and are good for controlling for mild to moderate DM. They offer up to a week of protection in dry weather. Rotate PAs with other protectant DM materials. For other alternatives to captan, see the note on later-season DM management in the introductory section. *Vinifera* varieties and susceptible hybrids may need PM control throughout the season on fruit and foliage. Sulfur is an effective, inexpensive option, especially if you have used up your seasonal allocation of SIs, Quintec, Endura, and Vivando. Use shorter spray intervals for sulfur and do not apply it when temperatures are above 85° F at the time you spray. For **active** PM—and for grape varieties that cannot tolerate sulfur—use a potassium salt. *You may also use one "rescue" spray of spray oil for severe PM after fruit set*, as research in New York indicates that a single spray on developing grapes will not delay ripening. **Do not** apply Quintec, Endura, or Vivando to active infections, as this may promote development of resistance.

GUIDELINES FOR BEARING VINEYARDS (continued from page 10)

Growth stage or timing	*Material and rate/acre*	*Comments*
Additional cover sprays at 10- to 14-day intervals	Same as 2nd cover spray **PLUS one of the following for Botrytis at bunch closing, veraison, and preharvest (as needed):** Elevate @ 0.5–1 lb/A or Scala @ 18 fl oz/A or Vangard @ 10 oz/A or Switch @ 14 fl oz/A or Iprodione @ 2 pt/A	At **bunch closing**, **veraison**, and **preharvest**, include a fungicide for Botrytis control, especially on bunch rot-prone varieties. For the rest of the season, scout for DM and PM in your vineyard and adjust your spray program according to the weather, the varieties you are growing, diseases observed, and anticipated harvest date. **Do not** apply sulfur or captan within 30–45 days of the expected harvest date, as it may affect wine quality. As you approach harvest, be aware of the preharvest interval (PHI) specified on the label for any fungicide you plan to use. In unusually wet or stormy years, when a higher level of DM protection for the canopy may needed after veraison, see the discussion of newer fungicides for later-season management of DM in the introductory section of this guide. Ranman, Reason, and Tanos have 30-day PHIs. Forum has a 28-day PHI. Presidio has a 21-day PHI. Revus has a 14-day PHI. All offer good to excellent protection against DM. To protect against fruit rots other than Botrytis, apply captan regularly until 30 days before harvest. If conditions favor the spread and development of rot in the preharvest period, you may make an additional spray of Pristine at the high rate (18.5-23 oz) as your preharvest Botrytis spray (14-day PHI) unless you have already used the seasonal limit. Switch is reputed to have a suppressive effect on sour rot and is another option for a final Botrytis spray.

GUIDELINES FOR NON-BEARING VINEYARDS (1st and 2nd years)

Growth stage or timing	*Material and rate/acre*	*Comments*
New shoots (3 or 4 sprays) **Begin at ½- to 1-inch shoot** **Spray every 10 days till pre-bloom**	Mancozeb @ 4 lb/A or flowable mancozeb @ 3.2 qt/A **PLUS one of the following for PM:** Wettable sulfur @ 5–10 lb/A or liquid sulfur @ 3–4 qt/A or JMS Stylet-Oil or Purespray Green @ 1.5-2% concentration	Use a simplified spray program to control black rot (BR), Phomopsis (Ph), downy mildew (DM), and powdery mildew (PM). For sulfur-tolerant varieties, mancozeb plus sulfur should be the backbone of your program. Observe the seasonal limit on mancozeb applications on the label for your formulation. Sulfur and spray oil (Stylet-Oil, Purespray) are inexpensive but require **thorough** coverage to be effective. **To avoid vine injury:** **Do not** use sulfur on Concords, red-fruited French-American hybrids, or any sulfur-sensitive variety. Use oil for the shoot sprays if possible. **Do not** combine sulfur with oil or spray them within 14 days of one another. **Do not** apply sulfur when the temperature exceeds 85°F at the time you spray. If rain is predicted between 7 and 10 days after your last spray, make another application **before** the rain. Most of these fungicides act only as protectants. They must be on the shoot before fungal spores arrive to be effective and do not move through the shoot. Protect new growth by sprays at regular intervals. Increase spray volume as the canopy fills out to ensure thorough coverage!
Pre-bloom to post-bloom (3 sprays) **Begin at immediate pre-bloom or early bloom (10 days after the last new shoot spray)** **Spray twice more at 10-day intervals**	Mancozeb @ 4 lb/A or flowable mancozeb @ 3.2 qt/A, **or** captan @ 3 lb/A **PLUS one of the following for PM:** Wettable sulfur @ 5 lb/A or liquid sulfur @ 3 qt/A or a sterol-inhibiting (SI) fungicide [Elite 45 WP* @ 4 oz/A **or** Rally 40WSP @ 4 oz/A] or Quintec @ 4 fl oz/A or Endura @ 4.5 oz/A or Vivando @ 10.3-15.4 fl oz/A	This is a **critical period** for controlling DM as well as BR, Ph, and PM. Use mancozeb plus sulfur if possible. One spray of an SI, Quintec, or Endura instead of sulfur might be preferable when planning canopy management tasks, as some people are sensitive to sulfur residues. Captan is less toxic to predator mites than mancozeb but also less effective against BR. **Do not** combine captan and oil or spray them within 14 days of each other to avoid vine injury. **__Note__: Tebuconazole, the active ingredient in Elite, is now available in several generic formulations.*

GUIDELINES FOR NON-BEARING VINEYARDS (1st and 2nd years) (continued from page 12)

Growth stage or timing	*Material and rate/acre*	*Comments*
Pre-bloom to post-bloom (3 sprays) *continued*		**If you are using an SI fungicide, Quintec, Endura, or Vivando**, rotate to one with a different mode of action after **each** spray to avoid resistance development. See Table 2 for classes of fungicides. Read labels for restrictions on the number of applications and amount to be applied in one season. In general, make no more than 2 sprays of any resistance-prone fungicide per season. **If PM colonies appear on leaves**, apply an eradicant such as one of the potassium salts (Armicarb 100, Kaligreen, or Nutrol) or spray oil. Oil is an excellent eradicant of active infections and provides several days of protection against new infections. Potassium salts provide moderate to good control of developing PM colonies but no protection against future infections. Nutrol may be cheaper than Armicarb or Kaligreen but is comparable in effectiveness, according to research in New York. Consult labels for usage rates and other recommendations. Use a high enough spray volume to ensure thorough coverage. **Never** spray an SI, Quintec, Endura, Vivando, or a strobilurin on actively sporulating PM colonies, as this will accelerate the development of resistance.

GUIDELINES FOR NON-BEARING VINEYARDS (1st and 2nd years) (continued from page 13)

Growth stage or timing	*Material and rate/acre*	*Comments*
Cover sprays **Begin 10 days after last post-bloom spray** **Spray at 14- to 21-day intervals, depending on weather, until frost**	Mancozeb @ 4 lb/A or flowable mancozeb @ 3.2 qt/A **or** captan @ 3 lb/A **or** a phosphorous acid product at the labeled rate **PLUS one of the following:** Wettable sulfur @ 5 lb/A or liquid sulfur @ 3 qt/A or Quintec @ 4 fl oz/A or Endura @ 4.5 oz/A or Vivando @ 10.3-15.4 fl oz/A or a potassium salt (Armicarb 100, Kaligreen, or Nutrol) at the labeled rate	The risk of BR or Ph is decreasing, and DM and PM will be the main threats for the rest of the season. In warm, wet weather, spray at shorter intervals. If you reach the seasonal limit on mancozeb (6 sprays at the full rate), switch to captan or a phosphorous acid (PA) for DM. Choose a PA product that is registered as a fungicide, such as Phostrol, ProPhyt, or Topaz, not a nutritional supplement or "plant conditioner." Consult the label for the rate. PAs may cause foliar injury, especially with repeated use at high rates. Sulfur remains the best and least expensive option for PM control on tolerant varieties, but is less rainfast than synthetic fungicides and may require shorter spray intervals. In a non-bearing vineyard, you can use sulfur until frost. For control of **active** PM infections on grape varieties that cannot tolerate sulfur, use a potassium salt or oil. **Do not** apply Quintec, Endura, or Vivando, as this may promote the development of resistance. The need for DM control will vary with weather conditions. Captan is effective and inexpensive. In unusually wet or stormy years, when a higher level of DM protection for the canopy may be needed, see the options for later-season management of DM in the introductory section of this guide. For **active** foliar DM, apply a phosphorous acid fungicide **as soon as possible** to prevent defoliation that could threaten vine survival. PA products (0-day PHI) offer good post-infection and anti-sporulant activity for mild to moderate DM. Apply weekly for good protection and rotate with other protectant DM materials.

Table 1. Relative Effectiveness of Selected Fungicides on Grape Diseases

(**Key**: E=excellent; G=good; F=fair; P=poor, N=none or not labeled, ?=unknown or no information)

Fungicide		***Effectiveness against***				
Brand	**Common (chemical) name**	**Black rot**	**Botrytis bunch rot**	**Downy mildew**	**Phomopsis cane & leaf spot**	**Powdery mildew**
Abound	azoxystrobin	E	P	G–E[1]	F–G	G–E[1]
Armicarb, Kali-green	potassium bicarbonate	N	N	N	N	F
Captan, Captec	captan	P	P	G	E	N
Coppers (various)	Bordeaux mixture, fixed coppers	P–F	N	G–E	P–F	F
Dithane, Manzate, Penncozeb	mancozeb	G	N	G	E	F
Elevate	fenhexamid	N	E	N	N	P
Elite, Orius	tebuconazole	E	N	N	N	G[2]
Endura	boscalid	N	F, E[3]	N	N	E
Flint	trifloxystrobin	E	F, E[3]	P[1]	F	E[1]
Forum	dimethomorph	N	N	G-E	N	N
Gavel	zoxamide + mancozeb	F	N	G	F	P
JMS Stylet-Oil, Purespray Green	spray oil	N	N	N	N	G
Inspire Super	difenoconazole + cyprodinil	E	G-E[4]	N	?	E[2]
Iprodione, Rovral	iprodione	N	G	N	N	N
Nutrol	potassium phosphate	N	N	N	N	F
Phostrol, ProPhyt, Topaz	phosphorous acid	N	N	G	N	N
Presidio	fluopicolide	N	N	E	N	N
Pristine	boscalid + pyraclostrobin	E	F, E[3]	E[1]	G	E[1]
Procure	triflumizole	F	N	N	N	G[2]
Quadris Top	difenoconazole + azoxystrobin	E	P	G-E[1]	F-G	E[1]
Quintec	quinoxyfen	N	N	N	N	E
Rally	myclobutanil	E	N	N	N	G[2]
Ranman	cyazofamid	N	N	G-E	N	N
Reason	fenamidone	N	N	E[1]	N	N
Revus	mandipropamid	N	N	E	N	N
Revus Top	difenoconazole + mandi-propamid	E	N	E	?	E[2]
Ridomil Gold/Cu	mefenoxam + copper	N	N	E	N	F
Ridomil Gold MZ	mefenoxam + mancozeb	P	N	E	P	N
Scala	pyrimethanil	N	E	N	N	N

Table 1. Relative Effectiveness of Selected Fungicides on Grape Diseases (continued)

(**Key**: E=excellent; G=good; F=fair; P=poor, N=none or not labeled, ?=unknown or no information)

Fungicide		*Effectiveness against*				
Brand	**Common (chemical) name**	**Black rot**	**Botrytis bunch rot**	**Downy mildew**	**Phomopsis cane & leaf spot**	**Powdery mildew**
Sovran	kresoxim-methyl	E	F	F[1]	F	E[1]
Sulfur (various)	sulfur	N	N	N	N	G[5]
Switch	cyprodinil + fludioxonil	N	E	N	N	N
Tanos	famoxadone + cymoxanil	N	N	G–E[1]	N	N
Vangard	cyprodinil	N	E	N	N	N
Vivando	metrafenone	N	N	N	N	E

Ratings based on mid-Atlantic fungicide trial data, the 2011 New York and Pennsylvania Pest Management Guidelines for Grapes, and the 2011 Virginia Pest Management Guide for Commercial Vineyards.

[1] Powdery mildew and downy mildew strains resistant to strobilurins (Abound, Flint, Sovran, and one component of Pristine) are present in Maryland vineyards and elsewhere in the mid-Atlantic. These strains may also be cross-resistant to related compounds in Group 11, including fenamidone (Reason) and famoxadone (one component of Tanos). Resistance may appear suddenly and result in a control failure. See the note on fungicide resistance on pages 5-6 for suggested substitutes and tank mixes to prevent crop loss.

[2] Powdery mildew strains resistant to Group 11 compounds may also be less sensitive to sterol-inhibiting fungicides (Elite and generic tebuconazoles, Rally, difenoconazole). See the note on fungicide resistance on pages 5-6 for suggested substitutes and tank mixes to prevent crop loss.

[3] Excellent control at the high rate labeled for Botrytis; fair control at the lower rate labeled for powdery mildew.

[4] At the labeled rate of 16-20 fl oz/A, Inspire Super contains the same amount of cyprodinil as 5.6-7 oz/A of Vangard. The "excellent" Botrytis rating for Vangard in this chart assumes a 10 oz/A rate. For maximum Botrytis activity, supplement Inspire Super with Vangard (3.0-4.4 oz/A, depending on Inspire Super rate used) to provide the same amount of cyprodinil as 10 oz/A of Vangard alone.

[5] Sulfur is highly effective when applied at high rates and short spray intervals (7 days), but efficacy declines with lower rates and longer spray intervals, or in rainy weather.

Table 2. Resistance-prone Fungicides by FRAC Group, Chemical Class, and Resistance Risk

FRAC group	*Chemical class*	*Risk*	*Common (chemical) name(s)*	*Trade name(s)*
1	MBC: thiophanates	High	thiophanate-methyl	Topsin-M
4	PA: acylalanines	High	mefenoxam (+ copper)	Ridomil Gold/Cu
			mefenoxam (+ mancozeb)	Ridomil Gold MZ
11	QoI fungicides	High	azoxystrobin	Abound
	(aka strobilurins)		famoxadone (+ cymoxanil)	Tanos
			fenamidone	Reason
			kresoxim-methyl	Sovran
			pyraclostrobin (+ boscalid)	Pristine
			trifloxystrobin	Flint
2	Dicarboximides	Medium to high	iprodione	Rovral, Iprodione 4L
7	SDHI: carboximides	Medium to high	boscalid	Endura
			boscalid (+ pyraclostrobin)	Pristine
21	QiI fungicides	Medium to high	cyazofamid	Ranman
	(aka cyanoimidazoles)			
U8	Benzophenones	Medium to high	metrafenone	Vivando
3	DMI fungicides	Medium	difenoconazole (+ azoxystrobin)	Quadris Top
	(aka sterol inhibitors)		difenoconazole (+cyprodinil)	Inspire Super
			difenoconazole (+ mandipropamid)	Revus Top
			myclobutanil	Rally
			tebuconazole	Elite, Orius
			triflumizole	Procure
9	AP: anilinopyrimidines	Medium	cyprodinil	Vangard
			cyprodinil (+ fludioxonil)	Switch
			pyrimethanil	Scala
13	Quinolines	Medium	quinoxyfen	Quintec
22	Toluamides	Medium	zoxamide (+ mancozeb)	Gavel
12	PP: phenylpyroles	Low to medium (RM required)	fludioxonil (+ cyprodinil)	Switch
17	Hydroxyanilides	Low to medium (RM required)	fenhexamid	Elevate
27	Cyanoacetamide-oximes	Low to medium (RM required)	cymoxanil (+ famoxadone)	Tanos
40	CAA: mandelic acid amides	Low to medium (RM required)	dimethomorph mandipropamid	Forum Revus
43	Pyridinylmethyl benzamides	Unknown (RM required)	fluopicolide	Presidio

Source: FRAC Code List© 2011: Fungicides sorted by mode of action, Fungicide Resistance Action Committee

Resistance ratings apply to *all* members of a class of fungicides. Fungicides at medium or high risk of resistance development, and those marked “RM required” in the table, *must* be used in accordance

with resistance management guidelines on the label. These may include limits on amounts or applications per year. As a rule of thumb, make no more than 2 applications per season of fungicides at high or medium risk of resistance. To avoid or slow resistance development:

- Rotate among fungicides from different classes. Make only one application of a resistance-prone fungicide before switching to a fungicide from a different class.
- Tank-mix fungicides from different classes that are effective against the same disease(s). Premixes such as Inspire Super, Quadris Top, Revus Top, Pristine, Switch, and Tanos take advantage of this tactic.
- Use the correct rate of fungicide and spray interval for the target disease, disease pressure, and weather conditions.
- Spray correctly. Use a properly calibrated sprayer with the right nozzles to deliver a spray volume sufficient to thoroughly cover all susceptible parts of the vine.

Fungicides at low risk of resistance development include sulfur, copper, Bordeaux mixture, phosphorous acid products, mancozeb, captan, ferbam, ziram, spray oils, potassium salts, and Oxidate (hydrogen peroxide). Consult the label for limitations on seasonal amounts or applications.

Table 3. Reentry Interval (REI), Preharvest Interval (PHI), and Seasonal Limits and Restrictions for Selected Fungicides

Cautionary note: *The information in this table is accurate as of the date of publication and is provided as a guide to choosing fungicides and planning a spray program.* ***Always*** *read the label before applying any fungicide. Labels change—and the label is the law.*

Brand/formulation	*Active Ingredient*	*REI (hr.)*	*PHI (days)*	*Seasonal limit/restriction*
Abound	Azoxystrobin	4	14	92.3 fl oz/A **&** 1.5 lb a.i./A in 4 solo/6 tank-mix appl.
Aliette	Fosetyl Al	12	15	7 appl.
Armicarb 100	Potassium bicarbonate	4	0	None stated
Captan 50 WP	Captan (50%)	72	0[1]	24 lb product (12 lb a.i.)/A
Captan 80 WDG	Captan (80%)	72	0[1]	15 lb product (12 lb a.i.)/A
Captec 4L	Captan (40%)	48	0[1]	12 qt product/A
Champ 2F	Copper hydroxide (37.5%)–Cu 24.4%	24	0[1]	None stated
Cuprofix Ultra 40 Disperss	Basic copper sulfate–Cu 40%	48	0[1]	50 lb product (20 lb metallic copper)/A
Dithane DF Rainshield	Mancozeb (75%)	24	66	24 lb product (18 lb a.i.)/A
Dithane F-45 Rainshield	Mancozeb (37%)	24	66	19.2 qt product (19.2 lb a.i.)/A **or** 6 appl.
Dithane M-45	Mancozeb (80%)	24	66	24 lb product (19.2 lb a.i.)/A
Elevate	Fenhexamid	12	0	3 lb product (1.5 lb a.i.)/A
Elite 45 WP	Tebuconazole	12	14	2 lb product (14.4 oz a.i.)/A
Endura	Boscalid	12	14	24 oz product/A; 5 appl. @ low rate or 3 @ high rate
Flint	Trifloxystrobin	12	14	24 oz product/A; 6 appl. @ any rate
Forum	Dimethomorph	12	28	30 oz product/A; 5 appl.
Gavel	Mancozeb (67%) + zoxamide	48	66	15 lb product/A or 6 appl.
Inspire Super	Difenoconazole (8.4%) + cyprodinil (24.1%)	12	14	80 fl oz product/A **&** 0.46 lb difen./A or 1.4 lb cyp/A
Iprodione 4L	Iprodione	48	7	4 appl.
JMS Stylet Oil	Paraffinic oil	4	0	None stated
Kaligreen	Potassium bicarbonate	4	1	None stated
Kocide 3000	Copper hydroxide (46%) -Cu 30%	48	0[1]	66.7 lb product/A
Kumulus DF	Sulfur (80%)	24	0[1]	None stated
Manzate FL	Mancozeb (37%)	24	66	19.2 qt product (19.2 lb a.i.)/A **or** 6 appl.
Manzate Pro-Stick	Mancozeb (75%)	24	66	24 lb product (18 lb a.i.)/A
Micro Sulf	Sulfur (80%)	24	0[1]	None stated
Microthiol Disperss	Sulfur (80%)	24	0[1]	None stated
Nutrol	Potassium dihydrogen phosphate	4	0	None stated
Penncozeb 4FL	Mancozeb (37%)	24	66	19.2 qt product (19.2 lb a.i.)/A or 6 appl.

Table 3. Reentry Interval (REI), Preharvest Interval (PHI), and Seasonal Limits and Restrictions for Selected Fungicides (continued)

Brand/formulation	*Active Ingredient*	*REI (hr.)*	*PHI (days)*	*Seasonal limit/restriction*
Penncozeb 75DF	Mancozeb (75%)	24	66	25.6 lb product (19.2 lb a.i.)/A
Penncozeb 80 WP	Mancozeb (80%)	24	66	24 lb product (19.2 lb a.i.)/A
Phostrol	Potassium phosphite	4	0	None stated
Presidio	Fluopicolide	12	21	12 fl oz/A **or** 4 appl.
Pristine	Pyraclostrobin + boscalid	12[2]	14	69 oz/A; 5 appl. @ low rate or 3 appl. @ high rate
ProPhyt	Potassium phosphite	4	0	None stated
Purespray Green	Petroleum oil	4	0	None stated
Quadris Top	Azoxystrobin (18.2%) + difenoconazole (11.4%)	12	14	56 fl oz/A in 4 appl. **&** 0.46 lb difen./A or 1.5 lb azo/A
Quintec	Quinoxyfen	12	14	33 fl oz/A **and** 5 appl.
Rally	Myclobutanil	24	14	1.5 lb/A (0.6 lb a.i.)
Ranman	Cyazofamid	12	30	16.5 fl oz **and** 6 appl.
Reason	Fenamidone	12	30	8.1 fl oz/A
Revus	Mandipropamid (23.3%)	4	14	32 fl oz/A (0.52 lb a.i./A)
Revus Top	Mandipropamid (21.9%) + difenoconazole (21.9%)	12	14	28 fl oz/A **and** 0.46 lb difen./A or 0.52 lb mandi./A
Ridomil Gold Copper	Mefenoxam (5%) + Cu hydroxide (60%)–Cu 39.1%	48	42	4 appl. **and** 0.4 lb a.i./A (also metalaxyl)
Ridomil Gold MZ	Mefenoxam (4%) + man-cozeb (64%)	48	66	10 lb/A **and** 19. 2 lb mnczb/A or 0.4 lb mfnxam/A
Rovral	Iprodione	48	7	4 appl.
Scala	Pyrimethanil	12	7	36 fl oz (1.4 lb a.i./A); no more than 40% of sprays
Sovran	Kresoxim-methyl	12	14	25.6 oz/A **or** 4 appl.
Sulfur 6L	Sulfur (52%)	24	0[1]	None stated
Switch	Cyprodinil (37.5%) + flu-dioxonil	12	7	56 oz/A **and** 1.4 lb cyp/A or 0.9 lb flu/A
Tanos	Famoxadone + cymoxanil	12	30	72 oz/A **or** 9 appl. of *all* Group 11 fungicides
Topsin-M 70 WP/WSB[3]	Thiophanate-methyl (70%)	48	7	6 lb/A (4.2 lb a.i./A)
Topsin-M 70 WDG[3]	Thiophanate-methyl (70%)	168	14	4 lb/A (2.8 lb a.i./A)
Vangard	Cyprodinil (75%)	12	7	30 oz/A **and** 1.4 lb cyp/A
Vivando	Metrafenone	12	14	46.2 fl oz/A (0.9 lb a.i./A) **and** 3 appl.

[1] Use caution in applying captan, copper, and sulfur within 30 days of harvest, as they may affect wine quality.

[2] The REI for Pristine is 5 days for cane work (tying, turning, or girdling).

[3] Because of widespread resistance to thiophanate-methyl in powdery mildew and Botrytis strains in mid-Atlantic vineyards, Topsin-M is currently recommended only for protecting pruning wounds from cankering diseases.

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The New Guidelines for Developing an Effective Fungicide Spray Program for Wine Grapes in Maryland, 2012

By
*Anne DeMarsay, Ph.D., The Fruit Doctor™

Reviewed by:
Dr. Joseph A. Fiola, Professor & Specialist in Viticulture and Small Fruit, University of Maryland Extension
Noemi O. Halbrendt, Project Associate in Plant Pathology, The Pennsylvania State University, Biglerville, PA
Henry Ngugi, Assistant Professor, Plant Pathology, The Pennsylvania State University, Biglerville, PA

**Anne DeMarsay, Ph.D. is the former Regional Specialist in Fruit Pathology, UME.*

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