GRAPE DISEASE CONTROL, 2005

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Time for the annual review of new developments and various options on the disease-control front. (For those interested in a similar review oriented almost exclusively towards native varieties, see the newsletter distributed by the Lake Erie Regional Grape Program). As always, I'd like to acknowledge the outstanding team of grape pathologists here in Geneva, including faculty colleagues (David Gadoury, Bob Seem); research technicians (Duane Riegel, Judy Burr); and graduate students and post-docs becoming too numerous to mention. Rick Dunst and the crew at the Vineyard Lab in Fredonia also play a very significant role on projects related to native varieties. It is the combined research efforts of all of these people that serve as the bases for most of the following.

FUNGICIDE CHANGES & NEWS

1. **New products.** (a) Pristine was registered by the US-EPA in late 2003. Approval of this label by the NYS DEC is still pending, although a decision on the application for NY registration is expected by late April. However, even in states where Pristine was registered, very little was available for sale during 2004 and few growers had a chance to become familiar with it. That situation should change this year as well.

As a reminder, Pristine is a combination of two unrelated fungicides: a strobilurin (pyraclostrobin) and a second compound (boscalid) representing a new class of chemistry on grapes. Both compounds have excellent activity against powdery mildew (PM), and they are packaged together to guard against the development of resistance to one or the other. This concept first proved its benefit in a trial that we conducted in a Finger Lakes Chardonnay vineyard in 2002, where resistance to the strobies developed suddenly and without warning. Severe PM developed in all plots where any strobilurin (including pyraclostrobin) was used by itself, yet control was excellent with Pristine, because the boscalid component was still very active. These results were repeated the following two years as well.

Boscalid itself is at risk for resistance development, and it will not get any help from the pyraclostrobin component of Pristine in vineyards where the strobies are no longer effective against PM. This is definitely an issue for a number of growers in the Finger Lakes and Long Island who have had problems with the strobies, and who don't want a repeat of this experience with another material. If these folks want to use it, I'd recommend a maximum of two sprays per year, and toss in some sulfur, "just in case". However, in vineyards where strobie resistance has not yet hit, use of the combination product should help to prolong the useful life of both components. Even in these vineyards, I would still limit use to a maximum of three applications per year. Cost is likely to discourage excessive use as well.

Pristine also provides outstanding control of downy mildew (DM). It has consistently been the top performer in our trials (which have not included Ridomil, perhaps the best DM fungicide ever developed). However, boscalid has no activity against DM, so all of the work against this disease is being done by the pyraclostrobin

component of the product. Which means that the combination product guards against PM resistance, but not against DM resistance.

With respect to additional major diseases, Pristine provides very good control of black rot, equivalent to the other strobies (only the pyraclostrobin component of the product is active) and good to very good control of Botrytis (both components are active). A higher rate is needed for Botrytis (12.5 oz/A) than for the other diseases (8 to 10.5 oz/A). And finally, it should be noted that Pristine causes injury to Concord foliage, so it is not labeled for use on this cultivar, nor on Niagaras. In a test that we conducted last year on 18 different native and hybrid cultivars (including Niagara), we did not get injury on any cultivar except Concord.

Because of its wide spectrum of activity, applications between the start of bloom and bunch closure will usually give the most bang for the buck, with the immediate prebloom and first postbloom sprays remaining the most critical for the whole spectrum of diseases. Another possible timing would be at veraison, to take advantage of the relatively long period of residual activity that Pristine provides against the two mildews, along with its Botrytis activity. The product has a 24-hr re-entry interval and a 14-day PHI.

(b) The boscalid component of Pristine is sold separately as the product, Endura, for control of Botrytis and PM. A significantly higher rate (8 oz/A) is required for Botrytis than for PM (4.5 oz/A). In limited testing, this higher rate of Endura has been no better than the "Botrytis" rate of Pristine, and the latter material also provides excellent control of DM and black rot, which Endura does not. However, Endura can be used to control PM on varieties such as Concord, where Pristine cannot. As with Pristine, this product was registered by the EPA prior to the 2004 season, and a decision on the application for NY registration is expected by the end of April.

(c) Scala is a newly-registered (even in NY!) product for Botrytis control. This material has been available internationally for some years, but is just now hitting the U.S. It is in the same chemical family as Vangard (the anilinopyrimidines, or "AP's") and appears to provide comparable activity, although our experience with it is limited. It has a 24-hr re-entry interval (versus 12 hr for Vangard) and a 7-day PHI (same as Vangard). It is labeled for use alone at 18 fl oz/A or at 9 fl oz/A in tank-mix combination with another material active against Botrytis. (Note that the Vangard label similarly differentiates rates based on use alone versus tank mix). In general, I don't like these low-rate combinations with Botrytis-specific materials, since two half rates can be less effective than one whole rate under some conditions. And from a resistance-management viewpoint, you're better off applying say, one spray of an AP plus one of Elevate at full rates rather than two sprays of each at half rate in tank mix. That being said, in cases where you're applying another material primarily for control of other diseases but which still provides significant suppression of Botrytis (e.g., many of the strobies at "standard" rates), adding an AP at its lower rate can provide an important boost at a relatively modest cost.

From a resistance-management perspective, Vangard and Scala should be considered as the same thing, so do NOT "rotate" between the two. The AP fungicides

are at risk for resistance development, and should not be used more than twice per year in total. They need to be rotated with other, unrelated Botrytis products within and between seasons.

I have heard that at full rates (10 and 18 oz/A for Vangard and Scala, respectively), Scala will be the significantly less expensive of the two. In our *one* trial where the two were compared head to head at these rates, they performed equally well. Different individuals will probably give different weighting factors to this cost versus experience trade-off.

(d) Sonata is a new "biofungicide" (a fermentation product of a natural bacterium) developed by the same company that produces Serenade. It is reported to have more activity than Serenade versus downy mildew, but the jury's still out.

(e) PureSpray Green. This is a new, organically-approved formulation of a spray oil for PM control from Petro-Canada, with properties and efficacy very similar to that of JMS Stylet Oil (which also has an "organic" formulation).

2. Ridomil Gold Copper PHI. The pre-harvest interval for Ridomil Gold Copper has been reduced to 42 days (it was 66 days). Although not heavily used in grape production, Ridomil is an outstanding downy mildew fungicide, and is the biggest of the big guns against this disease. This labeling change will allow use into late August or even early September on some vinifera varieties in NY, during a time when DM is often quite active. Until new labels are printed, growers must have a supplemental label on hand to apply "old" product within the new PHI restrictions (supplemental labels are obtainable from chemical retailers). Note that the PHI for Ridomil Gold MZ will remain at 66 days, due to the mancozeb component of this mix.

3. Quintec registered in NY. The federal label for Quintec, the new PM fungicide, has now been approved in New York. Recall that NY growers were allowed to use this product during 2004 according to a special state label that differed from the federal label, and which expired at the end of last year. For those who haven't heard, this means that any such product with the special (expired) NY label must be returned and exchanged for new containers bearing the current federal label. Like it or not, it's illegal to keep product in the old containers, and you can be cited for it.

Recall also that Quintec controls PM only, it has absolutely no effect on any other disease. It is strictly a protective fungicide, with no post-infection activity. It represents a completely new class of chemistry, so it is effective against strains of the PM fungus that are resistant to SI or strobie fungicides. It also makes a good rotational partner with these materials as part of a resistance-management program. Although the new label allows a large number of applications at a fairly broad range of rates and spray intervals, I feel most comfortable with the use directions that we helped put on the "special" NY label last year: 3 to 4 fl oz per acre at 14-day intervals, with a maximum of three applications per season. It seemed to do a very good job under these conditions in 2004.

4. Strobilurin resistance. No new developments on this front, but several questions keep coming up that I'll try to address.

(i) We do not know how widespread that PM resistance to the strobies is. In NY *V. vinifera* vineyards with a regular history of use (more than 15 or 20 applications in total over the years), it would be prudent to consider the risk as high. I don't want to "cry wolf" and discourage people from using something that works well, but the fact is that when problems have developed, they've been sudden and without warning, sometimes leading to complete crop loss. If you're going to use these products on *vinifera* vines, tank mix with sulfur or use Pristine (the combination product that includes boscalid), so that you have a safety chain to keep the trailer attached to your vehicle (maintain disease control) if it suddenly comes unhitched (resistance develops).

Native varieties are a different story, since they've generally seen considerably less use and a sudden outbreak of resistance is likely to be less devastating. We've seen no strong indication of resistance on natives yet, and would like to keep it that way. Abound is a great choice to control PM, DM, black rot, and Phomopsis fruit rot immediately after bloom, when many growers are prohibited by their processors from using mancozeb or captan. Sovran is at least as good on PM and BR, but weaker on DM, although that often is not too big an issue on Concords. And of course, this would be the material of choice if your farm is in Erie County, PA or right next to an apple orchard. I'd be looking to save these products for a single annual application during the immediate postbloom period, possibly two in the very occasional extremely high-pressure year. I hope that they will continue to last for a good long while if used in this manner.

As usual, hybrids occupy a large middle ground, which side of the exact middle depending on the cultivar. We've heard reports of failures on Rougeon (very susceptible to PM, can't use sulfur), and I had a failure in my test block of Rosettes last season. As with *viniferas*, those using the strobies on susceptible hybrids should tank-mix with sulfur or choose Pristine if and when it becomes available.

(ii) Our field tests have shown that if resistance to one strobie develops, none of them will work afterwards. And unlike the SI materials, we CANNOT compensate for resistance when we first detect it by increasing the rate of the material or switching to one with greater activity against PM (e.g., Flint rather than Abound). Unfortunately, once they're done, they're done. I wish it weren't so, but I say that about a lot of issues, and it doesn't change anything.

(iii) We have seen no evidence of DM resistance to the strobies as of yet (the inherent poor and moderate activities of Flint and Sovran, respectively, have nothing to do with resistance). However, it has become a serious issue recently in the DM regions of Europe. And remember that Abound was first registered in mid-1997, but that 1998, '99, 2001, and '02 were all relatively dry. The weather in these years was favorable for PM, and continued sprays and pathogen reproduction provided enough selection pressure so that PM resistance developed in some vineyards by 2002. However, there was little DM development, hence little pressure for selecting resistance to the strobies, in 4 out the first 5 full years of registration. Obviously, the weather the past 2 years has favored

reproduction of the pathogen, but strobie use has declined. All of this is to say that DM resistance to the strobies hasn't occurred here largely because we haven't had the right conditions for it. However, it is likely to occur eventually if we provide them. Restrict the number of annual applications and rotate with other materials. And remember that the boscalid component of Pristine has no activity against DM, so it will not help with resistance management for this disease.

5. Phosphorous acid products. By now, most grape growers and advisors in the eastern half of the country are aware of the phosphorous acid products (also called phosphites and phosphonates) and their utility for control of downy mildew (DM). These materials have received a real "baptism of fire" over the past two seasons, and have generally performed very well under commercial use conditions throughout a number of different regions. Nevertheless, our experience with them remains somewhat limited, and we will undoubtedly become more familiar with certain details of their activities as time goes on.

For those of you who may have missed it the last few times around (or forgotten), a brief reminder about terminology and products. (Everybody else can skip this bit if they've heard it often enough). Remember that phosphorous acid controls DM but doesn't provide P in a form that can be utilized by the plant (although most grapes don't need extra P, anyway). Of course, this doesn't stop some foliar feed products from including and marketing phosphorous acid to "promote plant health". The fact that they promote health by controlling downy mildew, without actually claiming to do so, is one of those gray areas of the law. There also are claims that phosphites "promote the natural defense system" of treated plants, for which there is at least some ambiguous, if not controversial, evidence. Nevertheless, phosphites appear to provide most, if not all, of their activity through direct toxicity to a small group of related fungi, the only important one of which on grapes is the DM organism.

In contrast, the phosphoric acid (phosphate) found in traditional fertilizers provides P in a form that is utilizable by plants, but doesn't control DM. Unfortunately, products claiming to be nutrient solutions must state the amount of P that they contain in terms of phosphoric acid equivalents (phosphate, the nutrient), even if they contain only phosphorous acid (phosphite, the DM material). Also note that it can be difficult to tell just how much phosphite is in some of these nutrient solutions, and that the rate matters for DM control. Sound confusing? It is. Products like ProPhyt and Phostrol are labeled for DM control, their manufacturers stand behind their labeled use, and there's no legal ambiguity involved. But I must admit, I have seen a number of awfully healthy vineyards treated with some of these phosphite nutrient solutions, as well.

Recall that phosphites are readily absorbed by the leaves (and fruit?), and they are highly mobile within the plant, accumulating in roots, shoot tips, and (possibly) fruit. This means that they have some post-infection activity, since they work from inside the plant, but their residual activity (protectant mode) is at least suspect, since they don't stick around in many places for too long. To get an idea of what these concepts really mean, we've conducted several different field tests over the past two seasons, examining control of fruit infections when labeled products were applied at recommended rates on a

regular 14-day schedule, and looking at control of foliar disease when applied at various times before and after an induced infection period.

When used at a rate corresponding to 2.5 pt of ProPhyt or Phostrol per acre during the mid-summer, we've gotten virtually complete control of foliar infections in all tests if applied 3 days before infection. In two trials during 2004, we got only slightly less control (91 to 99% relative to the unsprayed vines, depending on specifics) when applied 4 to 8 days before infection, but saw some breakdown on older (and, fortunately, less susceptible) leaves in a 7-day protective assay in a 2003 trial. However, even when leaf infections did occur, very few new spores were formed from the resulting lesions. For context, note that spore production from unsprayed vines averaged over one million per leaf after a single overnight dew period, demonstrating why DM can spread so explosively in a wet season. Thus, even when some leaf lesions form following protective sprays, their capacity to spread the disease is severely restricted. (Note that Ridomil and effective strobie fungicides also reduce spore production from developing lesions, whereas protective fungicides like mancozeb and captan, which are confined to the outer leaf surface, do not).

In 2003, we got excellent post-infection activity when a phosphite was applied 3 days after infection. In 2004, we extended the duration of the post-infection timing, and also looked at the effect of rate and a second "booster" application made 5 days after the first. The results from two tests are presented below. In the first note that (i) Control of leaf lesions (percent area infected) was much better when the spray was applied 4 days after infection rather than 6 days after, particularly at the lower rate; (ii) Even when leaf lesions occurred, spore production was almost completely stopped in five of the six treatments and was reduced by 86% in the remaining one; and (iii) When applied 6 days after infection (leaf lesions just starting to become easy to see), activity was increased by both raising the rate and making a second "booster" application. Results from the second trial, utilizing only one rate and timing, were consistent with those of the first. And in two trials conducted in 2003, we found that a single spray (2.5 pt/A) applied to well-established infections did not eradicate them, but did reduce spore production by approximately 80% relative to unsprayed vines.

Table 1. Percent control (100 = perfect) of diseased leaf area and new spore production with post-infection applications of a phosphite (Phostrol)

Rate (pt/A)[1]	Timing (days post-infection)	Area infected[2]	Spore production[2]
	TEST #1 (cv. Delaware)		
2.5	4	90	100
	6	27	86
	6 + 11	46	98
5.0	4	80	99
	6	59	98
	6 + 11	72	98
	TEST # 2 (cv. Chardonnay)		
2.5	5	84	92

[1] Corresponding to 0.3 and 0.6% solutions, applied to runoff
[2] Values represent the % reduction in disease and spore production compared to the unsprayed treatment.

In tests for control of cluster infections, where these materials have been applied at regular 14-day intervals to Chancellor vines (absurdly susceptible clusters), they have been roughly equivalent to mancozeb products but not as effective as Abound or Pristine (specific data are provided in the DM section later on). We know that 14-day intervals are too long with mancozeb under the extremely rainy conditions of the last two seasons, and this apparently is true for phosphites as well. And note that control of cluster infections has been better when the rate has been increased after bloom, which is when most phosphite usage occurs.

Phosphites are not silver bullets, and they do have their limitations. There have been several reports of occasional leaf burning, generally not severe, but definitely noticeable. The reasons for this happening are still not clear, but are under investigation. Although sudden and total resistance to these materials is not likely, experience on other crops suggests that they can lose some of their effectiveness over time if relied upon exclusively for DM control. So, use them in rotation with other materials, and expect good performance but not miracles.

6. Sulfur. Sulfur has always been popular with *vinifera* growers and on hybrid and native cultivars where it can be used. However, problems with resistance to newer modern fungicides has increased its importance over the past few years, prompting us to take a much closer look at its activities. Following are a few highlights from a series of experiments conducted last year. Some of them confirm what "everybody knows", some challenge conventional wisdom.

(i) Rain does indeed wash it off. In controlled experiments, 1 inch of artificial rain had a modest effect, but 2 inches significantly decreased its activity. The additional loss of activity that occurred when rain volume was increased from 1 to 2 inches was avoided by either increasing the rate of product (10 versus 5 lb/A of Microthiol) or adding a "sticker" surfactant to the 5 lb rate. In a field trial during the very wet 2004 season, activity was similarly increased by increasing the rate from 5 to 10 lb/A, or by adding a sticker surfactant. Note that labels for some sulfur products allow a 10 lb/A rate whereas this exceeds the maximum on others.

(ii) Vines can outgrow their coverage. When we inoculated clean plants in a greenhouse at intervals of 3 to 14 days after spraying them, control on the youngest leaves fell off precipitously the longer we waited after spraying (i.e., in relation to the number of new leaves that developed after the spray was applied). Under these conditions, the vapor activity from sprayed leaves was not sufficient to protect the unsprayed ones when they were inoculated.

(iii) Sulfur has significant post-infection activity. In repeated tests, sprays providing the equivalent of 5 lb/A and applied 1, 3 and 7 days after inoculation gave nearly complete control of the disease (for reference, the first signs of disease were visible on day 6 or 7). Applications made 10 days after inoculation reduced foliar disease

severity by 55% and spore production from these leaves by 85%. Experience also suggests that sulfur is not a good eradicant of well-established infections, but that it does have some effect against them. And the pronounced post-infection activity against incipient infections not only helps to clarify how this material works in the field, but may be useful to some who spray in response to previous weather events (the basis of the UC Davis risk assessment model, which is not well adapted to the Northeast).

(iv) Temperatures below 65°F may not be as detrimental to activity as "the book" says. This is an important challenge to conventional wisdom with serious practical implications, especially in regions with relatively cool spring temperatures. Therefore, we need considerably more solid evidence before our current "indications" become conclusions. Nevertheless, it's worth noting that the PM fungus is unquestionably much less active at cooler temps, and that a number of growers have historically utilized sulfur effectively during the spring (while also recognizing that some haven't).

POWDERY MILDEW (PM) NEWS AND REMINDERS

A 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. Spores produced within these cleistothecia are discharged between bud break and bloom (more or less) to initiate the disease, after which it can spread rapidly from the millions of new spores produced from these resulting "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. <u>An important consequence of this is that PM sprays during the first few weeks after bud break are likely to be far more important in blocks where PM was a problem last year, compared to blocks that remained relatively clean into September.</u>

Let's look at why this is so. In 2002-03 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 spores are discharged during the first couple of weeks after bud break (a reasonable approximation). But 20% of what? In the clean treatment (a), this number might be relatively inconsequential, whereas 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 the seasonal supply on the clean vines. This is important. When we intentionally withheld a modest spray program on these same vines until the immediate prebloom period in 2003, resulting cluster disease severities (% area infected) were (a) 11%, (b) 22%, and (c) 48%, even though all were sprayed the same. Conclusion: Higher disease in 2002 = More primary infections during the Spring of 2003 = More new ("secondary") spores by the time that fruit were susceptible to infection = Fungicide sprays applied to the clusters were overwhelmed by these extraordinary levels of new spores.

Also note that because cleistothecia need at least a month to develop from a new PM colony after it first appears in the early autumn (development is faster at higher temperatures in the summer), very late infections should have little effect on overwintering inoculum levels.

(ii) Powdery mildew functions as a “compound interest” type of disease, that is, a few infections can “snowball” and build up to many in a short period of time if conditions are favorable for reproduction of the fungus. The most important factor that governs the rate of reproduction is temperature, with a new generation produced every 5 to 7 days at constant temps between the mid-60's and mid-80's (more details are provided in the published Pest Management "Guidelines" and in an on-line fact sheet). Thus, days in the 80's and nights in the upper 60's and 70's during the bloom and early postbloom period provide ideal conditions for the fungus 24 hr a day, just when fruit are extremely susceptible to infection. This is exactly what happened in the Finger Lakes in 2002 and 2003, and the resulting disease pressure took its toll. Spray programs may need to be intensified with respect to materials, rates, and intervals in years when this happens. Interestingly, the bloom and early postbloom period was considerably cooler in 2004, and PM severity was noticeably moderated throughout the region compared to the previous two years (changes in spray programs probably had a significant effect as well). This is not meant as a suggestion to "ease up" in years when it is cool during this time, but as a reminder for the need to intensify efforts in particularly warm years.

(iii) Although not as important a factor as temperature, high humidity also increases disease severity. The optimum relative humidity is about 85%, although the disease functions to some extent over the entire range of humidities that we experience. Nevertheless, vineyard sites (and canopies) subject to poor air circulation and higher humidities are at higher risk for PM development.

(iv) Because the PM fungus lives almost entirely on the surface of infected tissues, and because it has no pigmentation (no "tan"), significant direct sunlight can be harmful. Conversely, significant shading seems to greatly promote disease development. There are few hard data on this factor, but plenty of consistent observations, e.g., PM is almost always worse next to tree lines or in other shaded parts of the vineyard. Yet another good reason for canopy management techniques that provide good light exposure.

(v) Berries are extremely susceptible from the start of bloom through fruit set, then become highly resistant to immune about 2 weeks (Concord) to 4 weeks (*V. vinifera*) later. This is your annual reminder.

(vi) Failure to control inconspicuous PM infections on the berries can increase the severity of berry rots (Botrytis and sour rot) at harvest, and can promote the growth of spoilage organisms such as *Brettanomyces* on the fruit. Another annual reminder. Remember that these so-called “diffuse” infections occur on unprotected berries just as they’re becoming highly resistant (about the time of bunch closure for *V. vinifera* varieties). They certainly aren’t the only cause of berry rots and wine spoilage, but they

represent one of the easiest to avoid. This is just one more reason to strive for excellent PM control during the first month after bloom.

BLACK ROT (BR) NEWS AND REMINDERS

1. As fruit mature, they become increasingly resistant to infection. Another annual reminder. Remember that berries are highly susceptible to black rot from cap fall until 3-4 weeks (Concord) or 4-5 weeks (Riesling, Chardonnay) later, then become highly resistant to immune after 2 additional weeks. Berries acquire resistance more quickly in warm summers relative to cool ones, hence the range given above. As often noted, we've regularly obtained excellent control with Nova sprays applied at the start of bloom plus 2 and 4 weeks later, which provide protection throughout the period of peak susceptibility and during most or all of the time remaining before they become highly resistant. Some growers get good control with just two of these sprays. Some try spraying only twice and end up with the disease. Note that in a test conducted on Concords during last year's wet conditions at the Vineyard Lab in Fredonia (Lake Erie), 22% of the berries on unsprayed vines had black rot; 7% of the berries had black rot when vines received just one mancozeb spray immediately before the start of bloom; and 0.1% of the berries had black rot when vines received this mancozeb spray plus one of Abound 14 days later. But remember that Concord loses susceptibility about 2 weeks earlier than *vinifera.*

Obviously, inoculum availability and weather have a lot to do with how soon you need to start spraying and when you can stop. Minimal programs like those described above have consistently worked well in NY vineyards with good (or even moderately good) control the previous year, but are likely to fail in vineyards where BR was a serious problem. BR likes it warm, and growers from more southern states have told me that minimal programs "would never work here". However, Mike Ellis at Ohio State has consistently gotten excellent control with the three-spray program (Nova or Elite at the start of bloom plus 2 and 4 weeks later) in Wooster, OH. Somebody will need to do the tests to see what will and won't work to the south of there.

Finally, recall that mummified berries are the main overwintering source of the BR fungus. Unless these are retained in the vine during pruning, spores from them are depleted within a couple of weeks after bloom. So, if the disease has been controlled by the time the overwintering spores run out, there should be no source for new infections and additional sprays won't be necessary; in contrast, if new black rot infections are established, protection will need to continue so long as fruit remain susceptible.

2. The incubation period for the disease can be very long. Under Geneva conditions, we've found that clusters infected during the first few weeks after bloom show symptoms about 13-15 days later and that disease progress is typically completed within 21 days after the infection event (since the fungus is responding to growing degree days rather than the calendar, these periods may be 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 fungicides are most effective in "reach-back" activity, whereas the strobilurins are most effective in "forward" activity. One more reminder of this fact. In 3 years of repeated field experiments, we have inoculated young berries at various intervals both before and after sprays with Nova or Abound. Nova showed greater activity when applied after the infection period, whereas Abound was the opposite. These general trends aren't surprising, but they're worth considering in certain circumstances. For instance, if the first BR spray of the season is applied after a number of potential infection periods, Nova or Elite may be the best choice if this disease is of significant concern. Conversely, the superior residual activity of the strobilurins may make them more attractive as the final BR spray of the program. No need to get too fancy here, other diseases also need controlled along with BR, but understanding how these materials work can help sometimes. For instance, if one spray during the BR control period is Nova or Elite (mostly backward activity) and the next is a strobie (mostly forward activity), there's a potential hole in the middle. This is easily plugged by tank-mixing the Nova/Elite with mancozeb (forward activity), which is probably needed for DM control anyway.

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 into August, long after spores have been depleted from mummies on the ground. Furthermore, these spores are far more likely to land on susceptible grape tissue than those produced on the ground, since they are released right next to leaves and fruit in the canopy. Even a few mummies retained within the vine can cause significant levels of infection around them. Don't forget how much additional control you can provide by the simple practice of dropping mummies to the ground during hand pruning or as a follow-up to mechanical pruning.

5. Fungicides. Nova and Elite remain the "kings", in my opinion. Unfortunately, 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 these materials makes them problematical at such a time in many vineyards. However, if BR is a significantly greater concern than PM, this may not matter so much. All of the strobies provide very good to excellent control, equal to mancozeb and ziram under moderate pressure and superior under very rainy conditions when pressure is high (probably due to a combination of their antisporulant activity, which limits disease spread, and their greater residual activity, since they're less likely to wash off). Of course, mancozeb and ziram are old standards and provide good control under most commercial conditions. Captan, Rubigan, and Procure are only fair, and are likely to be inadequate if there's any pressure. Copper and sulfur are poor. For example, in one trial with moderate disease pressure, copper provided only 40% disease control, and this may have been even worse if pressure had been higher. Thus, growers attempting to produce "organic" grapes will need to pay particular attention to non-chemical control methods, such as removing or burying (tillage, mulch) any mummies that they might find.

DOWNY MILDEW (DM) NEWS AND REMINDERS

The past two seasons have been tough ones for DM. Although most growers managed to keep on top of things (more or less), it's been a struggle, and those who didn't found out how quickly a downy mildew epidemic can develop when it stays warm and wet for an extended period of time. And some growers who didn't keep on top of things in 2003 found out last spring that premature defoliation really does reduce winter hardiness. A brief review of the disease biology and its implication for control programs:

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. And as with PM, high overwintering inoculum levels mean that early sprays are more important than they would be in a vineyard that was clean last year. Typically, the first oospores mature and are ready to cause infection when five to six leaves have unfolded on new shoots (in Geneva, approximately 2 to 3 weeks before bloom, or when shoots are about 10 inches long). However, the fungus apparently develops more rapidly than the vine does under unusually cool spring temperatures such as those in 2003, when the first infections occurred at a time that shoots had only developed two to three unfolded leaves. Nevertheless, this is the exception (1 year out of the 20 that have been monitored) that illustrates the rule (the other 19 years out of 20).

Infections originating from overwintering oospores ("primary" infections) require a minimum rainfall of approximately 0.1 inch (because the infective spores need enough rain to splash them from the soil up 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 these 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 the following day (to allow infection after dispersal). Without rain the next day, most of the sporangia die quickly after exposure to bright sunshine, but many can survive under cloudy conditions, 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 spread can be explosive if favorable conditions persist. Thus, the weather that many regions experienced for long stretches the past two summers (humid nights, frequent showers, long periods of cloudy weather) accounts for the intense DM pressure that resulted.

In a "typical" year, the disease “goes on vacation” once a long spell of warm, dry weather hits in the summer, and it can take some time for it to build back up after this occurs. The erratic occurrence 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. For

additional guidance, my colleagues, Bob Seem and David Gadoury, have developed a computer model (DMCAST) that integrates these various 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 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 infection about 2 weeks after the start of bloom, although losses due to berry stem infections can occur for at least 2 additional weeks after that. For many years, the standard test protocol on Chancellor vines at Geneva has been to start spraying about 2+ weeks prebloom and continue through 4 weeks postbloom. The best materials consistently provide good to excellent control of fruit and cluster stem infections using this schedule, even on the worst possible variety under abnormally high inoculum pressure.

Fungicides. Ridomil remains the best downy mildew fungicide ever developed for use on grapes, but its cost and lack of activity against other diseases have limited its general use. It's also highly prone to resistance development. Abound has provided excellent control every year since we began testing it in 1996, and Pristine has always been equivalent or just a little bit better. Phosphorous acid formulations were discussed above. Sovran is marginal, it seems to be OK under moderate pressure 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. However, these protective fungicides are prone to wash-off under heavy rains, so often need to be reapplied more frequently in very wet years when disease pressure is high.

To illustrate some of these points, I've summarized pertinent results from our trial the past two years to control fruit infections on Chancellor vines. Four sprays were applied at 2-wk intervals beginning about 2+ weeks before the start of bloom. Disease pressure was ridiculous (nearly all unsprayed clusters were completely destroyed). Data are expressed as both disease incidence (percentage of clusters showing any disease) and severity (percent cluster area affected or, roughly, percent berry loss). A few things to note: (i) We missed the first infection period in 2003, hence many clusters showed at least some disease in most treatments. (ii) Abound and Pristine were clearly superior to mancozeb and phosphite products (which were roughly equivalent) given the 2-wk spray intervals, with Pristine showing a bit of an edge. We have not seen these types of differences in drier years, and suspect that 2-wk spray intervals are too long for mancozeb and phosphites under extreme pressure. (iii) Phosphite rate matters. In 2004, Phostrol was better when the 2.5 pt rate was doubled after bloom, although there was no additional benefit from doubling it in the two prebloom sprays as well. And although it's not legitimate to directly compare different treatments in different trials, it is interesting to note that the 1.25/ 2.5 pt (pre-/ post-bloom) rate of ProPhyt in 2003 was considerably less effective than twice those amounts of Phostrol in 2004.

Table 2. Incidence and severity of downy mildew on clusters of Chancellor vines treated with different fungicides in 2003 and 2004

Material, rate/A[1]	DM infection, 2003 Trial % Clusters	% Cluster area	DM infection, 2004 Trial % Clusters	% Cluster area
Unsprayed	100	87	100	93
Pristine, 10.5 oz	6	<1	8	2
Abound, 12 ('03), 15 ('04) oz	33	2	20	5
Mancozeb, 3/ 4 lb[2, 3]	86	23	33	11
ProPhyt, 1.25/ 2.5 pt[3]	91	29	---	---
Phostrol, 2.5 pt	---	---	51	8
Phostrol, 2.5/ 5.0 pt[3]	---	---	23	4
Phostrol, 5.0 pt	---	---	25	3

[1] Two prebloom + two postbloom sprays at 14-day intervals.
[2] Dithane or Manzate DF.
[3] Pre-bloom/ post-bloom rates.

BOTRYTIS NEWS AND REMINDERS

1. Biology. The Botrytis fungus is a “weak” pathogen that primarily attacks highly succulent, dead, injured (e.g., grape berry moth, powdery mildew), or senescent (expiring) tissues such as wilting blossom parts and ripening fruit. The 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. Although the fungus grows well in berries that are ripening, it can gain entrance into young fruit through senescing blossom parts, old blossom "trash" sticking to berries, and scars left by the fallen caps. Such infections remain latent (dormant) until some of them resume activity and rot the berries as they start to ripen.

For some time now, we’ve been examining a number of issues concerning these and other aspects of Botrytis development, and their relative roles in disease loss. Some of the major conclusions from this ongoing study are as follows:

• Although latent infections can be common following a wet bloom period, the vast majority remain inactive through harvest and the fruit stay healthy. Many factors that cause latent infections to activate or not are poorly understood, although high humidity during the preharvest period and high soil moisture after veraison appear to be two that promote this process. Berries with elevated nitrogen levels (how elevated, specifically, is still not clear) or various types of mechanical injuries also are more prone to becoming diseased via the activation of latent infections.

• If Botrytis spores and wet conditions are available, berry infection can occur anytime after bloom begins. However, berries are much more susceptible to becoming diseased when conditions for infection occur after veraison.

• Serious Botrytis losses result from spread during the post-veraison/ pre-harvest period, after berries begin to ripen and become highly susceptible to rot by the fungus. However, latent infections established at bloom can be important in the development of an epidemic if they become active later and thereby provide the "primary" infections

from which "secondary" spread can occur during ripening. Because so few of these early infections typically 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 pay significant dividends if things turn wet before harvest. How confident are you of forecasts made in June for weather conditions in September?

• Cluster compactness has a pronounced effect on disease development. This appears to be due largely to its effect on berry-to-berry spread. For example, in experiments conducted on tight-clustered clones of Chardonnay and Pinot noir, disease spread was extensive when even a single berry was inoculated at veraison and became rotted 1 week later. This single diseased berry was meant to mimic the post-veraison activation of a small percentage of latent infections originally initiated at bloom, and vividly illustrates the particular importance of controlling early infections on tight-clustered varieties (e.g., Vignoles) and clones.

In contrast, disease spread on similarly-inoculated clusters in these same vines was minimal when the clusters were thinned by hand to resemble the looseness of a bunch of table grapes. Finding practical means of loosening clusters is the “holy grail” of Botrytis management, but the watch word is “practical”. A number of people have experimented with giberellic acid sprays over the years, but these can have negative impacts on the vine and, therefore, are illegal on wine grapes (product liability issues). Natural product extracts are being tested, but the results haven't been that exciting. The one technique that worked for us was hand removal of flowers during bloom with the aid of a small plastic brush, as is done in the production of some table grapes. This is probably practical only on very valuable varieties that are highly susceptible to the disease (did somebody say Pinot noir?), provided that adequate labor is available. And right now, we've got fungicides that do a pretty decent job with a lot less effort, provided they're applied before disaster strikes. But it's something at least worth thinking about in certain situations.

• Preharvest 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 need to be more intensive if they’re applied.

• There is no single “correct” timing regimen for fungicide applications in a Botrytis management program. In some years, early sprays (bloom and bunch closure) have given us better control than later sprays (veraison and preharvest). In more years, the opposite has been true. In some years, two early sprays OR two late sprays provided the same control as all four; in a majority of years, 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 varieties and clones (e.g., cluster architecture). Thinking in terms of early sprays as being designed to limit the establishment of primary infections, and later sprays as limiting disease spread, may help conceptually.

3. Fungicides. Cultural management, especially practices that promote good air circulation around the fruit zone and through the vine, is perhaps more important for controlling Botrytis than for any other of our common grape diseases. Recognizing this, consider that the availability of effective Botrytis fungicides provides additional tools to complement (rather than replace) non-chemical practices such as canopy management and leaf pulling.

Vangard and Elevate have both been consistent performers since their release. Vangard is absorbed by the blossoms and fruit, so it not only resists wash-off, but we've always assumed that it has at least some post-infection activity against Botrytis. Tests that we've conducted recently have confirmed this assumption, and we're now trying to determine the extent of its reach-back activity. As noted earlier, Scala is a newly-registered fungicide in the same chemical family as Vangard (the "AP" fungicides), and although our experience with it is much more limited, it appears to have the same general activities. The AP fungicides are highly prone to resistance development, so shouldn't be the only group used over a period of time (i.e., even if you only make one or two Botrytis sprays per year, DO NOT rely strictly on an AP year after year). An AP fungicide (Vangard and/or Scala combined) should not be used more than two times per season.

Elevate is a protectant fungicide that doesn't enter the blossoms or fruit, so it should not have any reach-back activity, nor does it appear to in our tests. However, it does appear to be quite rainfast. In several field trials that we have run, Vangard/Elevate rotations have provided the same level of control as either compound used alone throughout the season (seasonal programs of single compounds were applied for test purposes only, don't try this at home).

Rovral has a long and well-discussed history. Although thought of primarily as a protectant fungicide, it does enter sprayed tissues; therefore, it has some limited postinfection activity and is a good antisporulant material. Activity is improved by mixing it with an agent that improves uptake into the fruit, such as an oil or a nonionic surfactant. Because Rovral (and the related Ronilan) were the only Botrytis fungicides available for many years, their repeated use led to resistance development and erratic activity in a number of vineyards. Rovral might be safe to use in some vineyards for a maximum of one application per season, particularly if it has not been used for several years, but it should not be a primary component in rotational programs.

The strobies have shown moderate to excellent activity under moderately heavy pressure, depending on the material and rate. Flint is the only one strong enough to be labeled for Botrytis control, although at a higher rate (3 oz/A) than that used against PM and BR (1.5 to 2 oz/A). It has provided very good to excellent control in our trials at this 3 oz rate in several repeated tests.

Our experience with Endura is limited, most of the testing has been done with Pristine (the combination product containing Endura plus a strobie). What I have seen suggests that Endura will probably provide very good control at the higher (8 oz/A) rate recommended for Botrytis, and only moderate activity at the lower rate (4.5 oz) recommended for powdery mildew. However, note that in limited testing, Pristine also has provided moderate activity at its lower labeled rate (8.5 oz/A), and in our trial last

year, the rate labeled for Botrytis suppression (12.5 oz/A) was comparable to the high rate of Endura. Of course, pricing will determine a good deal (and at this point that issue is still not clear), but if the two products prove to be close in activity and price, I would much prefer the high rate of Pristine to the high rate of Endura, due to its added feature of excellent DM control (plus BR control if used in the late bloom period).

PHOMOPSIS (Ph) NEWS AND REMINDERS

1. Early sprays are the most important for control of rachis infections. Although fruit infections by the Phomopsis fungus can cause serious and spectacular losses in wet years (especially on Niagaras), rachis infections are the most consistent cause of economic losses from this disease in New York. In spray-timing trials conducted every year since 1999, we've found that the early, traditional Ph sprays (early shoot growth period, as clusters first become visible) are the most important for control of these infections. They are particularly important for control of the most serious infections, i.e., those that girdle significant portions of the rachis and cause berries to shatter before harvest. They 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. A minimal Ph spray program should include at least one application during the period soon after clusters emerge.

2. 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. Think of how the cane lesions of Ph typically occur on the basal region of new shoots, then think about what a pruning stub is (the most basal part of what was once a new shoot, now dead). Then get rid of 'em.

3. 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 for 3 consecutive years. And in each year, we detected few if any spores later than early- to mid-July, with the vast majority released between bud break and bloom. A similar study in Michigan has 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 low after berries become pea-sized, since inoculum is scarce beyond that time.

4. Effect of spray timing to control berry infections. In a trial conducted for 2 years in a problem Niagara block, we were surprised to find that sprays applied shortly after cluster emergence (the important ones for controlling rachis infections) also provided significant control of berry infections. These results suggest that some berry infections probably result from the fungus growing into the fruit from the berry stem, which is consistent with observations of symptom development in the field. However, for the best control, we needed to continue applications until the 2nd postbloom spray.

5. Canopy architecture and pruning system. Phomopsis spores are rain-splashed onto susceptible tissues from their overwintering sites within old canes, spurs, and pruning stubs. Gravity eventually makes them go down. Beyond differences in spray programs, this may be one reason why we tend to see much worse disease in native varieties (pendulous growth, usually drooping beneath these inoculum sources associated with high-wire cordons) rather than upright-growing *V. vinifera* and hybrid cultivars. The latter aren't necessarily more resistant, but they do escape some of the potential infections that natives don't. And of course, management systems that retain a lot of old canes and stubs in the canopy (e.g., mechanical hedging) increase the inoculum load and associated disease pressure within that vineyard, particularly if dead wood is retained. Even well-managed *V. vinifera* plantings can run into persistent problems if they are spur pruned and the wood retained for the spurs is infected with Phomopsis.

6. Fungicides. Mancozeb, captan, and ziram have all provided good control of basal shoot infections in our fungicide trials. Captan is being touted by some individuals as far superior to the others. This hasn't been my experience, although it did show a slight edge over mancozeb in one trial with extreme disease pressure. For those who aren't prohibited from using captan, I'd consider other issues (captan is better at conserving mite predators, mancozeb doesn't have the 3-day re-entry restriction) to be more important than any modest differences in biological activity between the two, especially in commercial vineyards that have maintained relatively good control over the years (low inoculum). 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. In our Niagara trial, we saw 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.

7. Dormant sprays of lime sulfur may help, but they won't do the whole job. In the 1980's, Jay Pscheidt and Roger Pearson showed that a dormant application of lime sulfur (calcium polysulfide) drastically reduced overwintering inoculum of the Phomopsis fungus. In 2002, Mike Ellis obtained similar results in Ohio, and showed that this single treatment provided nearly as much control as a standard fungicide program. However, when we tried this approach on Concord vines in 2003, the benefits were only modest at best. In fact, a program consisting of 10 gal/A of lime sulfur (a low rate, but not cheap) followed by a single mancozeb spray at the 3- to 5-in shoot growth stage provided 60% control of rachis infections, whereas omitting the lime sulfur and merely applying two additional mancozeb sprays provided 96% control. Mike Ellis tells me that results from his subsequent trials have been similar to mine. Lime sulfur is expensive, unpleasant to work with, and corrosive to machinery. It may be worth considering in certain blocks with persistent Ph problems where you want to "throw the book at it", but it's not something that I would typically recommend, nor would I want to over-sell its benefits.

8. Spray application technique. Many growers like to spray alternate rows in the very early season (the critical time for controlling Ph rachis infections), 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 the coverage was 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're having trouble controlling Ph and are using alternate-row spraying, the suggested remedy also is obvious.

PUTTING IT ALL TOGETHER

We all know that there are as may good programs for controlling these diseases are there are good growers and advisors. Here are some considerations. 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.

3- to 5-INCH SHOOT GROWTH. A critical time to control **Ph** rachis infections. 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. And recent research indicates that this spray will provide some benefit against fruit infections as well. Since the late 1980's, we've considered this the time to start control of **PM** on *vinifera* varieties if temperatures consistently remain above 50°F. This spray is much more likely to be important in vineyards that had significant PM last year than in those that were "clean", although it may be beneficial even in relatively clean blocks of highly susceptible cultivars in certain (poorly-defined) years. And since you should be spraying for Ph, why not include something for PM on highly susceptible (and valuable) varieties while you're at it. In NY, **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 (BR, Ph). Option C: Captan (Ph, some BR). Easier on predator mites than mancozeb (or ziram), but not as effective against BR, which seldom matters at this time. Option D: Sulfur (PM). Pronouncements concerning reduced activity of sulfur at temps below 65°F *may* be exaggerated, whereas data showing reduced activity of the PM fungus at these lower temps are not. A cheap insurance option. Option E: Nova or Elite (PM, BR). Use 3 oz/A for economy with so little foliage now, but remember that coverage becomes even more important when you're working with lower application rates (no room for error). Option F: Rubigan (PM). At 2 fl oz/A (minimum labeled rate), cost is only about $4. Cheaper than Nova and Elite, especially if BR control isn't an issue, and it usually isn't at this time. Same issue with coverage at low rates. Option G: JMS Stylet Oil (PM). Should eradicate young infections IF thorough coverage is provided, but provides little forward activity. Can use with mancozeb (or ziram), but not with captan (phytotoxicity). Option H: Nutrol, Armicarb, Oxidate, Kaligreen. (PM). Should eradicate young infections IF thorough coverage is provided, but no forward activity. Option I: Serenade or Sonata, if you want to experiment with "biofungicide" products while disease pressure is low. Option J: One of the PM products plus mancozeb or captan for Ph.

10-INCH SHOOT GROWTH. We used to recommend not waiting any longer to control **BR**. Continued experience tells us that this spray can generally be omitted under NY conditions unless BR was a problem last year (inoculum levels are high) and weather is wet and warm. Don't wait any later than this to control **PM** on susceptible varieties. Typically, we've recommended waiting until immediate prebloom on Concords, but 2003 was unusual and we started seeing PM on this variety around the 10-in growth stage. Although this scenario was not repeated in 2004 and may have just been a fluke, it would be prudent for Concord growers to at least get out and take a look at this time. One approach would be to apply a PM fungicide if any disease is observed, but wait until the immediate prebloom stage otherwise. Some will not want to take a chance on failing to detect a problem, preferring to just apply a spray instead, and this is an approach that certainly will be encouraged by those who stand to benefit from it without having to pay the cost. Now is one of the best times to use an SI, also 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, since the sparse canopy still allows good coverage and potential Brix reductions should not be an issue. The eradicative properties of oils can also be valuable against young "primary" infections, particularly if the spray 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 a danger in blocks with a history of the disease. Option A: Abound, Sovran, Flint, or Pristine if/where available (PM, BR, some Ph; also, variable DM). Not the most efficient time to apply these materials, particularly if you're trying to minimize the number of annual applications. Not recommended. Option B: Mancozeb (BR, Ph, DM). A broad spectrum, economical choice for everything except PM. Tank mix with a PM material to pick up everything. Excessive use can lead to mite problems by suppressing their predators. Option C: Captan (Ph, DM, some BR). An alternative to mancozeb if you're trying to avoid it due to mite concerns. The limited BR activity should be sufficient if the disease was well-controlled last year (limited inoculum) and good BR materials will be used in the next three sprays. Option D: Sulfur (PM). Still some concern about reduced activity at cool temps, but that concern is going down and temps are going up by now. Post-infection activity may be useful against new "primary" infections before they have a chance to spread. Option E: Nova or Elite (PM, BR). Option F: Rubigan (PM). Limited BR 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. Cheaper than Nova and Elite. Bump up to the 3 fl oz/A rate by now. Option G: JMS Stylet Oil (PM). If (and only if) coverage is thorough**,** this spray should eradicate early PM colonies that may be starting if previous PM sprays were omitted. But don't waste your money if you can't cover thoroughly. Also may help with mites. Other oils such as PureSpray Green should have similar effects, if you can find them. Option H: Quintec or Endura if/where available (PM). If trying to limit seasonal applications to two or three, probably more efficient to wait until prebloom, when cluster protection starts to become critical. Option I: Nutrol, Armicarb, Oxidate, Kaligreen. (PM). Should eradicate young infections IF thorough coverage is provided, but no forward activity. Option I: Serenade or Sonata, if you want to experiment with "biofungicide" products before entering the critical period for disease control. Option J: Mancozeb (BR, Ph, DM) + a PM material, based on previously-discussed characteristics and cost.

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, RATE, OR COVERAGE!** Option A: Quintec or Endura for PM control, plus mancozeb (for BR, DM, and Ph). A high rate of Endura will also provide protection against Botrytis, although a spray at or near the end of bloom might be better for this purpose (and less convenient). Option B. Pristine (PM, DM, BR). A high rate of Pristine will also provide some protection against Botrytis, although a spray at or near the end of bloom might be better for this purpose (and less convenient). **Note that NY registration for Pristine and Endura are still pending at press time, although a decision is expected very soon.** On highly susceptible cultivars, where SI resistance is usually an issue to at least some extent and strobie resistance has occurred or is deemed risky, Quintec, Endura, Pristine, and/or sulfur would be the materials of choice. Do not use Quintec or Endura/Pristine (consider them the same thing for resistance-management purposes) more than three times per season, nor more than two times in a row. Option C: Abound, Sovran, or Flint. Still an effective option in some vineyards, but with significant cautions and/or restrictions. Refer to point #4 (strobilurin resistance) in the "Fungicide Changes and News" section at the beginning of this epistle. Option D: Either Nova, Elite, or Rubigan PLUS mancozeb (PM, BR, Ph, DM). Add sulfur on *vinifera* and PM-susceptible hybrids (unless "sulfur shy"). Nova and Elite are the biggest guns against BR, so might be the best choice if pressure is high and BR control is more important than PM. Nova and Elite provide postinfection activity against BR, so would be the choice over Rubigan if significant unprotected infection periods occurred previously. Rubigan is cheaper that Nova or Elite, but doesn't provide nearly the same BR control; however, the mancozeb part of the mix should be adequate if postinfection control isn't required. If wet, mancozeb (or captan) 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 captan). Option D: Mancozeb + sulfur (PM, BR, Ph, DM). Cheap and effective, particularly if used at shorter spray intervals. Neither material is as rainfast as the strobies or SI fungicides, so frequency of reapplication can be an issue in wet years. Potential mite problems.

MID- to LATE BLOOM. Vangard, Scala, Elevate, Flint (3 oz rate), Endura, or Pristine for Botrytis control will probably be beneficial in wet years, particularly in problem blocks. Remember current lack of NY registration for Endura and Pristine, and higher rates of these products necessary for Botrytis. If sulfur was the only PM material in the previous spray, reapply about now on highly susceptible *viniferas.*

FIRST POSTBLOOM (10-14 days after immediate prebloom spray). **Still in the most critical period for 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. 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 if necessary.

SECOND POSTBLOOM. **BR** control is still advisable under wet conditions and is very likely to be important if infections are evident on the vine; however, BR sprays can often

be skipped from here on out if neither case is true, particularly on native varieties. Fruit are less susceptible to **PM** now, but those of *vinifera* varieties (and susceptible hybrids?) still need PM protection, particularly to guard against later bunch rots and wine-spoilage microorganisms. New foliage remains highly susceptible to PM throughout the season, in all cases. Try to avoid SI and, particularly, strobie fungicides if more than a little PM is easily visible. **Ph** danger is just about 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 (look and see). Foliar DM will remain an issue the rest of the season, depending on the weather. Option A: Pristine, Abound, Sovran, or Flint. See previous discussions. These provide good residual control of the listed diseases if used now, but limit their use to maintain viability. Should provide some Botrytis control as a pre-bunch closure spray. Option B: Endura or Quintec (PM) + captan or mancozeb (66-day preharvest restriction, mites) if DM and Ph control are needed. If DM is the only other issue, Ridomil (in a bad year) or a phosphite are additional options. Quintec and Pristine/Endura shouldn't be applied in more than two consecutive sprays, but are an option if not used in both the prebloom and first postbloom application. Option C: Nova or Elite (BR, PM) + the DM and Ph options presented in Option B. Option D: Rubigan (PM) + either (a) mancozeb (if more than 66 days before harvest) for BR, DM, and Ph; or (b) captan (DM, Ph, some BR); or (c) ziram (BR, Ph, some DM); or (d) Ridomil or phosphite (DM). Option E: Sulfur (PM) + the additional options just listed with Rubigan. In most years, lessening disease pressure makes this economical option increasingly practical as the season progresses. Option F: Copper + lime (DM, some PM). Adequate PM control for native varieties, 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 *vinifera* and other cultivars requiring continued **PM** control, use sulfur as an economical choice to maintain control. 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 (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/Endura, sticking to the maximum of three sprays per year for each of these. All of these materials provide the advantage of longer residual activity than sulfur, especially in wet weather, but resistance management (limited use) is important. So is wallet management. 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 conditions. Alternative materials such as Nutrol, Kaligreen, Armicarb, Oxidate, Serenade, and Sonata can have their place during this period, although they need to be sprayed fairly 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. For **DM**, copper + lime or captan are economical standards; phosphite products are quickly becoming standards themselves. Ridomil can be used in case of emergency, remember the 42-day PHI for the Ridomil Gold Copper formulation versus the 66-day PHI for the MZ formulation. And Pristine is excellent if and where it fits during this time. **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. Sprays for **Botrytis** may be necessary at veraison and/or preharvest, see previous discussion under that disease for details.

Have fun, grow some good grapes, and make some money!