**GRAPE DISEASE CONTROL - 2009**

Wayne F. Wilcox, Department of Plant Pathology, 
Cornell University,  
NY State Agricultural Experiment Station, Geneva NY  
[wfw1@cornell.edu](mailto:wfw1@cornell.edu)

It’s that time again: the annual review of new developments, basic principles (a.k.a. the s.o.s.), forgotten factoids, nagging reminders to do the obvious, and various options for fungal disease control. As always, I’d like to acknowledge the outstanding team of grape pathologists here in Geneva, including faculty colleagues (David Gadoury and Bob Seem in the fungal jungle; Marc Fuchs with viruses; Tom Burr with bacteria); research technicians (Duane Riegel, Judy Burr); and graduate students and post-docs too numerous to mention. Rick Dunst and the crew at the Vineyard Lab in Fredonia also play a very significant role, particularly on projects related to native varieties. It is the combined research efforts of all of these people that serve as the basis for most of the following.

I’d also like to acknowledge the financial support of the coordinated public and private viticulture research funding bodies that pool their limited budgets to allow bigger things to happen (the USDA Viticulture Consortium-East program, the New York Wine and Grape Foundation, the Grape Production Research Fund, Lake Erie Regional Grape Program, Dyson Foundation, New York Wine Grape Growers), not to mention the tremendous support that Cornell’s College of Agriculture and Life Sciences has devoted to multiple aspects of the viticulture and enology programs. Even in tough economic times, these various entities have committed to helping us do our part to keep the technology of grape growing and wine making on a forward path.

And finally, I’d especially like to thank the growers and industry support personnel--extension educators, processor fieldmen (field-persons?), consultants, agrichemical distributors and field reps, etc.--who are so helpful in identifying problems that require attention, sharing their experiences and observations (and opinions!), and letting us know when we get things right and when we don’t. This is truly a great industry to be associated with.

---

**IN THIS ISSUE**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grape Disease Control - 2009</td>
<td></td>
</tr>
<tr>
<td>Fungicide Changes &amp; News</td>
<td>2</td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td>4</td>
</tr>
<tr>
<td>Black Rot</td>
<td>10</td>
</tr>
<tr>
<td>Downy Mildew</td>
<td>13</td>
</tr>
<tr>
<td>Botrytis</td>
<td>16</td>
</tr>
<tr>
<td>“Other” Rots</td>
<td>19</td>
</tr>
<tr>
<td>Phomopsis</td>
<td>20</td>
</tr>
<tr>
<td>Wood Cankers</td>
<td>21</td>
</tr>
<tr>
<td>Putting It All Together</td>
<td>22</td>
</tr>
<tr>
<td>Upcoming Events</td>
<td>28</td>
</tr>
</tbody>
</table>
1. Mancozeb in short supply? Rumor has it that mancozeb will be in short supply this coming season. The effect of this will at the very least be significantly higher prices (I’ve already heard the screams), but may even include an inability for some growers to purchase the material. So, should mancozeb products either be hard to find or less easy to afford, it seems worth reviewing the diseases we use them against, the most viable alternative materials, and some considerations regarding these alternatives:

- **Phomopsis**--Captan (the 3-day REI is easiest to deal with in the early season, when Phomopsis control is critical); ziram. Strobies applied from immediate pre-bloom onwards for control of other diseases should be adequate for this tail-end period of Phomopsis activity. Pristine looked good even early season in my trial last year, as it appears likely that both components of this product have some Phomopsis activity.

- **Black rot**--Rally (Nova); Elite (or tebuconazole generics); Mettle (see below); strobies (Abound, Flint, Pristine, Sovran are all equivalent); ziram.

- **Downy mildew**--Captan; Abound or Pristine (limit use, watch for potential resistance); phosphites; coppers; Ridomil Gold (Copper or MZ formulations); several new downy mildew-specific products (see below). Ziram is far better than nothing and may be adequate under moderate pressure, but is significantly less effective than mancozeb or the preferred alternatives just listed, particularly under high pressure conditions. Ditto for Sovran.

- **Bitter rot, ripe rot**--Captan; strobies. Two non-Botrytis rots that growers in more southerly climes deal with on a regular basis, and which may be more common than we’ve traditionally appreciated to the north of these regions. For example, bitter rot was a commercial problem in several Long Island vineyards in 2008, and I hear reports of ripe rot from time to time from southern PA up into coastal New England. It’s not clear to me how common these are outside their “home range” (south of the Mason-Dixon line, more or less), but they’re something to consider in the north, especially if you’ve been having unexplained rot problems in wet summers (more on these diseases later in the tome). When and where needed, mancozeb provides control of infections that can occur during the early post-bloom period, while this material can still be used. It is possible that some northern growers have been getting the benefit of controlling these “sporadic” diseases as an unknown bonus while going after BR, DM, and Ph with mancozeb post-bloom. If so, strobies or captan should do the same thing.

2. Captain on juice grapes. With the potential mancozeb turmoil, some juice processors are now allowing captan use before bloom. For those that don’t remember this detail of the pre-Alar days, the bottom line is: activity equal to (perhaps even a tad better than) mancozeb for Phomopsis and DM, significantly inferior against BR. If using immediate pre-bloom, tank-mix with Rally or Elite (or generic), not Rubigan (or Vintage) to pick up BR.

3. New fungicides. Four new fungicides (three of them specific for downy mildew control) have received EPA registration for use on grapes in the past year or so. Note, however, that some individual states (I love NY!) have not yet approved all of them. A quick rundown:

(i) **Tanos.** This is a strobilurin-like fungicide, but with very good activity against downy mildew only. Although not technically a strobilurin (don’t ask), it has the same biochemical mode of action, so any downy mildew organisms resistant to Abound, Pristine, etc. will also be resistant to Tanos and vice versa. Which means that if you’re trying to limit the risk of resistance development by rotating among different groups of fungicides, Tanos is not a suitable rotational partner for Abound or Pristine (or Sovran). Also, be aware that the Tanos label (which is the law, remember) requires that it be tank-mixed with a protectant fungicide (e.g., mancozeb, captan, copper) when used. It has a 30-day pre-harvest interval (PHI) and a 12-hr re-entry interval (REI). Registered in NY.

(ii) **Presidio.** Another of the downy mildew-specific products, unrelated to other fungicides on the market (new chemistry). It was very effective in a high-pressure trial that I ran in 2008. Again, application with a “tank-mix partner” is required by the label. It is absorbed after application, so resists wash-off and provides at least limited post-infection activity. It has a 21-day PHI and a 12-hr REI. Not yet registered in NY, although that might change by the start of the DM season.

(iii) **Revus.** The third of the new downy-mildew specific products, also representing a unique class of fungicides on grapes. It provided very good control in a local trial during the wet 2008 season. It is absorbed after application, so resists wash-off and provides at least limited post-infection activity. It has a 14-day PHI and a 12-hr REI. There is no tank-mixing requirement. Registered in NY.
portfolio (e.g., Bayer’s Adament = the actives in their Elite formulations will become available and the original patent also, as patents expire on the older actives, new generic programs, and some of the new ones may even be better. So, stay tuned. Although there are no hard data yet, it appears that some of these newer materials *may* be more active than some of the older ones, so it’s worth keeping an eye on things as they start to unfold. Even though the old standards aren’t quite what they used to be, they’ve remained integral components of many growers’ spray programs, and some of the new ones may even be better. Also, as patents expire on the older actives, new generic formulations will become available and the original patent holders will develop mixtures with other molecules in their portfolio (e.g., Bayer’s Adament = the actives in their Elite

4. What’s with “new” DMI fungicides and products?
DMI fungicides have been used in U.S. viticulture for over a quarter of a century, and seemed to be on the ropes a few years back. “Suddenly” it seems, there’s a new active ingredient registered, at least two more are actively being developed and may be registered by next year (more info to come if/when appropriate), and older actives are showing up in pre-packaged mixes (e.g., Adament) and generic formulations (e.g., various products containing tebuconazole, the active ingredient in Elite). So, what’s going on?

Well, numerous DMI actives have been registered for many years in Europe and most other parts of the world, but the US-EPA was never enamored of these products. Basically, the agency made a policy decision some years ago that there were enough on the market, and that as they perceived it, the benefit to agriculture did not generally justify the environmental risk of adding new registrations. Then, a few years ago, a new fungus made its way into the US, which has the potential to cause a deadly disease (rust) on soybeans. And guess what’s the most effective class of fungicides against it? Suddenly, the benefit side of this equation gained a whole lot more traction (the U.S. soybean crop *is* worth a boat load of money), and the DMIs were back in favor.

So, stay tuned. Although there are no hard data yet, it appears that some of these newer materials *may* be more active than some of the older ones, so it’s worth keeping an eye on things as they start to unfold. Even though the old standards aren’t quite what they used to be, they’ve remained integral components of many growers’ spray programs, and some of the new ones may even be better. Also, as patents expire on the older actives, new generic formulations will become available and the original patent holders will develop mixtures with other molecules in their portfolio (e.g., Bayer’s Adament = the actives in their Elite

5. Strobilurin resistance, the annual reminder. Strobilurin resistance started causing a problem with powdery mildew control in the Finger Lakes and Long Island regions in 2002. In recent years, Dr. Anton Baudoin at Virginia Tech has also reported PM resistance from select mid-Atlantic vineyards, and downy mildew resistance has become so widespread in some southern regions that these materials are no longer relied upon there for DM control. Thus, real caution is in order now when considering their utility against DM in New York and other more northerly areas where problems have not yet become apparent. Similarly, other regions that have not yet had problems with powdery mildew would be well advised to learn the same lessons that we have when it comes to guarding against “surprise” failures to control this disease. As we often point out, the question regarding the development of resistance to these materials is one of “when”, not “if”. How you use them will determine whether the answer is “when I’m old(er) and gray(er)” or “any day now”.

Recall that control failures due to strobilurin resistance typically occur suddenly and without warning in an affected vineyard. As discussed many times before, the development of fungicide resistance is a simple but classical illustration of the principles of evolution (natural selection), a “survival of the fittest” for individuals within a fungal population that’s treated with the material. How quickly these individuals come to dominate the population to the point that the material no longer provides adequate disease control when used according to recommendations (i.e., not because you screwed up or pushed the envelope too far) depends primarily on (a) the number of selection events (spray applications) imposed on the population, and (b) the ability of the “selected” (resistant) individuals to multiply and spread. This latter factor is determined by a number of factors, including (i) the number and intensity of potential infection events (the weather); (ii) the relative ability of the disease-causing fungus to grow and reproduce on the particular vine (varietal susceptibility); (iii) the inherent “reproductive capacity” of the fungus (the time between initiation of infection and production of a new generation of spores, and the relative number of spores then produced; (iv) the extent to which these spores are dispersed over distance, to start their dirty work elsewhere; and (v) the extent to which reproduction is arrested (disease is limited) by other farming practices, including non-chemical means and applications of unrelated fungicides in rotation and/or
These somewhat self-evident principles explain a lot about our recent history with strobie resistance, where we’re likely to go with it in the future, and the options that we have at our disposal to address it. For example: (i) Why we got PM resistance in New York more quickly than DM resistance (a run of dry years shortly after introduction of the strobies—1998, 1999, 2001, 2002—that favored reproduction of PM but not DM); (ii) Why resistance to DM rather than PM is a greater problem further south (warmer temperatures are more favorable to DM reproduction and spread, we started aggressively limiting strobie use in PM country earlier in the game, due to resistance by that disease); (iii) Why the first PM problems were on Chardonnay (optimum pathogen reproduction); (iv) Why we haven’t hit problems yet on Concords, 7 years after hitting them on vinifera (significantly fewer sprays to select resistant individuals, less potential for reproduction on these vines should a few be selected); (v) Why the initial problems were so much less common in vineyards that had tank-mixed with sulfur (less reproduction of the resistant individuals that were selected); and (vi) Why nobody has yet encountered black rot resistance (BR has a much lower reproductive capacity than PM and DM—it takes two- to four times longer for infections to produce new spores [longer “generation” time]—and these new BR spores are dispersed only a matter of feet by splashing raindrops, whereas new PM and DM spores are spread far and wide by wind currents).

Remember, it is imperative to limit the use of these products if you want them to last—no more than two sprays per season is our recommendation. If using a strobie product to control PM, growers should either use Pristine or tank-mix with sulfur if using one of the other strobie materials (tank-mixing sulfur with Pristine is a good idea, too, to protect the non-strobie component in vineyards where the strobie portion isn’t doing much). As noted in previous missives, the non-strobie (tebuconazole) component of Adament is unlikely to provide adequate PM control by itself (if strobie-resistant individuals are selected and start to multiply) when used at the PM rates labeled on this product, whereas it might at the higher rates labeled for other diseases. Too bad higher rates cost more.

The non-strobie component of Pristine does not provide any appreciable control of downy mildew, so even this product must be tank-mixed with an effective DM fungicide (phosphite, mancozeb, captan, copper) to be safe in regions where DM resistance has begun to appear. This is a recommendation that’s a lot easier to make if you’re not the one needing to buy the second material. Nevertheless, the bottom line is, the strobies are no longer viable DM materials in significant portions of the eastern U.S. (again, the worst problems have appeared in regions where generally warmer and wetter weather has sped the reproduction of resistant individuals). In more northerly regions such as New York, we have not yet encountered documented control failures, but it’s most likely only a matter of time until it happens here as well. The DM activity of Pristine and Abound is part of what originally made them so attractive, and it still remains so in some regions. But use them for this purpose with caution and be ready to change horses if it looks like they’re no longer working for this purpose.

**POWDERY MILDEW (PM) NEWS AND REMINDERS**

*Your annual quick review of PM biology with respect to management considerations.*

(i) The fungus overwinters as minute fruiting bodies (cleistothecia) that form on leaves and clusters during late summer and autumn, then wash onto the bark of the trunk where they survive the winter. In New York, the spores of consequence produced within cleistothecia are discharged between bud break and bloom (more or less) to initiate the disease, after which it can spread rapidly via the millions of new spores produced from each of these “primary” infections. Thus, the amount of fungus capable of starting disease this year is directly proportional to the amount of disease that developed last year. An important consequence of this is that disease pressure will be higher, and PM sprays during the first few weeks of shoot growth are likely to be far more important, in blocks where PM control

*Powdery mildew infection on a Chardonnay cluster.*

*Source: T. Martinson*
lapsed last year than in blocks that remained “clean” into September. (In the fine-print section, note that in the Finger Lakes region, cleistothecia starting to develop from infections initiated after the beginning of September are unlikely to mature before frost kills the leaves and eliminates their food source. Thus, long warm autumns are more conducive to providing spores for next year than are short, cold ones.)

Let’s look at what this means. Several years ago, we conducted an experiment in a Chardonnay vineyard where we either (a) sprayed through Labor Day, maintaining a clean canopy throughout the year; (b) quit spraying a month earlier, simulating a vineyard with moderate levels of PM by the end of the season; or (c) quit spraying in early July, simulating a vineyard where PM control got away from us. The next spring, the levels of cleistothecia (number per kilogram of bark) in these treatments were (a) 1,300; (b) 5,300; and (c) 28,700, respectively. Now, consider the case where 20% of the overwintering spore load is discharged during the first couple of weeks after bud break (a reasonable approximation, based on published studies). But 20% of what? In the clean treatment (a), this number might be relatively inconsequential; in dirtier treatment (b), it’s equal to the entire seasonal supply on the clean vines; and in treatment (c), it’s four to five times greater than the entire seasonal supply on the clean vines. Not surprisingly, this makes a difference. When we intentionally withheld a minimal spray program on these same vines until the immediate prebloom period the following spring, the resulting cluster disease severities were (a) 11%, (b) 22%, and (c) 48% cluster area infected, respectively, even though all were sprayed the same. Conclusion: Higher disease one year = More primary infections to start off the season next spring = Many more new (“secondary”) spores by the time the fruit were susceptible to infection = Increasing disease pressure to “overwhelm” the fungicide spray program.

(iv) Berries are extremely susceptible to infections initiated between the immediate prebloom period and fruit set, then become highly resistant to immune about 2 weeks (Concord) to 4 weeks (V. vinifera) later. Your annual reminder.

(v) Failure to control even inconspicuous PM infections on the berries can increase the severity of Botrytis and sour rot at harvest, and can promote the growth of wine-spoilage microorganisms such as Brettanomyces on the fruit. Another annual reminder. Providing excellent PM control on susceptible wine grapes from pre-bloom right through bunch closing does not guarantee control of bunch rots and spoilage beasties, but it’s a relatively easy method to eliminate one way of getting them.

(vi) Powdery mildew is a unique disease in that the causal fungus lives almost entirely on the surface of infected tissues, sending little “sinkers” (haustoria) just one cell deep to feed. This makes it subject to control by any number of “alternative” spray materials (oils, bicarbonate and monopotassium phosphate salts, hydrogen peroxide, etc.) that have little effect on other disease-causing fungi, which live down inside the infected tissues. Recall that there are two primary limitations to the aforementioned group of products, which need to be considered if you want to use them effectively: (a) they work by contact, so can only be as effective as the coverage you provide; and (b) they...
work primarily in a post-infection/curative mode with little residual (protective) activity. This means that they need fairly frequent re-application, or should be tank-mixed with something that provides good protective (forward) activity in order to lengthen effective spray intervals.

**New research I: Effect of sunlight exposure**

As noted in previous missives, “it has long been known” that PM is more severe in shaded regions (canopy centers, near trees, etc.), but until recently there was very little work done to determine either the magnitude or cause(s) of this effect. However, graduate student Craig Austin has been working on this since 2005, and we’ve been reporting the highlights the past few years. The results are really quite striking, and it’s time for the next installment.

To recap: In a series of experiments utilizing both natural and imposed sources of shading, PM severity on shaded leaves has been anywhere from 8 to 45 (!) times greater than on fully-exposed leaves on the outside of the canopy, whereas disease severity on shaded clusters has been 50 to 100% greater than on those provided “good” sun exposure. It appears that sunlight helps to limit PM development in at least two different ways: (1) Because the PM fungus is unpigmented and lives primarily on the outside of infected tissues, it gets fried by ultraviolet radiation; and (2) at mid-day, sun-exposed leaves and fruit have been anywhere from 2 to 23°F hotter than shaded tissues (depending on water status of the vine, wind speed, and cloudiness at the time of measurement), which are approximately the same temperature as the air. This can be detrimental or even lethal to the PM fungus during the summer. For example, on an 83°F afternoon, shaded tissues are at a temperature that is optimal for disease development, whereas those in the sun are often 95 to 100°F. This not only prevents new disease development but can kill portions of existing PM colonies after just a few hours exposure.

Having established the general principles, this past year “we” (Craig and the faculty who take credit for his work) concentrated on determining the effects of variable canopy densities on disease development. In one experiment, we worked in a local fourth-leaf Chardonnay vineyard where vines had been trained to two different systems: (i) Vertical Shoot Positioning (VSP), or (ii) Umbrella-Kniffen, in which arching of the canes provides more buds per linear foot of row than VSP, with the potential for more internal shading of fruit.

![Figure 1. Powdery mildew severity on Chardonnay clusters subject-ed to five different leaf-removal treatments in each of two vine-training systems. Leaf-removal code: First letter is leaf removal severity, H = heavy, L = light (either two leaves or one leaf above and below each cluster, respectively); Second letter is leaf removal timing, E = early, L = late (2 and 5 wk post-bloom, respectively). Each data bar represents the mean for 30 clusters per treatment.](image)

Five different leaf removal treatments were imposed on selected clusters within each training system: Two weeks after bloom (EARLY), either (a) one (Light) or (b) two (Heavy) leaves were removed both above and below each cluster; also, 5 weeks post-bloom (LATE), either (c) the Light or (d) Heavy leafing treatment was imposed; or (e) no leaves were removed (Control). Vines were treated regularly with Stylet Oil (negligible vapor activity) to control PM on all tissues except the test clusters, which were inoculated at bloom and covered with plastic bags during spray applications.

As shown in Figure 1, disease severity in the VSP system was 26% lower than that in the Umbrella-Kniffen, when averaged across all leafing treatments. And in the VSP system, early leaf removal further reduced disease by...
approximately 20% relative to the unleafed control treatment. Early leaf removal also helped to a lesser degree on the Umbrella-Kniffen vines, whereas late leaf removal provided no benefit in either system. Bottom line: relative to the control clusters on Umbrella-Kniffen vines, disease severity on VSP clusters with early leaf removal was reduced by approximately one-third simply by employing these two cultural practices that increased light exposure.

Figure 2. Powdery mildew severity as a function of Cluster Exposure Layer (the number of shade layers between the cluster and the sun) on panels of Chardonnay vines subjected to three sulfur application regimes: (A) unsprayed; (B) treated biweekly with 2 lbs/A of sulfur; (C) treated biweekly with 8 lb/A of sulfur. Each data point represents average disease severity in one panel of four Chardonnay vines, as determined from 10 clusters within each panel.

The effects of light exposure on PM development in a sprayed vineyard was also investigated in collaboration with Dr. Gary Grove of Washington State University, utilizing a Chardonnay planting at Prosser, WA within which canopy densities were highly variable. Vines rows were selected and designated to receive biweekly sulfur application of either 0, 2, or 8 lb/A. Clusters in individual panels were tagged at the start of the season for disease assessment near harvest, following natural infection.

To quantify canopy structure and density in the individual panels, we collaborated with Dr. Justine Vanden Heuvel at Cornell and her graduate student, Jim Meyers, who have recently expanded the Point Quadrat Analysis (PQA) technique for this purpose. Briefly, the PQA measurements involved probing the entire volume of the canopy every 8 linear inches (approximately 40 measurements per panel) to record the presence of leaves, clusters, or other sunlight obstructions, and summarizing those data as mean values per panel. Such measurements were then compared with the measures of mean disease severity within the same panel.

Among the many metrics provided by this technique is Cluster Exposure Layer (CEL), a measure of the number of shade-producing canopy obstructions (layers) that exist between a cluster and the sun. As shown in Fig. 2, there was a clear, linear relationship between disease severity on clusters and the number of shade layers between them and the outside of the row (light), in all three of the fungicide regimes. Not surprisingly, this was strongest in terms of increased disease severity with incremental increases in shade layers when vines were unsprayed (Fig 2A), and was weakest for vines that received 8 lb/A of sulfur every 2 weeks (Fig 2C). Note the lower levels of disease severity for vines that received sulfur treatments versus those that were unsprayed (shock!). However, also note that whereas sulfur applications controlled the vast majority of PM in their own right, they did not control it completely: incremental increases in light exposure (lower CEL values) continued to provide incremental decreases in average disease severity, even at the high sulfur rate.

For the two sulfur treatments, it is not possible to separate the effects of sunlight exposure per se from the increased fungicide coverage that also may have occurred on clusters with lower CEL values. But the net effect is clear: More exposure = Less disease.

Keep these concepts in mind, in terms of both (i) trying to limit PM by providing “optimal” levels of sun exposure (i.e., as much as the fruit will tolerate without becoming burned) through appropriate pruning and training systems, plus early leaf pulling on varieties where the economics support this practice; and (ii) recognizing that prolonged periods of rainy, cloudy weather are taking away the natural “fungicide” provided by sunlight and may require the spray program to be turned up a notch, especially if temperatures favor the disease.

New research II: What’s a bad PM year?

Cornell graduate student Michelle Moyer, working in the lab of Drs. David Gadoury and Bob Seem, has spent the last couple of years analyzing reams of historical data on
PM disease levels and associated weather conditions, in addition to conducting new biological experiments, to better determine just what makes a “bad” PM year. The goal is to recognize one of these while it is occurring and take action to prevent damage, rather than simply conduct a post-mortem when it’s mercifully over.

Although the study is still ongoing, Michelle is getting some interesting results. Some of these are “obvious” in retrospect (hindsight is 20-20), others not so. A few highlights:

• Severe fruit infection is much more likely if the disease become well established on the foliage pre-bloom, providing abundant new spores to affect the fruit while they’re highly susceptible. This is logical, but she’s demonstrated it quite nicely. Another example of the point made earlier about the importance of maintaining clean foliage into September, in order to limit the load of overwintering spores available to renew the disease cycle in the spring.

• Relatedly, Michelle has also shown an association between severe disease one season and accumulated degree days the previous autumn. Huh? Simple: A long, warm autumn allows late-season infections an opportunity to form mature cleistothecia (i.e., containing viable overwintering spores), whereas leaves will be killed and fewer viable overwintering spores will form in shorter/cooler falls.

• Cold nights (below 40°F) throw PM for a loop. Portions of existing colonies are killed, new infections take longer to form colonies with “secondary” spores that spread the disease, and the colonies that do form are reduced in size (hence, can form fewer new spores). It appears that at least some of this effect is due to the vine’s response to the cold. Thus, cold nights during the period between early shoot growth and bloom have the potential to restrict the ability of the PM fungus to produce new spores capable of infecting the young, highly susceptible berries. Or seen another way, lack of such nights can give the disease a running start relative to a “normal” year. Note that prolonged cloudy conditions that otherwise favor PM also keep us from getting those really chilly spring evenings. For example, there has been only one year since 2000 in which we did not have a single night in Geneva that went below 40°F after the 1- to 2-inch shoot growth stage: 2003, the year from PM hell in upstate NY.

• So, we know that PM is favored by warm temperatures, cloudy weather, and high humidity, but is there an easy way to integrate these factors for measurement purposes? Interestingly, Michelle has found a strong correlation between relative PM severity in any given year and the “pan evaporation” measurements that year (pan evaporation is a figure used by some weather stations that measures, um, the amount of water that evaporates from an exposed pan, and is sometimes used to help schedule irrigations; indeed, it does integrate the three environmental variables mentioned above). Work is continuing to see whether this might be used as a simple “warning tool” in real time, and how. Stay tuned.

The basic two-spray program (pre-bloom, 10-14 days later) will keep the berries clean and appears to be good enough in “average” vineyards in a “typical” year. However, those with double-digit yields might benefit from (and be able

A note to Concord growers: Remember that the value of mid-summer control on Concord is strongly influenced by crop level, and that foliar PM is one more limitation on the vine’s ability to photosynthesize and ripen the crop. When its capacity to do so is not being pushed (plenty of water and sunshine relative to crop size, few other stresses), research has shown that it can tolerate a lot of PM without significant negative consequences. However, this same research has shown that at high cropping levels, good PM control can be necessary to get the fruit to commercial levels of ripeness. Unfortunately, there is no simple formula to tell you how much control is cost effective, and every case is likely to be different, depending on disease pressure, growing conditions, vine vigor, fruit prices, etc.
to afford) one or two more in order to ripen the crop and bring it back strongly next year, depending on the season. We’d like to—but shouldn’t—forget the 2003 season. You need leaves to ripen the fruit, and the more of it you have, and the less sun that there is, the more you’ll need all of those leaves to be healthy and firing on all cylinders. Unfortunately, these low-sunlight years are also the years where PM is the most difficult to control (see above), and failing to do so can lead to disaster. The principles are simple, it’s choosing among a set of less-than-desirable options that isn’t.

**Fungicides**

**Sulfur.** Another summary of the major findings and conclusions from our recent studies on sulfur activities:

- We were unable to demonstrate any negative effects of low temperatures on either the protective or post-infection activities of sulfur. In a number of repeated tests, utilizing the equivalent of either 5 or 10 lb/A (6 or 12 g/L, sprayed to run-off), control was the same at 59°F as it was at 82°F. Workers from Australia have reported very similar results, i.e., they found a slight decrease in activity when a very low rate of 2 g/L [1.7 lb/A] was used at 59°F versus 68 or 86°F, but no difference among temperatures when the rate was increased to the equivalent of 5 lb/A. It appears that the potential detrimental effect of low temperature on sulfur efficacy has been significantly over-emphasized in our region, particularly in light of the fact that the PM fungus itself is not that active at cooler temperatures. Nevertheless, don’t cheat on rate or coverage if using it early, and don’t forget that rain will wash some of it off.

- **Sulfur provides very good protective activity on sprayed tissues, but this is limited by the tendency of shoots to “outgrow” the spray coverage as they expand.** Sulfur can persist on sprayed tissues for quite some time (particularly in the absence of rain), but adequate redistribution to newly-developed, unsprayed foliage is questionable, even via the vapor phase. This may necessitate shorter application intervals during periods of rapid shoot growth.

- **Sulfur provided consistent and extensive control when applied after inoculation with fungal spores, up through the time that young colonies emerged (about 1 week after the start of an infection under summer temperatures, longer under cooler conditions).** This activity was just as strong at 59°F as it was at 82°F. **Post-infection sprays applied to heavily-diseased tissues were much less effective than those applied to incubating or very young colonies.** Sulfur is not the material of choice as an eradicant if you reach the “Omigod!” stage. That would be Stylet Oil or the similar PureSpray Green (or Oxidate, a much more expensive alternative). And remember that once the leaf or berry cells beneath a well-established mildew colony have been sucked dry, nothing’s going to bring them back to life even if the mildew is eradicated. Successful eradication will, however, limit further spread of the disease.

A number of different field and greenhouse trials designed to clarify the effects of rainfall produced occasionally variable, but generally consistent results. To wit:

- **Rainfall of 1 to 2 inches decreases sulfur’s protective activity.**
• This effect is more pronounced with generic “wettable” formulations than with so-called “micronized” formulations (e.g., Microthiol), which have smaller particle sizes. These latter formulations cost more for a reason.

• The negative effects of rainfall can be somewhat compensated for by adding a “spreader-sticker” adjuvant to the spray solution and/or increasing the application rate (from 5 to 10 lb/A in our field experiments, or their equivalents in the greenhouse). Both increased rate and adjuvant do the job, and the effects of the two appear to be additive. See Table 1 below for field data, standardized to reflect % disease control relative to the unsprayed check. Recall that 2005 was very dry during the period of berry susceptibility, hence no benefit of higher rate or surfactant on cluster disease control. And 2007 was dry, period.

“Alternative” materials. As noted many times in previous years, there are numerous “alternative” materials labeled (and not) for PM control. In 2006, we compared seven products currently registered by the EPA and classified as “biostatistics”, on Rosette vines in Geneva under two different scenarios: (a) season long, to determine the extent of their activities without any help; and (b) using Elite and Pristine to provide control into the early post-bloom period, then switching to the alternative products to maintain disease control on the leaves and cluster stems after the berries had become relatively resistant to infection. Generally, sprays were applied at 10-day intervals, and a “commercial standard” rotating Rubigan, Pristine, and Microthiol at 14-day intervals was also used for comparison. The bottom lines were:

• When applied throughout the season at 10-day intervals, none of these products (Elexa, Kaligreen, Nutrol, Oxidate, Prev-Am, Serenade, Sonata) were as effective as the Rubigan/Pristine/Microthiol program at 14-day intervals. However, using Elite/Pristine through 10 days post-bloom followed by the alternatives provided control of berry infections equivalent to the “standard. This is hardly surprising, since we all know that the prebloom through early post-bloom period is when you get (or don’t get) most all of your control of berry infections. But it’s another reminder that this is the time when you want to use the best materials available to you.

• There was a wide range in the efficacy of keeping foliar disease down in the summer. A few materials (Nutrol, Kaligreen, and Prev-Am) were nearly as efficacious as the standard program, which relied on sulfur to finish the season. These may have particular interest for growers who are trying to avoid sulfur in late-season sprays.

• Kaligreen is a potassium bicarbonate product, as are several other similar, labeled products not examined here (e.g., Milstop, Armicarb). Nutrol is monopotassium (or, “dihydrogen potassium”) phosphate. This is the fourth consecutive trial that we ran in which Nutrol and the bicarb products provided almost exactly the same degree of control when used at recommended rates. Prices among these materials used to differ significantly, although I hear that such differences may no longer be so pronounced. In any case, if you’re going to use one of them, look for economy, since their activities are basically the same. Be aware that unlike the bicarbs, which are formulated with a surfactant, you’ll need to add one with Nutrol to get optimal coverage of the entire surface of the leaves and berries. Also, Nutrol is not certified “organic”, if that’s important to you philosophically or commercially.

BLACK ROT (BR) NEWS AND REMINDERS

1. As fruit mature, they become increasingly resistant to infection. Another annual reminder. Remember that under NY conditions, berries are highly susceptible to black rot from cap fall until 3-4 weeks (Concord) or 4-5 weeks (Riesling, Chardonnay) later. Then, they begin to lose susceptibility, finally becoming highly resistant to immune after an additional 2 weeks. Note this means that Conmonds can become infected up to 6 weeks after the last cap has fallen, and V. vinifera varieties up through 7 weeks post-bloom. In the mythical “average” year, most growers won’t need to be too concerned towards the end of these susceptible periods, since the overwintering spore load is long gone by then and the leaves and berries on the vine are presumably clean. However, they sure will need to be concerned if the disease is established in the vineyard (control broke down and there are lots of new spores on the diseased tissues for spread), especially if it’s warm and wet.

Recall that in most vineyards, mummified berries are the main overwintering source of the BR fungus. Unless these are retained in the vine during pruning, spores from those on the ground are typically depleted by a week or two after bloom. (But also remember that they’re liberated from the mummies during rains. If it doesn’t rain from prebloom until 3 or 4 weeks later, as occasionally happens, they’ll just sit tight and finish their coming out into viticultural
society when the rains finally do arrive). So, if the disease has been very well controlled by the time the overwintering spores are depleted, there should be no source for new infections even though fruit may still remain susceptible to infection, and additional sprays are not likely to be necessary. In contrast, if new black rot infections are established (and producing spores right within the clusters), protection will need to continue so long as fruit retain any susceptibility.

As often noted, we’ve regularly obtained excellent control with Nova (or Elite) sprays applied at the start of bloom plus 2 and 4 weeks later. Such a program provides protection throughout the period of peak susceptibility and during most or all of the time remaining before berries become highly resistant. But read the fine print! Growers routinely get away with stopping their sprays before berries are fully resistant when there are few to no new infections and/or the weather is dry, but they routinely get nailed when they quit too early (e.g., 10-14 days post-bloom for common minimal spray programs on juice grapes and other native varieties) when there are active infections capable of spreading the disease and we get the rains to do so. Recognize when you can cut corners and when you can’t.

2. The incubation period for the disease can be very long. Under upstate NY conditions, we’ve found that clusters infected during the first few weeks after bloom show symptoms about 2 weeks later and that all diseased berries are apparent within 21 days after the infection event. (Note that since the fungus is responding to growing degree days rather than the calendar, these periods are probably a bit shorter in significantly warmer climates). However, clusters infected near the end of their susceptible period do not develop symptoms until 3 to 5 weeks after infection. In New York vineyards, black rot that begins to show up in mid- to late August is probably the result of infections that occurred in mid- to late July, depending on the cultivar. This fact should be considered when trying to determine “what went wrong” should such disease occur.

3. The SI [DMI] fungicides are most effective in “reach-back” activity, whereas the strobilurins are most effective in “forward” activity. We’ve been giving you this conclusion the past few years, and will repeat last year’s unveiling of the hard data on which it’s based. They should provide one more reminder of this fact, and of why an SI + mancozeb (or ziram; or strobie, for that matter) combination gives such good BR control (reach-back activity from the SI plus forward protection from the other component).

4. Mummies retained in the canopy provide significantly more pressure for BR development than those dropped to the ground. Mummies in the canopy produce many more spores than those on the ground and continue to produce them throughout the period of berry susceptibility, whereas spores from ground mummies are finished shortly after bloom. Furthermore, spores from mummies in the canopy are much more likely to land on and infect susceptible berries than are those produced from mummies on the ground, since they are released right next to the new clusters. As I’ve often noted, when I go into a vineyard and find a BR “hot spot”, the first thing I do is look for last year’s mummies still hanging in the trellis near the current zone of activity. I almost always find them.

5. Fungicides. Nova and Elite remain the “kings”, in my opinion, although in many of our tests, the strobies have been right up there with them. Of course, the most important time to control black rot (bloom and early postbloom) is also the critical time for controlling PM on the clusters, and diminishing levels of PM control with the SI fungicides make them potentially problematical at this critical

<table>
<thead>
<tr>
<th>Table 2. Protective and post-infection activities of a strobilurin (Abound) and sterol inhibitor (Nova = Rally) fungicide in control of black rot under field conditions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective (days)^a</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>Post-infection (days)^b</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

^a Sprays were applied indicated number of days before infection with black rot spores.
^b Sprays were applied indicated number of days after infection with black rot spores.
^c Percent control relative to the unsprayed check.

Labeled rates of Nova (equivalent to Elite) and Abound (equivalent to the other strobies vs. BR) were applied to Concord vines, in the field, at various times before (protec tant assay) or after (post-infection assay) inoculation with BR spores. (Unsprayed clusters were hammered, with over 80% of the berries rotted). Data are “standardized” to reflect percent disease control relative to the unsprayed check (100% is the ideal).
time in many vineyards. However, if BR is a greater concern than cluster PM (many native and hybrid cultivars, all cultivars in some production regions well to the south of NY), this may not matter so much. All of the strobies appear to be equivalent to one another and provide very good to excellent control, equal to mancozeb and ziram under moderate pressure and superior under very wet conditions, since they’re more rainfast. Of course, this is when superior performance is most important. (FYI, the non-strobie component of Pristine provides virtually no control of black rot). Mancozeb and ziram are old standards and provide very good control under most commercial conditions. Captan, Rubigan/Vintage, and Procure are only fair, and are likely to be inadequate if there’s any pressure. Copper is discussed below. Sulfur is poor.

6. Special considerations for “organic” growers. Black rot is probably the “Achilles heel” for organic grape production in the East. In the only good trial that we’ve run with copper, it provided 40% disease control when applied at 2-week intervals, versus essentially 100% control with Nova. That being said, towards the end of the wet 2006 season I visited an organic grower who had suffered severe losses to BR in several previous wet seasons, anticipating that I’d see more of the same. But I had to search to find a black rot berry. What had he done? Implemented a rigorous program to remove mummies during pruning, and sprayed copper once a week throughout much of the growing season. This was hard on some of the hybrid vines and runs counter to the thinking of many with a “sustainable” orientation (after all, copper is an element and doesn’t break down into anything else, so it stays in the soil forever), but it did control the disease in an organically-acceptable manner.

Unfortunately, we don’t know of any magic bullets for organic producers to spray, although there are several products out there that claim to be. Bryan Hed at Penn State has been looking at a number of possibilities and we’ve followed up with a couple of the most promising, but the typical scenario is that things look good in the greenhouse and fall flat on their face in the field (most likely, they wash off, among other things). Right now, it looks like nothing is as good as copper.

Therefore, although we’d love to have a magic bullet (or even a good slingshot), the simple fact remains that sanitation and cultural practices form the absolutely critical first (and second and third....) line(s) of defense for growers who wish to produce grapes organically. So if this means you, you’ll need to pay strict, bordering on religious, attention to limiting inoculum within the vineyard. Ideally, this would include removing or burying (tillage, mulch) any mummies that you might encounter at the site. At the very least, it is imperative that all mummified clusters be removed from the trellis during pruning. And if you’re able to patrol the vineyard from 2 to 6 weeks after cap fall and prune out any affected clusters before they allow the disease to spread, all the better (spores for disease spread are dispersed by rain primarily within the canopy, so should pose little risk of causing new infections if said clusters are simply dropped to the ground).
DOWNY MILDEW (DM) NEWS AND REMINDERS

In the Finger Lakes region, and much of the East, we’re on something of a roller coaster for DM years: wet and bad in 2004, 2006, and 2008; dry and easy in 2005 and 2007. Let’s hope this pattern continues for one more season. In any case, last year was a vivid reminder of the effort it takes to control this disease when it’s warm and wet for long stretches of time.

Recall that the fungus persists in the soil as resting spores (oospores) that originate within infected leaves. Hence, the more infection last year, the more oospores this year. (Because the oospores can persist for more than 1 year, any vineyard with significant disease in the recent past should probably be considered a “high inoculum” vineyard). And as with PM, high overwintering inoculum levels mean that early sprays are more important than they would be in a vineyard that has remained clean in the past. This is particularly true in years when the weather favors infection during the 2- to 3-week period before bloom, when the first oospores become mature and ready to cause infection. It’s the same old story: A low percentage (the first ones mature) of a few overwintering spores is probably inconsequential, whereas a low percentage of a lot is still a lot.

These first “primary” infections, originating from overwintering spores in the soil, require a minimum rainfall of approximately 0.1 inch (to activate the infective spores and splash them into the canopy or onto nearby sucker growth) and a temperature of 52°F or higher. Of course, heavier rainfall and warmer temperatures will increase the probability and severity of primary infection.

Once primary infections occur, new “secondary” spores (sporangia) form in the white downy growth visible on infected clusters and, particularly, the underside of infected leaves. Several different weather factors must come together for sporangia to form and spread the disease, but this can occur rapidly when they do. Basically, what’s required are warm, humid nights (to form the sporangia) with rain following soon thereafter (to allow germination and infection). Without rain, most of the ungerminated sporangia will die the next day if exposed to bright sunshine; however, they can survive for several days between rainfalls if conditions remain cloudy, which helps to keep the epidemic running.

Spread is most rapid with night and morning temps of 65-77°F, although it can occur down into the 50’s. With an incubation period (generation time) of only 4 to 5 days under ideal conditions, disease levels can increase from negligible to overwhelming in very short order if the weather remains favorable for long stretches of time—repeated humid nights, frequent showers, and extended periods of cloudy weather. See: Summer, 2008.

The erratic development of DM coupled with its explosive and potentially devastating nature make it an ideal candidate for scouting, especially after fruit have become resistant and the consequences of incomplete control are diminished. No need to spray for it when it isn’t there, but you don’t want to let it get rolling if it’s active. Keep an eye on the vineyard to see which of these possibilities is the current reality. For additional guidance, my colleagues, Bob Seem and David Gadoury, have developed a computer model (DMCAST) that integrates a number of weather and crop development factors to advise when infections are likely to occur. This model can be accessed via the NYS IPM Program website (www.nysipm.cornell.edu/newa/).
Fruit susceptibility. Clusters of some varieties—including all V. vinifera cultivars—are highly susceptible to infection as soon as the fungus becomes active during the prebloom period. Recent research indicates that berries become highly resistant to direct infection within 2 weeks after the start of bloom, although losses due to berry stem infections can occur under some (poorly-defined) conditions for at least 2 additional weeks after that.

When berry stem infections occur, the DM organism takes that route into the fruit and causes the aptly-termed “leather berry” symptom (hard and dry berry, no DM spores produced upon it). There was a good bit of this on Niagara vines in western NY last season. Lack of fungicide protection (mid-summer sprays too few or far between for an unusually bad year like this and/or inadequate deposition on the clusters) is a likely cause in many of these cases. This year will almost certainly be different from last, but file the experience in the memory bank. It will happen again, sometime.

For many years, the standard fungicide test protocol on hyper-susceptible Chancellor vines at Geneva has been to start spraying about 2+ weeks prebloom and continue through approximately 4 weeks postbloom. The best materials consistently provide virtually complete control of fruit and cluster stem infections using this schedule, even in bad years and on perhaps the worst possible variety, under abnormally high inoculum pressure. But remember that vines remain vulnerable to defoliation from DM right into the fall if disease-conducive weather persists, even long after the fruit have lost their susceptibility. That’s bad.

Fungicides. Ridomil remains the best downy mildew fungicide ever developed, but cost and lack of activity against other diseases have limited its use. Although it’s highly prone to resistance development, this has never been detected on grapes in the U.S., probably due in large part to its lack of use. But if you get to the point that you’re ready to call in the big guns, this is your cannon. (Remember that the PHI on Ridomil Gold Copper was reduced to 42 days several years ago, versus 66 days for Ridomil Gold MZ).

Abound has provided very good to excellent control every year since we began testing it in 1996, and Pristine has typically been even just a teeny bit better. Note, however, the discussion regarding DM resistance to these materials at the beginning of this tome: use them with caution in regions where resistance has not yet become a problem, and think of use in regions where it has developed as a disease-management form of Russian roulette. Sovran is marginal, it seems to be OK under moderate pressure or on marginally-susceptible cultivars (e.g., Concord), but don’t rely on it in a bad year or site. Flint is poor. Copper, mancozeb, and captan are old standards because they work, but are prone to wash-off under heavy rains and may need to be reapplied more frequently in wet years. Ziram is much better than nothing, but wouldn’t be your first choice if good materials were an option.

Which brings us to the phosphorous acid (also called phosphate and phosphonate) products. We’ve discussed these ad nauseam for the past few years, so will only review the main points this time around. Recall that these are excellent materials for anyone consciously seeking a “least toxic” or “sustainable” approach to growing grapes, due to their low toxicity (4 hr REI, exempt from US-EPA residue tolerances) and minimal environmental impact. They’re also very good for anybody who wants a DM fungicide that’s easy to use, price-competitive, and effective. Although there are occasional reports and testimonials alluding to the ability of these materials to control other grape diseases, I have not found this to be so in several different trials. In general, these are very good and reliable fungicides against a whole slew of downy mildews (and closely related diseases, none of which are important on grapes). However, reports of control of diseases beyond this narrow spectrum on other crops are both legion and erratic. If you’re going after DM and get some activity against another disease, think of it as an unanticipated bonus. But I certainly wouldn’t encourage you to count on it.

Most of you know that products such as ProPhyt and Phostrol are labeled as fungicides for control of DM, whereas there is a number of “nutrient formulations” on

Defoliation prior to harvest caused by downy mildew.
the market that contain phosphonate but are not labeled for DM control. Which means that it’s legal to obtain disease control with these latter products only if you do so unintentionally. Although this may seem somewhat less than fully rational, remember that the law requires any material applied for a pesticidal purpose to be labeled for such, and this generally benefits us all. Even if you disagree with that last statement, just remember that you can still be cited for breaking a law even if you consider it dumb.

Also recall that products claiming to be nutrient formulations must state the amount of P that they contain in terms of phosphoric acid equivalents (this refers to phosphate, the nutrient form of P, which has no effect on DM), even if they contain only phosphorous acid (phosphite or phosphinate, the DM material which, ironically, has little to no nutritive value). Also note that it can be difficult to tell just how much phosphonate is in some of these nutrient solutions, and that the use rate very much matters with these materials when it comes to DM control.

From 2003-05, we ran a series of field experiments designed to determine the so-called “physical modes of action” of phosphonates in control of downy mildew. Most tests were conducted with ProPhyt and/or Phostrol, applied at rates corresponding to the low and/or high rates on their labels. These results and conclusions have been reported in detail in previous years, but let’s review the major points:

- **Phosphonates generally provided good to excellent, albeit limited, protective activity when applied 3 to 8 days before an infection period, depending on the rate used.** Protective activity sometimes declined significantly over time in the older leaves (phosphonates are “shipped” from older leaves to the growing points), particularly at the lower rate. These materials have protective activity, but I wouldn’t consider it their strength. Sometimes you’ll get a week, sometimes you won’t. Rate matters.

- **Phosphonates provided excellent “kick-back” activity against new infections; again, there was some rate effect.** When applied 3 or 4 days after infection, few lesions developed at either rate and spore production was greatly to totally inhibited. When applied 6 days after infection (small lesions just starting to become visible), lesions continued to expand but production of spores was greatly inhibited. Control was better at the higher rate, or when the initial application of the lower rate was repeated 5 days later. If you truly need some significant kick-back activity, don’t go cheap and do keep an eye on things; if it looks like you didn’t get it all the first time, hit it again.

- **Phosphonates did not eradicate well-established infections, but when applied to actively sporulating lesions, they limited further spore production by approximately 80%. Limiting the production of these spores will obviously limit the potential for disease spread.**

Two additional points:

- **In simple “spray and count” trials using 14-day application intervals (too long under high pressure), we’ve seen significantly better control on clusters when post-bloom sprays of materials like ProPhyt and Phostrol were applied at rates in the high versus low end of their label range; similarly, we got relatively poor control when a nutrient solution containing phosphonate was applied at the equivalent of 60% of the low rate of the registered products’ label recommendation. This latter dosage is similar to some that I’ve heard rumored as applied for nutritional purposes in the Finger Lakes region.**

- **CAUTION:** The phosphonate products have become very popular, for the good reasons cited above. But they’re not miracle drugs, and some people like to push them past their limits in terms of both spray intervals and rates. More important, there can be a subconscious tendency to think that these aren’t “real” fungicides, since they’re sometimes sold as activators of plant defense mechanisms (there may be some aspect of truth to this, although the jury’s still out and it’s far from the whole story), not to mention nutritional supplements. However, they are real fungicides when it comes to the group of organisms to which DM belongs, i.e., they’re toxic to these beasties. And just as with other real fungicides, these organisms can develop resistance to the materials if given a chance.

Although sudden and total resistance to the phosphonates (as has happened with the strobies and both PM and DM in certain vineyards) is not likely, experience with these materials on other crops suggests that they can lose some of their effectiveness over time after long and repeated use (similar to what we’ve seen with PM and the DMI fungicides). We have not documented this happening, but have had at least one anecdotal case that raised suspicions. This is not to raise a cry that the sky is falling. However, it is a reminder that these are useful materials, and we need to take the same precautions we would with any other new group of fungicides to make sure that we can keep using them into the future. Don’t burn them out by relying on
them exclusively throughout the summer. Rotate them with something else, like you would any other fungicide with the potential for resistance development.

**BOTRYTIS NEWS AND REMINDERS**

Although there are a number of fungi that can cause bunch rots, Botrytis is still “king” in the cooler or more “moderate” climates of the East. And it had quite a reign last season. So let’s review what makes it tick.

**1. Biology.** The Botrytis fungus thrives in high humidity and still air, hence the utility of cultural practices such as leaf pulling and canopy management to minimize these conditions within the fruit zone. It’s a “weak” pathogen that primarily attacks highly succulent, dead, injured (e.g., grape berry moth, powdery mildew), or senescing (expiring) tissues such as wilting blossom parts and ripening fruit. Although the fungus does not grow well in berries until they start to ripen, it can gain entrance into young fruit through wilting blossom parts, old blossom “trash” sticking to berries, and scars left by the fallen caps. Such infections typically remain latent (dormant) all the way through harvest, but some may become active as the berries as start to ripen, causing them to rot. Should this occur, disease can spread rapidly through the rest of the cluster (or others nearby), reducing both marketable yield and quality. Some recently-determined details re the above:

- Latent infections can be common following a wet bloom period, but the vast majority remain inactive through harvest and never rot the fruit. Factors that cause latent infections to activate (cause disease) are incompletely understood. High humidity and high soil moisture are two environmental factors that promote this process. Note that for the preceding reasons, a wet bloom period (to establish latent infections) followed by a wet mid-summer and pre-harvest period (to activate them and provide conditions for further spread) is a perfect “recipe” for Botrytis. Did somebody say 2008? Berries with high nitrogen levels or subject to various mechanical injuries (nice work by Bryan Hed from Penn State on that last one) also are more prone to becoming diseased via the activation of latent infections.

- Serious Botrytis losses result from disease spread during the post-veraison/pre-harvest period, after berries begin to ripen and become highly susceptible to rot by the fungus. Thus, latent infections established at bloom can be important if only a few of them become active and provide the initial “foot hold” from which subsequent spread can occur during ripening. Because relatively few of these early infections typically do become active and turn into rot, controlling them at bloom provides only modest benefit if the post-veraison season is dry and doesn’t support further disease spread. However, it can be critical in a year with a wet pre-harvest period (especially if the mid-summer was wet as well), which favors both the increased activation of latent infections and their rapid spread. So in one sense, bloom sprays are an insurance policy against the future unknown. And sometimes they pay huge dividends, as we saw last year (data below).

- The pronounced impact that cluster compaction has on Botrytis development appears to be due largely to its effect on berry-to-berry spread. In one experiment with a tight-clustered Pinot Noir clone, a single diseased berry first showing symptoms 2.5 weeks after veraison spread the disease to over 50 (!) berries per cluster by harvest. In contrast, spread was reduced by 90% (!) in the same group of vines where clusters had been loosened by removing some berries by hand. This was possible on a small scale to demonstrate the principle, but unfortunately, there are few practical ways of achieving the same effect on a commercial scale other than through clonal and varietal selection. However, this goal has been and continues to be worked on by a number of investigators, since it represents the “holy grail” for Botrytis management. Note that this single diseased berry per cluster was meant to represent the post-veraison activation of a few latent infections initiated at bloom, and vividly illustrates the particular importance of controlling blossom infections
on tight-clustered cultivars and clones.

- Preharvest disease spread can be increased by increasing the N content of berries (foliar sprays of urea after veraison). This does NOT mean that such treatments should be avoided if one is trying to use them to ameliorate the atypical aging (ATA) phenomenon in white wines. However, it DOES mean that Botrytis management may be more critical if they’re applied, or if N availability is high for any other reason.

- There is no single “correct” timing regimen for fungicide applications in a Botrytis management program. The standard “full” program used in fungicide trials and by some growers of highly susceptible and valuable cultivars consists of four sprays: at bloom, bunch closure, veraison, and 2-3 weeks pre-harvest. We have looked at the relative contributions of the two early sprays, the two late sprays, or all four in most years of the past decade; a summary of these data is presented in Figure 3. Note that in some years, the two early sprays provided better control than the later sprays. In an equivalent number of seasons, the opposite was true. In some years, two early sprays OR two late sprays provided the same control as all four; in a majority of years, applying all four provided the best results.

The relative benefits of early versus late applications, and the total number necessary, will vary among years according to rainfall patterns and, quite likely, differences between cultivars and clones (e.g., cluster tightness). Think in general terms of early sprays as limiting the establishment of primary infections, and later sprays as limiting disease spread. But remember that Botrytis is not a disease that you can just “spray your way out of”. These materials help, but they won’t do the job by themselves in a tough block and tough year if you don’t give them a hand with cultural practices (canopy management, leaf pulling, etc.).

**So what happened in 2008?** In upstate NY, and many other parts of the East, 2008 was a banner year for Botrytis. But perhaps not surprisingly, success levels in managing it were all over the board, even on the same varieties. To try and find out why, Extension educator Hans Walter-Peterson and I interviewed a number of Finger Lakes *V. vinifera* growers last December, to look for clues that separated the good, the bad, and the ugly (we also asked about their vineyards, but that’s another matter). But before completing this story, let’s complete the spray-timing data in Fig. 3, to account for 2008.

Clearly, in this trial, we lost control if we didn’t stop bloom infections from occurring and if we didn’t stop those that did occur from spreading. But we did OK when we threw the kitchen sink at it and provided control both early and late. It was that kind of year.

OK, so what did we find from our grower surveys? No big surprises. Basically, those that had significant problems had omitted the bloom spray or, in one case, relied on an application 7-10 days before the start of bloom to do the trick (another sprayed at bloom but used no Botrytis materials thereafter). Growers that sprayed at bloom/late bloom and 2 or 3 additional times generally had few or no problems, with two exceptions: One had a serious drainage problem in the block where control broke down (it *never* dried out), the other had a new sprayer. Unfortunately, this was not a year to be working those bugs out.

**2a. Fungicides, physical modes of action.** Over the past few years, we’ve been looking at the various “physical modes of action” of the available Botrytis fungicides, to get a better idea of some of their specific characteristics and differences. Following is a repeat of last year’s summary of the major findings and conclusions for this project:
In one set of tests, we examined the ability of the fungicides to protect the internal berry tissue against infection from spores that might be deposited inside them following mechanical damage, such as that from rain cracking, berry moth feeding, etc. Chardonnay clusters were sprayed at pea-sized berries, bunch closure and veraison, then a hypodermic needle was used to inject berries with Botrytis spores 2 weeks after the last spray. Scala, Vangard, and Elevate provided excellent control, and Rovral was close. Pristine (19 oz/A) was comparable in preventing rot, but was less effective in limiting spore production from the limited number of berries that did develop symptoms. Flint and Endura provided the least protection of the internal berry tissues. However, all fungicides completely prevented spread to the neighboring berries when inoculated berries became diseased; in contrast, such spread occurred in two-thirds of the unsprayed clusters.

In another test, Pinot Noir clusters were inoculated with Botrytis spores at late bloom but weren’t sprayed with Botrytis fungicides until veraison. The purpose of this test was to see whether the fungicides could eradicate or suppress latent (dormant) infections long after their initiation, so long as the materials were applied before such infections became active. (Recall that pre-harvest activation of bloom-initiated latent infections is often the kick-start to a Botrytis outbreak). Under the conditions of this test (individual clusters sprayed by hand, complete spray coverage to an extent not likely in commercial production), a single application of Scala or Vangard at veraison provided almost complete control of latent infections established at bloom, 60 days earlier. Elevate and Rovral were almost as good. When additional clusters re-treated a second time, 15 days after veraison, Scala, Vangard, and Elevate provided complete control. Rovral reduced infection by about three-fourths, whereas Flint, Pristine, and Endura provided 55-60% control.

Take home-messages and cautions:

- All of the current “standard” fungicides registered for Botrytis control provided excellent protective activity on the surface of the berries. That’s why they got developed and marketed in the first place.

- The so-called AP fungicides (Vangard and Scala) and Elevate also provided very good protective activity within the berries. This was anticipated for the AP’s, since such fungicides are known to be absorbed by plant tissues, but Elevate has always been sold as a surface protectant. But this appears to have more to do with “market positioning” than science (colleagues in South Africa tell me that they’ve repeated some of these results with Elevate).

- Similarly, the same three materials provided very good curative activity against latent infections initiated at bloom, even when applied 2 months after infection. Nevertheless, as shown in Figures 3 and 4, we often get better control in our field trials when these fungicides are sprayed at bloom and bunch closure in addition to veraison and 2 weeks later. This suggests that the level of curative effect from the later sprays doesn’t replace the need for earlier applications when conditions favor infection at bloom, although it probably contributes to the overall level of control obtained.

2b. Fungicides, Pristine and Flint. For biological reasons, most common fungicides provide relatively little control of Botrytis and, conversely, most good Botrytis fungicides (Rovral, Vangard, Scala, Elevate) provide relatively little control of fungi other than Botrytis (and a few close relatives that affect crops other than grapes). Two striking exceptions to this general rule are Pristine and Flint.
Recall that both components of Pristine provide control of Botrytis, although the non-strobie ingredient is the more active of the two (and, fortunately, reputed to be somewhat less prone than strobies to resistance development). This non-strobie component is not that active against any grape diseases other than Botrytis and PM, but the strobie part picks up the erratic “summer rot” diseases (and helps a bit with “sour rot”) in addition to PM, DM, and BR. This same broad spectrum of activity applies to Flint (minus the DM), which has consistently provided excellent Botrytis control at its higher (3 oz/A) rate in my trials.

**“OTHER” ROTS**

SOUR ROT is a catch-all term often used to describe the “snork” that takes over injured clusters during the pre-harvest period if the weather becomes good and wet. In truth, berries typically are colonized by a mix of various wound-invading fungi and bacteria and give off a strong smell of vinegar, the result of infection by a specific group of bacteria. Ethyl acetate (nail polish remover) is another nasty aroma produced by some of these microorganisms, and can be especially prominent in wines made from such fruit (yuck). Diseased berries drip juice and spores or cells of the sour rot microorganisms onto nearby healthy berries, which in turn become infected through any wounds that might be available. Damage from Botrytis is a particularly common point of entry for these secondary beasties, although rain cracks and bird or insect damage can do the trick as well.

Although it is almost impossible, under wet conditions, to stop sour rot once it has become established, controlling the aforementioned causes of injury will greatly reduce the probability of it getting started in the first place. Excellent control of powdery mildew and, especially, Botrytis are two measures that will significantly minimize sour rot development. And as mentioned above, there is some indication that Pristine and Flint used for Botrytis control may provide *some* additional control of the wound-invading sour rot fungi due to their relative broad activity spectra, although they certainly won’t prevent it. However, any product that gives good Botrytis control will help to limit sour rot.

SUMMER ROTS is a term sometimes used for two similar diseases (ripe rot and bitter rot) common in more southern, humid (and quite warm) production regions, although they occur sporadically to the north. In particular, there were several confirmed outbreaks of bitter rot on Long Island in 2008, and industry members there believe that this was far from the first time, i.e., it was just not diagnosed previously. Those beneath the Mason-Dixon line and in the lower Midwest deal with these diseases on a regular basis; those of us to the north should start being more aware of them, especially in very wet years. It’s not a threat to be over-emphasized in our region, but neither is it one to be flat out ignored.

Bitter rot appears to be the more likely threat in our “marginal” northern areas. In part, this is due to the very high susceptibility of Chardonnay to this disease. Usually, symptoms first occur after veraison, as the bitter rot fungus moves into the berry from the berry stem and turns the diseased portion brown (on white varieties) or a dull purple. Once the berry is completely rotted, it becomes covered with numerous prominent, raised black pustules (the fungal fruiting bodies). You can’t miss ‘em. More details on the appearance of symptoms and how to distinguish them from Phomopsis and BR symptoms can be found in the 2009 Pest Management Guideline (hard copy and on-line).

Ripe rot tends to predominate further south, although it has been documented as far north as New England. Symptoms do not develop until after veraison and become increasingly prevalent by harvest. Infected fruit initially develop circular, reddish brown lesions on their skin, which eventually expand to affect the entire berry. Under humid conditions, small “dots” of slimy, salmon-colored spores may develop across the rotten berry, and serve to spread the disease to healthy fruit if rains continue. Infected fruit shrivel and mummify, and may either remain attached or fall to the ground. No foliar symptoms are produced.

Both diseases are favored by abundant, warm rains (77°F to 86°F is optimum) between fruit set and harvest. Infections occurring before veraison typically remain “dormant” until fruit begin to ripen. Captan and the strobilurin fungicides are particularly useful for control of these diseases in regions where they are common (as is mancozeb, within its PHI restriction), or to the north if the weather is unusually wet and warm. Susceptibility to both diseases increases with fruit maturity, so fruit become especially vulnerable when harvest is delayed.

Cultural practices, such as pruning out dead spurs, removing overwintered mummies, and removing weak or dead cordons, are important to help reduce the inoculum in the vineyard. Both diseases are frequently controlled in the early- to mid-summer by sprays containing mancozeb, captan, or a strobie product targeted against other diseases. However, with the exception of Flint and Pristine,
fungicides used for Botrytis management (Elevate, Scala, Rovral, Vangard) provide little control of bitter rot or ripe rot, and their exclusive use during wet preharvest seasons can lead to outbreaks of these diseases in regions where they are not routine and, therefore, are not consciously managed. Sprays targeted against bitter rot and/or ripe rot may be needed in the late season if the weather is warm and wet, especially if the diseases are observed in the vineyard or have occurred there in the past. In southerly regions where the diseases are consistent problems, it is typically necessary to apply protectant fungicides on a 2-week schedule from bloom until harvest, except during periods of drought. Because fruit are especially vulnerable in their final stages of ripening, pre-harvest sprays can be particularly useful when these diseases are active. This potential utility must be balanced against wine makers’ concerns about the effects of such sprays on fermentation, and of course legal preharvest interval restriction must be followed.

PHOMOPSIS (Ph) NEWS AND REMINDERS

1. Early sprays are the most important for control of rachis infections. Your annual reminder that in multiple spray-timing trials, we’ve found that applications during the early shoot growth period (as clusters first become visible, about 3 inches of shoot growth or so) are the most important for controlling disease on the rachises. Rachis infection by the Phomopsis fungus is among the most common causes, if not *the* most common cause, of disease loss that I see on Concord and Niagara grapes (although DM gave it a run for the money on Niagaras last year). Early sprays also provide the greatest control of shoot infections, which serve as sources of Ph spores in subsequent years if retained as infected canes, spurs, or pruning stubs.

2. They also provide significant control of berry infections. In a trial conducted several years ago in a problem block of Niagaras—the poster child for Ph problems on clusters—we were surprised to find that sprays applied shortly after cluster emergence (the important sprays for controlling rachis infections) also provided nearly 70% control of berry infection. In retrospect, this shouldn’t have been surprising, since it’s common to see rachis infections expand into the berry stem and then into the berry itself, especially on this variety.

In a subsequent trial in a different Niagara vineyard, we documented a loss of over 3 tons/A when early Ph sprays were withheld in 2006 (not an especially wet spring), primarily due to rachis infections and those that progressed into the berries. Most of this loss was prevented with a single mancozeb spray (captan would have been just as good) around the 3-inch growth stage. Although little Ph developed in the dry year of 2007, we again increased yield by over 3 tons/A (that is, avoided 3 t/A of loss) in 2008 by applying just one mancozeb spray around the 3-inch shoot growth stage.

Of course, there was less Ph overall on rachises, shoots, and berries in both 2006 and 2008 when we sprayed against it four times through fruit set, rather than just once. Nevertheless we got most of our economic benefit in both years from that one early spray. Thus, a minimal Ph spray program should include at least one application during the period soon after clusters emerge. Research has repeatedly shown that waiting until the immediate prebloom spray is far too late if there is any significant disease pressure going on (inoculum in the vineyard + rain). Commercial experience last year showed the same thing.

3. Dead wood and canes may be particularly important sources of Ph spores. The Ph fungus is especially prolific in dead tissues, including dead wood. The obvious practical implication of this observation is that removing dead wood during pruning operations is an important component of a Ph management program. This includes not only obvious sources such as dead canes and arms, but also less-obvious ones such as old pruning stubs. The Ph fungus can remain active in such wood for at least several years, so a “dirty” block is going to stay that way until you prune the stuff out.

4. Little fungal inoculum, if any, is available by mid-summer. We monitored the release of Ph spores in several Lake Erie and Finger Lakes sites over 3 consecutive years.
And in each year, we detected few if any infectious spores beyond early- to mid-July, with the vast majority released between bud break and bloom. A similar study conducted by Annemiek Schilder at Michigan State University produced generally similar results. These data suggest that even though berries may remain susceptible throughout the season, as indicated by recent work from Ohio, the risk of infection is probably very low once berries become pea-sized, since inoculum is scarce beyond that time.

5. Fungicides. Mancozeb, captan, and ziram have all provided very good to excellent control of basal shoot and rachis infections in our fungicide trials. Experience with the strobies has been mixed. Fortunately, they’ve looked better against fruit (and maybe rachis) infections than they have against basal shoot infections. We’ve seen no difference between the efficacy of Abound versus Ziram for controlling fruit infections when mancozeb was used prebloom and these materials were compared in subsequent postbloom sprays. In a trial on Niagaras in Fredonia last year, four sprays of Pristine were as effective as four of mancozeb, with some indication that the non-strobie component of the product was making a significant contribution. Sulfur, although touted as a Ph material in California (where it doesn’t rain during most of the growing season) did practically nothing in this same trial.

6. Spray application technique. Many growers like to spray alternate rows in the early season when it’s the critical time for controlling Ph, assuming that sufficient spray will blow through the target row and impact on vines in the “middle” row. For 3 consecutive years, Andrew Landers helped us examine this issue in a commercial Niagara vineyard. Consistently, vines in the middle row received less spray than vines subjected to every-row spraying, and perhaps more importantly, the coverage on them was much more variable. The benefits of alternate-row spraying are obvious and there’s no reason to fix things if they ain’t broke; however, if you’ve had trouble controlling Ph while using alternate-row spraying, the suggested remedy is obvious as well.

WOOD CANKERS

Eutypa dieback has been on the radar of eastern grape growers for many years; in fact, it is standard practice to cut through a piece of cankered trunk or cordon, see a wedge-shaped area of dead tissue, and diagnose it as Eutypa. However, work conducted over the past decade at the University of California, primarily in the lab of Dr. Doug Gubler at UC Davis, has shown that there are a number of different fungi that cause canker diseases in the west, each with its own specific biology and, potentially, appropriate management program. In the east, we (understandably) tend to preoccupy ourselves with the panoply of fruit and foliar diseases found in humid climates, which can destroy a crop in a single season if not adequately controlled.

Nevertheless, we also have canker diseases, and although less flamboyant than our usual rots and mildews, they are slow but surreptitious (silent but deadly, if you prefer) robbers of production and profit. There already are signs that they will become increasingly visible and important as many of our newer and higher-value vineyards continue to age. Thus, it seems time to start paying more attention to these diseases, and a good place to start would be to determine just which organisms are responsible in our region.

We were very fortunate to have Dr. Philippe Rolshausen-a 10-year veteran of Doug Gubler’s lab at UCD, with a wealth of experience in this field--working on the problem at the University of Connecticut over the past 2 growing seasons. During this period, he sampled cankered tissues from multiple eastern vineyards, and determined the identities of the fungi associated with them. Although he has returned to California, Philippe recently began a 3-year cooperative project in which he will determine the relative aggressiveness of the many different fungi he recovered while here, and when they are most likely to invade pruning wounds, working on both Chardonnay vines in Geneva and Concords near Lake Erie.

Philippe’s results to date suggest that canker diseases are a larger problem in the East than is commonly acknowledged. Many of the organisms that he found are well-
known causes of disease in California and Europe (including those responsible for esca and “black goo”). Although management options are limited, at the very least it appears that we need to do a better job of getting dead wood out of the vineyard and putting it to the torch before the fungi within make spores and attack new pruning wounds, thereby spreading the disease.

PUTTING IT ALL TOGETHER

As I preface this section every year, we all know that there are as many good disease control programs as there are good growers and advisors. The following are some considerations among the many possible. As always, just because it isn’t listed here doesn’t mean it’s a bad idea. And remember, don’t make this any harder than you need to.

1-INCH SHOOT GROWTH. A Ph spray may be warranted if wet weather is forecast, particularly if the training system or block history suggests high risk. Option A: Nothing. Option B: Captan or mancozeb (or ziram).

3- to 5-INCH SHOOT GROWTH. A critical time to control Ph rachis infections if it’s raining or likely to be soon, especially in blocks with any history of the disease. Early is better than late if it starts raining. This spray can provide significant benefit against fruit infections as well, since many of them appear to move into the berries from infected rachises and berry stems. Also an important time to control shoot infections, since this is where the fungus will reside in the future if infected tissue is retained in canes, spurs, or pruning stubs. Now is the time to start thinking about control of PM on vinifera varieties if temperatures remain above 50°F for long stretches of the day. This spray is much more likely to be important in vineyards that had significant PM last year than in those that were “clean” into the fall; however, it may be beneficial even in relatively clean blocks of highly susceptible cultivars, particularly in cloudy, wet years when temperatures aren’t limiting. And if you’re already spraying for Ph, why not include something for PM on highly susceptible (and valuable) varieties while you’re at it. In NY, spending extra money for BR control is almost never justified this early unless you’re trying to clean up a severe problem block AND weather is wet and reasonably warm. Still too early for DM. Option A: Nothing. Option B: Mancozeb or ziram (BR, Ph). Option C: Captan (Ph, some BR). Easier on predator mites than mancozeb or ziram, probably good enough against BR this early, but 3-day REI issue. Option D: Sulfur (PM). As discussed above, historical pronouncements concerning reduced activity of sulfur at temps below 65°F appear to have been significantly exaggerated. It should be good enough, and is a cheap insurance option. With thorough coverage, can eradicate incipient infections initiated during the last week or 10 days (depending on temps since then). Option E: Rally [Nova], Elite [or tebuconazole generics], or Mettle [where allowed] (PM, BR). Use 3 oz/A of Rally or Elite for economy with so little foliage now, but remember that coverage becomes even more important when you’re working with lower application rates (the activity of these materials is very rate-dependent, particularly in vineyards with a long history of use, so incomplete coverage with a low rate is unlikely to cut it). Did I already mention coverage problems with alternate row spraying? Option F: Rubigan (PM). Cheaper than Nova and Elite, especially if BR control isn’t an issue, and it usually isn’t at this time. Same issue with the need for superior coverage at low rates. Vintage (the non-stinky version of Rubigan) isn’t labeled for use this early. Option G: JMS Stylet Oil (PM). Should eradicate young infections IF thorough coverage is provided, and can provide limited forward activity (although much of this washes away with less than ½-inch of rain). Can use with mancozeb or ziram, but not with or near captan or sulfur (plant injury). Option H: Nutrol, Armicarb, Oxidée, Kaligreen. (PM). Should eradicate young infections IF thorough coverage is provided, but no forward activity. If choosing this option so early in the year, go with the low end of the label rate and use the cheapest one. Option I: Serenade or Sonata, if you want to experiment with these “biocontrol” products while disease pressure is low. Option J: One of the PM products plus mancozeb, ziram, or captan for Ph.
10-INCH SHOOT GROWTH. We once recommend not waiting any later than this to control BR. Continued experience tells us that this spray can be omitted under most commercial conditions in NY unless BR was a problem last year (inoculum levels are high) and weather is wet and warm. Don’t wait any later than now to control PM on susceptible varieties. On Concord and other “moderately susceptible” cultivars, we generally recommend waiting until immediate prebloom. However, recall that in 2003 (wet, cloudy spring) we started seeing PM on Concords around the 10-in shoot growth stage, and uncontrolled early infections spread to the clusters and really caused havoc.

So get out in the vineyard and see what’s happening. No need to spray before you need to, but if you already see PM, you definitely need to. Now is one of the best times to use an SI [DMI], and a possible time to experiment with “alternative” materials if you’re so inclined. It’s also one of the best times to use an oil or other eradicant material against young “primary” infections that might be getting started, particularly if the PM program up until now has been marginal or absent. DM control should be provided on highly susceptible varieties, especially if disease was prevalent last year and rains of at least 0.1 inches at temps >52°F are anticipated or have occurred recently. Rachis and fruit infections by Ph are still a danger in wet years, particularly in blocks with some history of the disease.

**Option A:** Mancozeb [or ziram] (BR, Ph, DM). A broad spectrum, (formerly?) economical choice for everything except PM; tank mix with a PM material to complete the picture if necessary. Excessive use can lead to mite problems by suppressing their predators. **Option B:** Captan (Ph, DM, some BR). An alternative to mancozeb if you’re trying or are forced to avoid it. The limited BR activity should still be sufficient if the disease was controlled well last year (limited inoculum) and good BR materials will be used in the next three sprays. Toss in something for PM where needed. **Option C:** Sulfur (PM). Historical concern about reduced activity during cool weather is going down as we look at experimental data and temps should going up as we look at the calendar. Post-infection activity may be useful against new “primary” infections before they have a chance to form new spores and spread to developing clusters. **Option D:** Rally [Nova] or Elite [or tebuconazole generics] or Mettle [where allowed] (PM, BR). **Option E:** Rubigan (PM). Limited BR activity usually is not a problem if effective materials are applied in the next three sprays, and is a non-issue if tank-mixing with mancozeb or ziram. Cheaper than Rally and Elite. Bump it up to the 3 fl oz/A rate by now. Still too early to use Vintage due to label oddity. **Option F:** JMS Stylet Oil (PM). If (and only *IF*) coverage is thorough, this spray should eradicate early PM colonies that may have started, should previous PM sprays have been omitted or incompletely applied. But don’t waste your money if you can’t cover thoroughly. Also may help with mites. Recent research indicates some protectant activity as well, although much of that will disappear after a rain. Some other petroleum-based oils such as PureSpray Green should have similar effects, if you can find them, although the botanically-based oils are generally less effective. **Option G:** Quintec (PM). If this will be your Cadillac PM material and you’re trying to limit seasonal applications to two or three (as we recommend), it’s probably more efficient and cost-effective to wait until prebloom, when cluster protection starts to become critical. If you’re planning to use another Cadillac material in 2 or 3 additional sprays, go for it, you ought to get great control. **Option I:** Nutrol, Armicarb, Oxidate, Kaligreen. (PM). Should eradicate young infections IF thorough coverage is
provided, but no forward activity. Option H: Serenade or Sonata, if you want to experiment with “biocontrol” products before entering the critical period for disease control.

IMMEDIATE PREBLOOM TO EARLY BLOOM. A critical time to control PM, BR, DM, and Ph on the fruit! This and the first postbloom spray are the most critical sprays of the season—DON’T CHEAT ON MATERIALS, RATES, SPRAY INTERVALS, OR COVERAGE! Option A: Quintec for PM control, plus mancozeb (for BR, DM, and Ph). Effective and no current resistance concerns, but let’s keep it that way (avoid over-use). Option B: Pristine (PM, DM, BR). The 12.5-oz rate of Pristine will also provide significant protection against Botrytis, I wouldn’t go to the higher “Botrytis” rate (18.5-23 oz/A) this early unless Botrytis pressure was really high and/or I was really worried. On highly susceptible cultivars, where SI resistance is usually an issue to at least some extent and strobil resistance has occurred or is deemed risky, Quintec or Pristine (plus sulfur) would be the materials of choice, unless BR is more of an issue than PM. Do not use Quintec or Pristine more than three times per season (considering the DM resistance potential, I’m more comfortable with a limit of two annual applications for all strobies, including Pristine), nor more than two times in a row. And if you do hit DM resistance to the strobies, you’re less likely to risk fruit loss if you avoid sequential applications altogether (two in a row = 3 to 4 weeks of nothing effective on the clusters, more than enough time for big trouble). As noted above, I’d toss in some sulfur, especially in blocks where PM has already developed strobil resistance, just for additional insurance at this critical time. Option C: Abound or Sovran [plus sulfur, on cultivars where it can be used] (PM, BR, DM). Still an effective option in some vineyards (although only moderate DM activity for Sovran), particularly on native and certain hybrid varieties that have seen limited use over the years; if those are located well away from vinifera or hybrid blocks that have had resistance problems, so much the better (why? the answer is blowin’ in the wind, just like the PM and DM spores from those blocks). Refer to the discussion on strobilin resistance in the “Fungicide Changes and News” section at the beginning of this epistle. Option D: Flint plus sulfur (PM, BR, Botrytis at the 3-oz rate) plus mancozeb, captafol, copper, or phosphonate for DM. Consider substituting Adament for Flint if the price is right, especially if you need superior BR control. Option E: Either Rally [Nova], Elite [or tebuconazole generics], Rubigan [or Vintage], or Mettle [where allowed] (PM, BR ) PLUS mancozeb or captafol (DM, Ph). One of the new DM-specific fungicides could also be used for this purpose, but they’ll probably give more bang for the buck after bloom. Add sulfur on vinifera and PM-susceptible hybrids (unless “sulfur shy”). Rally, Elite, and Mettle are excellent against BR, so might be the best choice if pressure is high and BR control is more important than PM; their postinfection activity against BR can make them especially valuable if significant unprotected infection periods occurred in the last week or 10 days. Rubigan and Vintage are cheaper than Rally and Elite, but don’t provide nearly the same BR control; however, the mancozeb part of the mix should be adequate if postinfection control isn’t required and/or disease pressure is relatively low (little inoculum and/or dry weather the past week or two). If wet, mancozeb (or captafol) should be included for control of Ph fruit infections in blocks where this has been a historical problem (note some processor restrictions and poor BR control with captafol). Option D: Mancozeb + sulfur (PM, BR, Ph, DM). Used to be cheap and effective, particularly if used at shorter spray intervals; still effective. Neither material is as rainfast as the strobies or SI fungicides, so shorter spray intervals can be both necessary and difficult in wet years. Potential mite problems.

BLOOM. Vangard, Scala, Elevate, Flint (3 oz rate), Endura, or Pristine for Botrytis control will probably be beneficial sometime around now on susceptible varieties, particularly in wet years. It’s certainly easier to use or include one of these materials for Botrytis purposes in the “immediate prebloom/early bloom” or “first postbloom” spray, and from what we know of these materials’ activities, they should be effective when applied then, although it’s best to try and avoid timings that are too far before or after significant capfall. One problem with tank-mixing Botrytis-specific materials like the AP’s and Elevate is that you’ll be distributing them throughout the entire canopy, whereas the only place they’re effective is on the clusters. But you don’t need to make a special spray, which would allow you to direct it into the cluster zone. Also, if sulfur was the only PM material in the previous (immediate pre-bloom)
spray, reapply about now on highly susceptible viniferas, especially if it’s been raining since then or will soon.

FIRST POSTBLOOM (10-14 days after immediate pre-bloom/early bloom spray). **Still in the critical period for controlling PM, BR, DM, and Ph on the fruit.** Shorten the spray interval and/or jack up the rate on PM-susceptible varieties if weather is warm and cloudy. Same considerations and options as detailed under IMMEDIATE PREBLOOM. Juice grape growers can substitute Ziram (very good BR and Ph, only fair DM) for mancozeb or captan if necessary, or just go with Abound or Sovran for everything. Captan, mancozeb, or the strobies will protect against bitter rot and ripe rot, where those are concerns.

SECOND POSTBLOOM. **BR** control is still advisable under wet conditions and is strongly recommended if infections are evident on the vine, unless you’re willing to bet that it’s not going to rain within the next few weeks; however, BR sprays can often be skipped from here on out if the vineyard’s clean, especially on native varieties. Fruit are less susceptible to **PM** now, but those of vinifera varieties (and susceptible hybrids?) still need good PM protection, particularly to guard against later bunch rots and colonization by wine-spoilage microorganisms. New foliage remains highly susceptible to PM throughout the season, although Concords can withstand a lot of foliar PM unless the crop is very large and/or ripening conditions are marginal. Try to avoid SI [DMI] and, particularly, strobie fungicides if more than a little PM is easy to see (yes, clouds of spores kicked up by the pickup qualify as “more than a little”). **Ph** danger is basically over unless very wet and a problem block. Clusters are still susceptible to **DM** and should be protected on susceptible varieties if weather is wet, especially if disease already is established (take a look and see). Foliar DM will remain a potential threat and can quickly turn into an epidemic on susceptible cultivars throughout the season, although Concords can withstand a lot of foliar PM during the season, generally not enough for vinifera and susceptible hybrid cultivars.

ADDITIONAL SUMMER SPRAYS. Check the vineyard regularly to see what’s needed, the main issues will be **PM** and **DM** on the foliage (remember, you’d like to keep foliage clean of PM into September). Also **Botrytis** on susceptible cultivars, from veraison through pre-harvest. The “summer rot” diseases (bitter rot, ripe rot) are potential threats in wet years, particularly in blocks or regions where they’ve occurred before.

On vinifera and other cultivars requiring continued **PM** control, use sulfur as an economical choice. However, this can be a problem as you approach veraison, as some wineries are setting fairly long withholding intervals. SIs also are options, but only if they’ve been used minimally earlier in the season (try to stick to a maximum of 3 applications per year) AND little disease is evident. So is an occasional application of Quintec or Pristine (or another strobie +
sulfur), not exceeding the recommended maximum number of sprays for each. All of these materials provide the advantage of longer residual activity than sulfur (especially Quintec or Pristine), particularly in wet weather, but limiting seasonal use for resistance management is important. Not to mention wallet management. (BTW, since Quintec has no activity against fungi other than powdery mildews, residues should have no effect on yeasts doing the fermentation). Copper + lime can be used on Concords, but mid-summer sprays for PM on this variety are probably worth the expense only under high crop and/or poor ripening conditions. Alternative materials such as Nutrol, Kaligreen, Armicarb, Oxidate, Serenade, and Sonata can have their place during this period, especially if you’re trying to avoid sulfur later on, although they generally need to be sprayed more frequently and most of them are not cheap. The well-documented ability of oils to decrease photosynthesis and consequently decrease Brix accumulation makes me hesitant to recommend these products once the crop nears veraison, although a single application should be OK. For DM, phosphonate products have become economical and effective standards, but don’t forget to rotate them with something else if you want to make sure they last; copper + lime and captan are tried and true options as well. Ridomil can be used in case of extreme pressure or emergency, remember that the PHI has been reduced to 42 days for the Ridomil Gold Copper formulation versus 66-days for the MZ formulation. And there are the three new DM-specific materials (Tanos, Revus, and Presidio, the last of which is not yet registered in NY; refer to earlier discussion concerning specifics). Pristine and Abound have provided excellent activity in the past when they still fit into the program this late, but avoid using them if you’ve already sprayed a strobie product twice or have reason to suspect that resistance may be developing (or, if using Pristine for late-season Botrytis control, include something else for DM if you need to control this disease and have doubts about its efficacy).

Summer rots are controlled with mancozeb, captan, and strobies; the peak period of susceptibility appears to be near veraison. Strongly consider an “insurance” application against Botrytis soon after veraison (depending on the weather), then determine the need for a subsequent pre-harvest spray based on weather and the need to limit spread of the disease, should it be revealed by scouting. BR should not be an issue after the second postbloom spray, except in very unusual circumstances (disease is established in the clusters of vinifera varieties, wet weather is forecast, and it’s possible to direct sprays onto the clusters). Ph should not be an issue.
UPCOMING EVENTS

Hybrid Canopy Management
Tuesday, May 12  3:00 - 5:00 PM
West Lake Fire Hall
5214 West Lake Rd. (Route 14)  Geneva, NY
Update on canopy management research for hybrid varieties, including discussion of production costs and tasting of experimental wines.

Effective Spraying of Vineyards
Thursday, May 14   9:00 - 4:00 PM
Branchport Fire Hall
Cost: $10
Dr. Andrew Landers will present this highly informative one-day course on improving sprayer performance, deposition, drift reduction and more. NY Pesticide recertification credits available. Limited to 20 people. Please register with Linda Davis at leb15@cornell.edu or 315-536-5134.

Finger Lakes Spring Grape IPM Meeting
Tuesday, May 19    3:30 - 6:00 PM, with dinner following
Doyle Vineyard Management Farm
1255 Ridge Road, Penn Yan NY
Agenda for this year’s meeting can be found at the Finger Lakes Grape Program’s website. Please register with Linda Davis at leb15@cornell.edu or 315-536-5134.

Cornell Cooperative Extension
Finger Lakes Grape Program
417 Liberty Street
Penn Yan, NY 14527

Helping You Put Knowledge to Work
Cornell Cooperative Extension provides equal program and employment opportunities. NYS College of Agriculture and Life Sciences, NYS College of Human Ecology, and NYS College of Veterinary Medicine at Cornell University, Cooperative Extension associations, county governing bodies, and U.S. Department of Agriculture, cooperating.