FINGER LAKES VINEYARD NOTES

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> Finger Lakes Grape Program
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GRAPE DISEASE CONTROL, 2006

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Time, once again, 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 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 (USDA Viticulture Consortium-East, 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 that of the NY State government through Cornell's College of Agriculture and Life Sciences, that allows us to keep moving forward. We're all very fortunate to be associated with one of the most dynamic segments of agriculture today, and this doesn't happen by accident.

FUNGICIDE CHANGES & NEWS

1. **Maneb registrations cancelled.** The labels for use of maneb products (e.g., Manex) on grapes have been "voluntarily" cancelled. This reflects a financial decision by the manufacturers based on the costs of re-registration versus potential future sales, not one by the government based on toxicology problems. What it means is that the labels on any new containers of the materials will no longer list grapes as an approved crop. So far, the "tolerance" (allowable residue level) has not been revoked, which should allow growers to use up any existing stocks on hand so long as the label directions are followed. Eventually, however, the tolerance will be revoked, and then it will no longer be possible to use even these existing stocks. This date has not yet been set (the EPA usually allows a reasonable amount of time), but the best idea would be to use up any maneb products that you may have without unnecessary delay.

Regardless of EPA's general policy that allows end-users to use such cancelled products until depleted, New York State DEC will only allow use in our state if a product's registrant continues to register it in NYS. The two Manex products I find in the NYS database (from Griffin and DuPont) are currently registered through the end of 2006.

NOTE: Mancozeb products (Dithane, Manzate, Penncozeb) are NOT affected by this action. Although maneb and mancozeb share a number of similarities (including their names), they are different chemicals and only the former is affected.

2. **Pristine label changes.** ***(i) "Supplemental" label for Botrytis control.*** A "supplemental" label has been approved for Pristine, which allows use at a significantly higher rate than those on the standard label, if excellent Botrytis control is needed. To summarize: The "base rate" on the standard label is 8-10.5 oz/A, which provides control of a whole slew of diseases other than Botrytis. This label also allows a rate of 12.5

oz/A for "suppression only" of Botrytis; this wording implies that disease reduction will be significant, but not all that it might be (i.e., don't sue us if you don't get as much as you hope for). In contrast, the supplemental label specifies a rate of 18.5-23 oz/A for "control" of Botrytis, which implies that it's expected to work well if used according to directions. Two potential negatives of this higher "supplemental" rate range: (i) applicators must obtain (chemical distributors, web sites) and possess a copy of the supplemental label in order to use it legally; and (ii) whereas use rates of 12.5 oz/A or less require a 24-hr re-entry interval, rates greater than 12.5 oz require a 5-day REI.

We've compared rates in two trials. In the very wet 2003 season, the rates of 10.5, 12.5, and 19 oz/A provided 49, 76, and 94% control, respectively, compared to the untreated plots. In 2005, when most of the fruiting season was relatively dry, these same rates provided 74, 93, and 96% control, respectively. In a limited trial during the wet 2004 season, where we only examined the 12.5-oz rate, a full season program provided 75% control versus 85% control for a Vangard/Elevate alternation (and 85% control for a Pristine [12/5 oz]/Elevate alternation).

Bottom line: I wouldn't go below 12.5 oz/A if I were looking for Botrytis control. This rate should do a pretty decent job under most conditions, although the "supplemental" rates are likely to do better under high disease pressure. But there's also the issue of obtaining the supplemental label and the extended REI. Oh yeah, and cost.

(ii) "Native" variety restrictions. The strobie component of Pristine can cause some leaf burning on Concords. Most other native and hybrid cultivars are not affected, although applications to the as-yet unnamed NY73.0136.17 have caused injury in several different plantings. There have been a couple of local reports of more limited burning on Rougeon, although problems on this cultivar have been somewhat erratic. Based upon commercial experience and various research trials, the "do not use" restriction on new labels is now limited to Concord and NY73.0136.17, with the warning that "foliar injury could occur to Worden, Fredonia, Niagara, Steuben, Rougeon or related varieties".

3. Strobilurin resistance: <u>Downy</u> mildew. Dr. Anton Baudoin at Virginia Polytechnic Institute has reported detecting downy mildew resistance to the strobilurin fungicides in several different mid-Atlantic vineyards where these materials gave poor DM control in 2005. Such resistance has been a major problem in the wetter grape-growing regions of Europe since 2002 and has also been reported from Brazil, so no surprise that it's finally happened in North America as well. But what should we do now?

First, a couple of considerations: (1) Pristine, the combination product of a strobie and an unrelated fungicide (boscalid), has provided excellent control of powdery mildew in vineyards where PM resistance to the strobies has developed. But such control has been provided primarily by the boscalid component of the product, and boscalid provides ZERO control of downy mildew. So no help here like we've gotten with PM resistance.

(2) So far, the DM resistance has been noted in just a handful of vineyards; in many more throughout the east, strobie products were used effectively to control this disease last year. In New York, we're lucky to have had a number of relatively dry seasons since these materials were first introduced (1998, 1999, 2001, 2002, 2005), which has limited the pressure for "selecting" resistant individuals within DM populations and allowing them to take over. Additionally, many NY growers have cut back on their strobie use since powdery mildew problems began surfacing a few years ago, which has further limited the pressure for DM resistance development. These two factors are probably responsible for the fact that problems with DM are just starting to appear, and probably explain why they popped up in the mid-Atlantic region before they did in NY (i.e., generally higher DM pressure there and no regional strobie-related powdery disasters). The clock is ticking, but how long do we have?

Unfortunately, it's impossible to say, since the answer depends on the previous history of strobie use in individual and neighboring vineyards, how these materials are used in the future, and the disease pressure to which they will be exposed. But remember that as we learned with PM resistance, when the strobies fail, they fail suddenly. Thus, the most conservative approach would be to simply quit using them for DM control. For those who want to keep getting the benefits of these products so long as they remain effective, some or all of the following options should be employed:

• Strictly limit the number of applications each year. Two is a nice round number.

• Use them early in the DM season, before populations of this fungus "explode". A smaller fungal population means a smaller chance of selecting rare resistant individuals for subsequent multiplication and problems. The upside to this approach is that it means using the fungicide during the immediate prebloom through early postbloom period, when you'll also pick up most of the other major diseases. The potential downside is that this is when clusters are highly susceptible to DM, so keep a sharp eye out and be ready to use something else at the first hint of DM coming through the spray program unexpectedly.

• Tank-mix with an unrelated fungicide that's effective against DM (copper, mancozeb, captan, phosphonates). This is a great recommendation to make in theory, too bad that it's not as cheap as tossing in some sulfur for PM "insurance".

4. Strobilurin resistance: Powdery mildew. No real news, just a couple of reminders.

(i) We do not know how widespread that PM resistance to the strobies is, but it appears to be common in NY on *V. vinifera* and susceptible hybrid cultivars. Anton Baudoin from VPI has reported some evidence that it may be present in Virginia as well. In 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. If you're going to use these products on *vinifera* vines, tank mix with sulfur and/or use Pristine (the combination product that includes boscalid). If using Pristine in a vineyard with known or suspected strobie resistance, tank-mixing this product with sulfur is strongly recommended. The reason: boscalid is at risk for resistance development itself, and since the strobie component won't be providing dependable insurance in these vineyards, you'll need to get some from sulfur.

Native varieties are a different story, since they've generally seen fewer strobie sprays over the years and a sudden outbreak of resistance is likely to be less devastating. PM pressure was relatively light last year, and we've still yet to see signs of resistance on natives. We'd like to keep it that way. Abound remains a great choice to control PM, DM, black rot, and Phomopsis fruit rot on these cultivars immediately after bloom, when many growers are prohibited by their processors from using mancozeb or captan. Sovran is a little stronger on PM, equal on BR, but weaker on DM; this latter difference is not that important on Concords, but can be on Niagaras in a season that is very wet early post-bloom, while fruit are still susceptible to the disease. And of course, Pristine is an option on cultivars other than Concord (see above). I'd be looking to save these products for a single annual application during the immediate postbloom period on most native cultivars, thereby employing both resistance and wallet management. I hope that they will continue to last for a good bit longer if used in this manner.

As usual, hybrids occupy a large middle ground between *vinifera* and natives, which side of the middle depending on the particular cultivar. We've heard several reports of failures on Rougeon (very susceptible to PM, can't use sulfur), and straight strobies no longer work in my test block of Rosettes. As with *viniferas*, those using the strobies on susceptible hybrids should strictly limit the number of annual applications and tank-mix with sulfur (if they can) or choose Pristine. Rougeon remains a challenge.

(ii) Resistance to one strobie means resistance to all of them. And unlike the SI materials, we CANNOT compensate for resistance when we first detect it by increasing the rate or switching to another product with greater PM activity (e.g., Flint rather than Abound). Unfortunately, once they're done, they're done.

5. Phosphorous acid products. We've discussed the phosphorous acid products (also called phosphites and phosphonates), their relative safety (4 hr REI, exempt from residue tolerances), and their utility for control of DM in great detail the past few years. By now, most growers know the basics and have had some experience working with them, generally with good success. They also know that products such as ProPhyt and Phostrol are labeled as fungicides for control of DM, whereas there are a number of "nutrient formulations" on the market that contain phosphonate but are not labeled for DM control. Which means that it's only legal to obtain disease control with these latter products if you do so unintentionally. Remember, the law requiring that any material applied for a pesticidal purpose must be labeled for such generally benefits growers as well as the public at large. And although life is full of ironies, getting cited for a violation of the pesticide laws isn't among the delicious subset, regardless of the specifics.

Also recall that products claiming to be nutrient solutions must state the amount of P that they contain in terms of phosphoric acid equivalents (phosphate, the nutrient, which has no effect on DM), even if they contain only phosphorous acid (phosphite or phosphonate, the DM material which, ironically, has 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 rate matters for DM control.

For the past 3 years, we've conducted a series of field experiments to help clarify the so-called "physical modes of activity" of phosphonates in control of downy mildew (for technical reasons, most experiments have been conducted on leaves rather than fruit). A summary of the major results is as follows:

- Phosphonates generally provided good to excellent protective activity when applied 3 to 8 days before an infection period, depending on the rate used. However, in some tests, activity declined significantly in the older leaves as the time between application and infection lengthened. This loss of persistence presumably reflects the well-known mobility of phosphonates within plants, i.e., they appear to be "shipped" from older leaves to the growing points. This effect was particularly pronounced when we reduced our rate from a soaking coverage of 0.3% Phostrol or ProPhyt (equivalent to 2.4 pt/A in 100 gal of water, which is near or below the minimum labeled rate) down to half that dosage.

- These materials provided excellent post-infection activity; again, there was some rate dependency. When applied 3 or 4 days after infection, few lesions developed and spore production was greatly to totally inhibited. When applied 6 days after infection (small lesions visible), lesions continued to expand but production of spores was reduced by 86 to 98% relative to the unsprayed check. Control of both lesion expansion and spore formation appeared to improve when the rate was increased from 0.3 to 0.6% or when the initial application of the lower rate was repeated 5 days later.

- Phosphonates did not eradicate well-established infections, but when applied to actively sporulating lesions, they greatly limited further spore production. In addition to the results cited above, we were able to reduce new spore production by approximately 80% in two different tests when a 0.3% solution was sprayed onto actively sporulating lesions on the vines. Since these spores are the agents of disease spread, limiting their production should limit disease spread.

The take-home message is that phosphonates provide good to excellent control of DM through a combination of protective, post-infection, and anti-sporulant activities. These activities are affected by both the application rate and spray interval, and the materials are most likely to "break" with longer spray intervals (relative to an infection period) and lower rates. In simple "spray and count" trials using 14-day application intervals (probably too long under high pressure), we've seen significantly better control on clusters when materials like ProPhyt and Phostrol were used at rates in the high versus low end of their labeled range, and relatively poor control when a nutrient solution containing phosphonate was applied at the equivalent of 60% of the low rate. This latter dosage is similar to some of those I've heard rumored as contained within solutions applied for nutritional purposes in the Finger Lakes region.

Two final points:

(i) We continue to get occasional reports of leaf burning, generally not severe, but definitely noticeable. We have not been able to nail down the reason(s) for this, but spray concentration is one potential factor. If you're applying 2.4 pt/A in 20 gpa rather than 100, the spray concentration is 1.5% rather than 0.3%. Amount of product per unit area treated (not spray concentration) is the important factor for disease control, but concentration of the spray solution can sometimes impact burning reactions. If you've had a problem with these materials, check your records and see how much water you were using.

(ii) 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 after long and repeated use. Don't live in fear of burning them out, but be aware that you might be able to do so if you try. Don't rely exclusively on phosphonates for DM control all summer.

6. Sulfur. Sulfur has always been popular with *vinifera* growers and on hybrid and native cultivars where it can be used without injury. However, problems with resistance to newer modern fungicides have increased its importance over the past few years. This prompted us to take a much closer look at various factors that might affect its activity, through an extended series of experiments in 2004 and 2005. Some of the results confirmed what "everybody knows", whereas others were unanticipated. Following is a summary of the major findings and conclusions:

- 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 recently 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.

I'd be the first to acknowledge that laboratory and growth chamber studies do not necessarily reflect field conditions, but this is what all of the available data indicate. In contrast, we can find no data to support the "conventional wisdom" warning growers to avoid sulfur when it's cool, and colleagues in Germany tell us that they consider sulfur to be more effective under cool temperatures rather than warm ones. That being said, the Aussie results suggest that you should be sure to keep your rates up if using sulfur during the cooler portion of the season; which, of course, you can afford to with this material. And because sulfur appears to provide a significant portion of its activity through contact and requires excellent spray coverage for best efficacy, don't be surprised if early season control falters when you spray alternate rows on a breezy spring day. Regardless of temperature.

- Sulfur's protective activity is limited by the tendency of shoots to "outgrow" the spray coverage as shoots 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. This may require more frequent application intervals during periods of rapid shoot growth.

- Sulfur provided consistent and extensive post-infection activity when applied up through the time that young colonies emerged after inoculation with fungal spores (about 1 week after the start of an infection under summer temperatures, longer under cooler conditions). As mentioned above, this activity was just as strong at 59°F as it was at 82°F. When plants sprayed post-infection were held at 59°F for 10 days and then moved to warm conditions, they remained clean. That is to say, a post-infection spray applied at the lower temperature didn't just put these infections on hold, it killed them.

- Sprays applied to heavily-diseased tissues were sometimes significantly less effective than those applied to incubating or very young colonies. We attribute this effect, at least in part, to the tendency of the spray solution to run off the fungal colonies rather than adhere to them under our high spray volume test conditions. We did not improve the activity of such sprays by doubling the sulfur rate (from the equivalent of 5 lb/A up to 10 lb/A), or by the addition of two different surfactants (indeed, eradicative activity was often lowered by the addition of surfactant, which exacerbated runoff). However, it's possible that the eradicative activity of sulfur versus well-established colonies might be improved if it could be applied with a sprayer that provides thorough coverage with lower volumes of water, which might be less prone to runoff. Calling Andrew Landers.

  - A number of different field and greenhouse trials designed to clarify the effects of rainfall produced sometimes variable results. Nevertheless, the data suggest that:

  - 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, which have smaller particle sizes
  - 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; in our experiments, doubling the application rate (from 5 to 10 lb/A or equivalent) was more effective than inclusion of the adjuvant.

7. Botrytis fungicide activities. Over the past couple of years, we've been looking at some of the "physical modes of activity" of the available Botrytis fungicides as well. Following is a summary of the major findings and conclusions for this project:

- When applied to diseased berries, Vangard, Elevate, Rovral, and Flint (3 oz/A) each reduced new spore production by about half relative to the water check treatment. Inoculum reductions of this magnitude are likely to provide little more than modest benefit if conditions are highly favorable for disease development, but they may help to improve control under more marginal conditions. Pristine (12.5 oz/A rate tested in this experiment) and Endura had no significant effect on resporulation. Scala wasn't examined.

- In another set of experiments, we sprayed Chardonnay clusters at pea-sized berries, bunch closure and veraison, then used a hypodermic needle to inject them with Botrytis spores 2 weeks after the last spray. This test was designed to determine the ability of the fungicides to protect the **internal** berry tissue against infection from spores that might be deposited within after rain cracking, insect feeding, etc. Scala, Vangard, Rovral, and Elevate provided excellent control of internal infections. Ninety-six to 100% of these berries were free of symptoms or showed only limited necrosis (typically restricted to the region immediately surrounding the injection point), although Elevate was less effective in completely preventing symptom development. Pristine

(19 oz/A) was comparable in preventing necrosis, but was less effective in limiting sporulation from those internal infections that did occur. Flint and Endura provided the least control. Whereas the disease spread to adjacent berries from two-thirds of the inoculated berries in the check treatment, there was no evidence of such spread in any of the fungicide treatments. This reflects not only the effect of the fungicides in limiting disease development within the inoculated berries, but also their protective effects on the surfaces of the adjacent ones when the inoculated berries did become diseased.

- In a more direct test for residual protective activity on the berry **surface**, clusters on a second set of Chardonnay vines were sprayed on the same dates as above and inoculated by applying Botrytis spores to the surface 2 weeks after the final application. All fungicides provided virtually complete control, whereas 22% of the cluster area was diseased in the unsprayed treatment.

- In yet another test, Pinot noir clusters were inoculated with Botrytis spores at late bloom and sprayed with fungicides for the first time at 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 preharvest activation of bloom-initiated latent infections is often the kick-start to a Botrytis outbreak). 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 gave statistically comparable control, but did allow one or more latent infections to become active in approximately one-sixth and one-fourth of the treated clusters, respectively. When additional clusters were treated a second time, 15 days after veraison, Scala, Vangard, and Elevate provided complete control of latent infections within symptomless berries (versus 37% infection in the untreated clusters). Rovral reduced infection by about three-fourths, whereas Flint, Pristine, and Endura provided 55-60% control.

Take home-messages and cautions:

- Clusters in these experiments were sprayed individually by hand, so we got close to 100% coverage on 100% of the clusters. This doesn't happen in real life, but it does show what the materials are capable of if you can put them where they belong.

- 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 <u>within</u> 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 merely a surface protectant.

- Similarly, the same three materials provided very good curative activity against latent infections initiated at bloom, even when applied 2 months after infection. We had hoped that this might happen, but were still pleasantly surprised when it did. Nevertheless, 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 any curative effects from the later sprays don't completely replace the need for earlier applications when conditions favor infection at bloom (incomplete coverage? irreproducible results?). But our data at least suggest that the efficacy of these fungicides in the field is result of curative as well as protective activities.

- Finally, the isolates of the pathogen that we used for "challenge" inoculations in these experiments were pre-tested to assure sensitivity to Rovral and to the AP fungicides. Rovral resistance appears to be "not uncommon" in vineyards with a long history of use, and this material would not provide such levels of activity at a site where resistant isolates make up a significant part of the fungus population. We have no indication of resistance to the AP fungicides in North America, but these materials are at risk for resistance development and should not be overused.

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. Not surprisingly, this is makes a difference. When we intentionally withheld a modest spray program on these same vines until the immediate prebloom period in 2003 (a banner year for PM, recall), 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 in 2002 = More primary infections during the Spring of 2003 = More new ("secondary") spores by the time that fruit were susceptible to infection = Increasing disease pressure to "overwhelm" the minimal fungicide spray program.

Also note that cleistothecia need at least a month to develop from a pair of PM colonies after they first appeas in the early autumn (development is faster at higher temperatures in the summer, or further south in the early autumn). Thus, 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 on pg. 19 of the NY and PA Pest Management Guidelines for Grapes, and in an on-line fact sheet). Thus, days in the 80's and nights in the 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. Spray programs may need to be intensified with respect to materials, rates, and intervals in years when this happens.

(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) 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.

(v) 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 wine-spoilage organisms such as *Brettanomyces* on the fruit. Another annual reminder. This is just one more reason to strive for excellent PM control on susceptible wine grapes during the first month after bloom.

(vi) Powdery mildew is a unique disease in that the causal fungus lives almost entirely on the surface of infected tissues, sending little "sinkers" just one cell deep to feed. This makes it subject to control by any number of non-traditional materials (oils, bicarbonate and monopotassium phosphate salts, hydrogen peroxide, etc.) that have little or no significant effect on other disease-causing fungi, which live down inside the infected tissues where they can't be reached by such materials. Lots of stuff can control powdery mildew, but 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 generally work in a post-infection/curative mode with little "forward" activity. This means that they need fairly frequent re-applications, or should be tank-mixed with something that provides good protective (forward) activity.

And now the "news"

Observant growers have long noticed that PM is most severe in parts of the vineyard that are regularly shaded, e.g., near tree lines and in the centers of dense canopies. The general admonition to provide good sun exposure as part of a PM management program has been a staple of this treatise for the past few years, but we have begun a project to examine the phenomenon quantitatively. In one set of experiments last summer, we covered selected vines with a layer of shade cloth, which allowed only 45% of the available sunlight to pass through and strike the vines, without affecting ambient temperature or humidity. This more than doubled the level of mildew that developed, and quadrupled the production of new mildew spores (agents of disease spread). When a different group of vines was covered with a double layer of shade cloth, which allowed only 20% of the available sunlight to pass through, disease severity increased more than four-fold, and the fungus produced nearly 10 times as many spores as on leaves in the full sun.

To look at the issue under more natural conditions, we took two groups of Chardonnay vines in a different vineyard. One group was at the edge of the vineyard, immediately west of a group of tall pine trees (providing morning shade); the second was in the same row, but in a cleared area not shaded by the trees. Within these two groups, we inoculated PM spores onto shoots that were either (a) on the outside of the canopy, fully exposed to the sun, or (b) trained into the centers of the canopies, subjected to natural shading. The results are summarized in Figure 1.

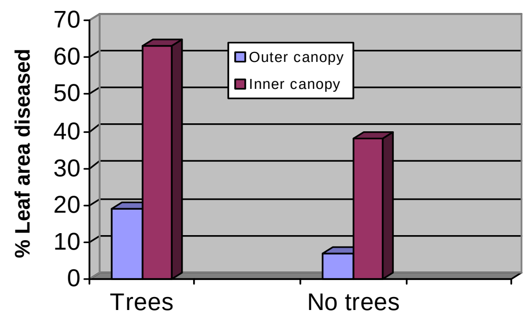

Fig. 1. *Effect of two sources of shading on the development of powdery mildew.* Evaluated leaves were from shoots on the outer (sun-exposed) or inner (shaded) portions of the vines, which were (a) adjacent to a group of tall trees (morning shade) or (b) away from the trees and exposed to available sunlight all day.

Note that both sources of shading increased disease development. Shade from the trees roughly doubled disease severity for both the outer and inner portions of the canopy. Similarly, severity on leaves within the canopy was three to five times greater than on those comprising the outer edge, for both sets of vines. And these effects were cumulative, with fully 63% of the leaf area diseased on the inner shoots of vines shaded by the trees, versus only 9% on shoots that were provided optimal sunlight exposure.

This project is still in its infancy, but the early results dramatically illustrate just how effective sunlight can be as a PM "fungicide". It seems likely that this effect has at least two major causes: (1) The unpigmented body (no "tan") of the powdery mildew fungus, which resides almost entirely on the surface of infected tissues, gets fried to some extent by the UV rays of the sun; and (2) The surface temperature of sun-exposed leaves can heat to a point that is detrimental or fatal to the fungus, even while air temperatures are in its optimum range (last summer, we measured leaf temps that were anywhere from 1 to 23°F higher in the sun versus shade, depending on the day and drought stress of the vines).

Of course, excessive sun exposure can be detrimental to grape berries for these same reasons, so we need to avoid too much of a good thing where the fruit are concerned. But keep these concepts in mind, both in terms of trying to limit PM by providing "optimal" levels of sun exposure, and by recognizing that prolonged periods of cloudy weather are taking away this natural control agent. Spray programs may need to adjusted accordingly, should such conditions occur. Recall that some of our worst years for PM cluster infections have started with multiple rain events (promoting primary infections from the overwintering cleistothecia) and prolonged cloudy weather (allowing primary infections to flourish and multiply) during the weeks leading up to fruit set, providing lots and lots of inoculum to infect the clusters. Toss in post-bloom weather that encourages disease spread, and you've got the potential for real losses if the control program has any holes in it.

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, becoming highly resistant to immune after about 2 more weeks. 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, 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 the first two of these sprays. Some try spraying only twice and end up with the disease. Note that in a test conducted on Concords at the Vineyard Lab in Fredonia (Lake Erie) during the wet 2004 season, 22% of the berries on unsprayed vines had black rot; 7% of the berries had black rot when vines received just one mancozeb spray just before the start of bloom; and 0.1% of the berries had black rot when vines received this immediate prebloom spray of mancozeb 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 has been a consistent problem and inoculum is plentiful. BR likes it warm, and growers from more southerly states have told me that such minimal programs "would never work here". However, Mike Ellis at Ohio State University 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. But as with PM, the first few weeks after bloom are going to be critical anywhere.

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 typically depleted within 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 happened in some locations in 2005, they'll just sit tight and finish coming out when the rain finally does arrive). So, if the disease has been controlled by the time the overwintering spores are depleted, there should be no source for new infections and additional sprays won't be necessary; this is almost certainly why some growers have been able to stop black rot sprays before the fruit attain full age-related resistance. 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 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 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 fungicides are most effective in "reach-back" activity, whereas the strobilurins are most effective in "forward" activity. One more reminder of this fact. 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. And of course, mancozeb provides forward activity (only), so tank-mixing it with Nova or Elite (usually needed to pick up DM, anyway) will control the disease both coming and going. In repeated tests, we've obtained excellent control with Nova when it was applied to clusters up to 8 days after the start of an infection period (we assume that Elite would perform similarly). This isn't an encouragement to stretch these materials to their limits (again, we hand-sprayed the clusters, so our coverage was ideal), but it does suggest that they should give you a little flexibility in timing, provided you get them on as well as possible.

4. Mummies retained in the canopy provide significantly more pressure for BR development than those dropped to the ground. Mummies in the canopy produce <u>many</u> more spores than those on the ground and continue to produce them into August, long after spores have been depleted from the ground mummies. Furthermore, these spores are <u>much</u> 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. 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 (although in many of our tests, the strobies have been right up there with them). 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 the SI fungicides make 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 wet conditions, when superior performance is most important (probably due to a combination of their antisporulant activity, which limits disease spread, and their greater ability to resist 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.

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 only 40% disease control, and this may have been even worse if disease pressure had been higher. Still, it's probably the most dependable "organic" material available. Unfortunately, we don't know of any magic bullets for organic producers, although there are several out there that claim to be. We'll be evaluating some possibilities this season in cooperation with Bryan Hed and Jim Travis at Penn State, and will report these results next year. Nevertheless, growers attempting to produce grapes organically will need to pay <u>strict</u> attention to non-chemical control methods, particularly inoculum reduction. Ideally, this would include removing or burying (tillage, mulch) any mummies that they might encounter at the site. At the very least, it is <u>imperative</u> that <u>all</u> 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 rain-splashed, so they won't go far if said clusters are simply dropped to the ground).

DOWNY MILDEW (DM) NEWS AND REMINDERS

We finally caught a break from the weather last year, at least with respect to disease control programs, but the previous two showed just how "explosive" DM can be when it stays wet. And the winter injury that we got following those wet years was even worse on vines that lost leaves prematurely due to inadequate DM control. 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).

"Primary" infections, originating from overwintering oospores in the soil, require a minimum rainfall of approximately 0.1 inch (to liberate 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, 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 (humid nights, frequent showers, long periods of cloudy weather). As we have found from recent experience.

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 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. Take a look and see which of these possibilities is the case. 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 fungicide 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 virtually complete 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. Although it's highly prone to resistance development, this has never been detected on grapes in the U.S., probably due to its limited use. Abound has provided excellent control every year since we began testing it in 1996, and Pristine has always been equivalent or even a bit better. Note, however, the recent report of resistance to these materials in the mid-Atlantic region, discussed at the top of this tome. Phosphorous acid formulations also 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 may need to be reapplied more frequently in very wet years when disease pressure is high.

To illustrate some of these points, I'll repeat a summarization of some pertinent results from our 2003 and 2004 trials to control fruit infections on Chancellor vines (2005 was boring, almost everything worked perfectly). 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).

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

	DM infection, 2003 Trial		DM infection, 2004 Trial	
Material, rate/A[1]	% Clusters	% Cluster area	% Clusters	% Clstr 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.

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 that year. (ii) Abound and Pristine were clearly superior to mancozeb and phosphonate products (which were roughly equivalent) in 2003, 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 just too long for mancozeb and phosphonates under extreme pressure. (iii) Phosphonate 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.

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 does not grow well in berries until they start to ripen, 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.

A review of some relatively recent findings about this disease:

• Latent infections can be common following a wet bloom period, but the vast majority remain inactive through harvest and the fruit stay healthy. Factors that cause latent infections to activate (cause disease) or not are poorly understood. 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 (just how elevated, specifically, is still not clear) or subject to various mechanical injuries also are more prone to becoming diseased via the activation of latent infections.

• 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. Latent infections established at bloom can be important if they become active and provide the initial “foot hold” from which subsequent 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 good is anybody at predicting September and October weather in June?

• The pronounced impact that cluster compactness 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 berry per cluster inoculated at veraison spread the disease to over 50 berries per cluster by harvest. This single inoculated berry per cluster was meant to mimic the post-veraison activation of a few latent infections initiated at bloom, and vividly illustrates the particular importance of controlling early infections on tight-clustered cultivars (e.g., Vignoles) and clones.

• 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 cultivars and clones (e.g., cluster architecture). Think in terms of early sprays as limiting the establishment of primary infections, and later sprays as limiting disease spread.

3. Fungicides. See the section above, under “Fungicide Changes and News”.

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 multiple spray-timing trials, we’ve found that applications during the early shoot growth period (as clusters first become visible) are the most important for controlling disease on the rachises. 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, unless it’s a very dry spring.

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 how 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 midsummer. 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 once berries become pea-sized, since inoculum is scarce beyond that time.

4. Spray timing to control berry infections. In a trial conducted for 2 years in a problem block of Niagaras (the cultivars most commonly affected by Ph berry rot), we were surprised to find that sprays applied shortly after cluster emergence (the important sprays 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. Control improved when we continued applications through the immediate prebloom phase, and was almost complete when we continued 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, often 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 encounter persistent Ph pressure if they are spur pruned and the wood retained for 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 has been 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 reentry 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. The efficacy of sulfur and copper is limited, but we don't have good recent data. It's too late to worry about dormant sprays, but we're looking at the topic in detail this year and will address it before next season.

7. 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 if it's raining. 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 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", although it may be beneficial even in relatively clean blocks of highly susceptible cultivars in certain (poorly-defined) years. And if you're 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). As discussed above, historical pronouncements concerning reduced activity of sulfur at temps below 65°F appear to have been significantly exaggerated. 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 (don't forget that the activity of these materials is very rate-dependent, particularly in vineyards with a long history of use, so partial coverage with a low rate is unlikely to cut it). Did somebody say alternate row applications? 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 the need for superior 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. Nutrol is <u>much</u> cheaper than the other materials in this group, and has provided control equivalent to both Armicarb and Kaligreen in several of our head-to-head tests. 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 be omitted under most commercial conditions in NY <u>unless</u> 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. On Concord and similar cultivars, we generally recommend waiting until immediate prebloom. However, in 2003 (wet, cloudy spring) we started seeing PM on Concords around the 10-in shoot growth stage, and uncontrolled early infections really spread and caused havoc. This was an unusual occurrence, and Spring 2006 is starting out as anything but wet and cloudy. However, things can change quickly, and it doesn't take long to get out in the vineyard and have a look. No need to spray before you need to, but if you see PM this early, you need to. Now is one of the best times to use an SI, 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 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 wet years, particularly in blocks with some history of the disease. Option A: Abound, Sovran, Flint, or Pristine (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 controlled well last year (limited inoculum) and good BR materials will be used in the next three sprays. Option D: Sulfur (PM). Historical concern about reduced activity during cool weather is going down and temps should 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 have started if previous PM sprays were omitted or incompletely applied. 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 (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, RATES, SPRAY INTERVALS, OR COVERAGE!** Option A: Quintec for PM control, plus mancozeb (for BR, DM, and Ph). Option B. Pristine (PM, DM, BR). The 12.5-oz rate of Pristine will also provide some protection against Botrytis. 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, Pristine, and/or 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 even more comfortable with a limit of two annual applications for all strobies, including Pristine), nor more than two times in a row. Option C: Abound or Sovran (plus sulfur). (PM, BR, DM). Still an effective option in some vineyards, but with significant cautions and/or restrictions. Refer to points #3 and 4 on strobilurin 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, captan, or phosphonate for DM. Option E: 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 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 valuable 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, it 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 both necessary and difficult 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. 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. The main problem is that for Botrytis-specific materials like the AP's and Elevate, you'll be distributing them throughout the entire canopy, whereas the only place they're effective is on the clusters. 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, although Concords can withstand a lot of foliar PM unless ripening conditions are marginal. 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 a potential 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: Quintec (PM) + captan or mancozeb (66-day preharvest restriction, mites) if DM, BR, and Ph control are needed. If DM is the only other issue, Ridomil (in a bad year) or a phosponate are additional options. Quintec and Pristine 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 phosphonate (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, 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**. Also **Botrytis** on susceptible cultivars. 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 (or another strobie + sulfur), not exceeding the recommended maximum number sprays for each. All of these materials provide the advantage of longer residual activity than sulfur, especially in wet weather, but resistance management (limited use) is important. Not to mention cost. 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, 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. A single emergency "rescue" application, should PM blow up for some reason, would be an exception to this warning. For **DM**, phosphonate products have become economical and effective standards; 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. Pristine and Abound will provide excellent activity if they still fit into the program this late, but avoid using them if you've already sprayed a strobie product twice. **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 advisable at veraison and/or preharvest, see previous discussion under that disease for details.

NEW ZEALAND AND SAUVIGNON BLANC.

Tim Martinson

As many of you know, I attended the International Cool Climate Symposium on Enology and Viticulture in Christchurch New Zealand last February. One of the most valuable aspects of traveling to a different region and attending meetings such as this one is the opportunity to compare 'their' industry with 'ours'. I'd like to share some impressions and a few facts and figures about the wine industry there, and then draw some parallels with our experience here in New York. I'll focus only on New Zealand's Marlborough district, which is where most of the wine for export is produced.

The Marlborough region is located on the North end of the South Island. Bordered on the West by mountains that interrupt prevailing winds, the area is one of New Zealand's driest, with temperatures moderated by the neighboring Pacific Ocean and Cook Strait that separates the North and South Islands. It accounts for almost one half of total vineyard area in NZ (about 23,000 acres), and 58% of the annual production. Sixty percent is planted to Sauvignon blanc (15,000 acres; 65,000 Tons) , about 80% of which is produced for export.

This 15,000 acres of Sauvignon blanc in Marlborough grew from zero acres in 1980, when Muller Thurgau was the dominant variety used to produce bulk white wines. Land was cheap.

There were few acres of Sauvignon blanc until after 1985, when a young winemaker entered Marlborough Sauvignon blanc into the London International Wine Challenge. It knocked the judges' socks off, and started the exponential growth that is still continuing today.

What made the NZ Sauvignon blanc so special? The answer is a group of 4-6 chemical compounds called 'methoxypyrazines', and in particular the dominant form of 3-isobutyl- 2-methoxy pyrazine (abbreviated **IBMP**). These chemicals are the principal aroma molecules that produce the characteristic Sauvignon blanc flavor. Wines produced in Marlborough have 4 to 10 times more **IBMP** than Sauvignon blancs from anywhere else in the world. That makes their aroma more intense, and the wines more desireable.

Interestingly, as cited by one speaker, all of the IBMP produced in the 53,000 metric tons (about 60,000 English tons) of fruit would weigh 2.2 grams if it were possible to separate it out. Quite literally, the success of the NZ wine export industry is built upon that 2.2 grams of aromatic chemicals produced in the unique climate of Marlborough.

NZ's success in the export market demonstrates that a relatively small player (a drop in the bucket along side of Australia's wine exports) can succeed with a unique signature product. Moreover, NZ Sauvignon blanc sells at a higher average price than do Australian exports.

Research Focus. Given the importance of IBMP and other flavor components to NZ's success, a good deal of effort is being expended in finding out how to consistently produce them. Like other cool climates (theirs is a bit cooler than ours, at about 2100 growing degree days, compared to our 2400), they see a lot of variability in the timing of harvest and big see-saw fluctuations in average yield, between 6 and 12 metric tones per ha (2.8 to 5.5 tons/acre). Researchers are actively looking at how growing and winemaking practices influence these flavors and the balance of their wines. It is an integrated effort starting with vineyard practices and carrying all the way through to wine chemistry and sensory evaluations. One example was the impact of cropping level on acid and sugar levels:
Standard pruning (4 canes) was compared to a reduced number of canes (2-cane). At 5 sites, bloom occurred over about 7 days; veraison over 8 days, and harvest (at 21.5 brix) over 28 days. Leaving 2 canes rather than 4 accelerated sugar accumulation, translating to about a week's difference in harvest, while decline in acids (titratable acidity) was not affected by the reduced crop. So the cropping level completely changed the balance between sugar and acidity.

Similarly, different vineyards in the same year or the same vineyards in different years showed a 20 to 70 fold difference in the final concentration of the IBMP flavor compounds. This had a strong effect on flavor intensity of the wine.

Lessons for the Finger Lakes? The Marlborough region is an undeniable 'sweet spot' for producing intensely-flavored Sauvignon blanc wines that are highly desired in the marketplace and that command premium prices in export markets. The Finger Lakes is gaining a reputation for producing Riesling with very desirable flavor characteristics. Will our region be able to capitalize on its emerging 'signature' wine?

One key to doing so will be understanding the diverse flavors Riesling produces, where they come from and how vineyard and winemaking practices influence these flavor profiles. Our climate consistently produces superior riesling wines - and one advantage this variety has for growers is that even in a poor growing season the flavors are there to produce acceptable wines. Not only are the flavors appealing, they also vary consistently from vineyard to vineyard. Keuka Lake Riesling does not taste like South Seneca Lake Riesling.

How much Riesling can the Finger Lakes support? Supply is short with the existing 400 acres, and wineries routinely 'sell out' of riesling in a few months. Whether the ultimate acreage the region can support is double what we have now, or a nice round figure like 1000 acres, it appears that the developing national market and recognition make this a premium wine that can compete nationally and internationally with any other region in the world. That should provide a solid foundation for growth in Riesling acreage. While other wines, like 'traminette' and 'vignoles', for example, arguably have similarly unique flavor profiles, their current market is largely limited to a smaller regional consumer base that visits our local tasting rooms. The 'Wine Spectator' does not feature Traminette, wonderful as it is.

Lets take a page from the New Zealand experience and capitalize on what the region does well by 'farming for flavors'. Understanding what flavors the region can produce, 'where', and how vineyard practices can be tweaked to enhance them are keys to exploiting this market opportunity. The developing national premium Riesling market will also help wineries market and sell other wines from the region. This will benefit all growers in the Finger Lakes.

Upcoming Events

May 18. *Spring Pest Management Field Day*. Lakewood Vineyards, Watkins Glen. 3 Pesticide credits. Preregistration Required. Call us at 315-536-5134

July 11-13. *American Society of Enology and Viticulture Eastern Section.* Rochester, NY. Meeting will feature official release of new cultivars from Bruce Reisch's program, and an update on multicolored asian lady beetle. Details in next month's newsletter.

June 5 - 6, 2006 – Uncorked Grape and Wine Industry Conference and Trade Show. Niagara College, Glendale Campus, 135 Taylor Road, Niagara-on-the-Lake, Ontario. This year, the conference will address two major themes: Cold Hardiness and The Market. The first ever Niagara based two-day conference will feature local and international speakers and best-of-class exhibitors. A closing panel discussion will address the challenges and opportunities ahead and form the foundation for an action plan for our industry. To view the schedule, visit: http://www.uncorked.info/schedule.html To register, visit: http://www.uncorked.info/register.html

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