FINGER LAKES VINEYARD NOTES

Newsletter 4 April 26, 2002

CORNELL Cooperative Extension
Finger Lakes Grape Program

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ANNUAL SPRING SPRAY MEETING

May 23, 2002, 3:00-6:00 PM, Lance Fullager Farm, Old Bath Rd, 4 Mi S of Penn Yan. Join us for our annual Spring Pest Management Update and barbecure. This year we will have updates from the NYS DEC on worker protection, pesticide storage, and record keeping; updates on disease, insect, and weed management, and updates from industry on product labels and uses. We will also introduce Dr. Juliet Carroll, new IPM program Fruit Coordinator.

The meeting will be followed by a barbecue featuring food, grape juice and wine, chaired by a member of the Bluff Point Benevolent Barbecue Association. Wine and juice will be served - we will have wine purchased for or donated for the grape convention, but if you are associated with a winery, consider bringing a bottle to share. **We recommend that you bring a portable lawn chair to sit on**. *Please preregister with our office* by calling 315-536-5134, by e-mail (tem2@cornell.edu) or by filling in the registration form included with the newsletter**. Please bring your pesticide certification number. Up to 3 recertification credits are anticipated.**

Program Schedule:

2:45 – 3:00	Sign up for pesticide credits
3:00 – 3:20	*Worker Protection, Pesticide Storage and Record Keeping Options.* **Ed Hanbeck**, NYDEC. Bath, NY.
3:20 – 3:40	*Weed and Floor Management Update, and What's New in the NY and PA Grape Pest Management Guidelines.* **Tim Weigle**, Grape IPM Specialist, Finger Lakes and Lake Erie Regional Grape Programs.
3:40 – 4:00	*Insect Management Update with emphasis on Grape Cane Borer.* **Greg English-Loeb**, Dept. Entomol. NYSAES.
4:00 – 4:20	*Grape Disease Management Update.* **Wayne Wilcox**, Dept. Plant Pathology, NYS AES, Geneva, NY
4:20 – 4:30	*Plans for the IPM Fruit Program.* **Juliet Carroll**, Fruit IPM Coordinator, NYS IPM Program.
4:30 – 5:15	**Industry representative updates on label changes and new products**. Technical representatives from chemical companies will speak about label changes and product updates.
5:15 – 6:00	*Sprayer setup options for early season sprays – including demonstration.* **Andrew Landers**, Senior Extension Associate, Dept. Agricultural and Biological Engineering. NYSAES, Geneva, NY
6:00	*Barbecue*, Sponsored by **industry representatives**, and cooked by the **Bluff Point Benevolent Barbecue Association**. Certificates will be distributed at this time.

GRAPE DISEASE CONTROL IN THE FINGER LAKES 2002

Wayne Wilcox
Department of Plant Pathology
Cornell University, NYSAES, Geneva

Time for the annual review of new developments and various options on the disease-control front. As always, I'd like to acknowledge the outstanding team of grape pathologists here in Geneva, including faculty colleagues (D. Gadoury, R. Seem), research technicians (Duane Riegel, Judy Burr), and graduate students and postdocs becoming too numerous to mention, all of whose research efforts are the bases for most of the following.

Fungicide Changes & News

Benlate cancellation. As many know, Benlate is history. Worldwide manufacture halted in 2001, sale and distribution of product remaining in the "pipeline" will be allowed through the end of 2002. All registrations have been cancelled, although it still is legal to use whatever product is on hand, according to label directions. EPA "expects" that use of such product will end in 2003, and is seeking comment on its proposal to revoke residue tolerances (thereby making any residue in fruit or wine illegal after a reasonable length of time). So, use what you have, but don't stockpile. Benlate is a minor fungicide for NY grape producers, used primarily to protect major pruning wounds against Eutypa. An application to register a closely-related benzimidazole fungicides (Topsin-M) for use on grapes is currently being considered by the EPA.

ProPhyt, Aliette, and phosphorous acid. ProPhyt (potassium phosphite) is a formulation of phosphorous acid (PA) that is now labeled by the EPA to control downy mildew on grapes (NY registration is still pending, but may be forthcoming by summer). It does not control any other major grape disease. Various formulations of PA have been used for approximately 15 years to control downy mildew in Australia, and I repeatedly have gotten excellent results with several different formulations (including ProPhyt) in my own trials, even under very high pressure.

PA provides good post-infection control of downy mildew, but because it is highly mobile in the plant, the Aussies contend that it has only a few days' worth of residual (protective) activity before it gets shipped down into the roots. Thus, they tend to spray it after an infection period has occurred, tank-mixing with a traditional protectant (such as mancozeb or copper) to provide forward protection against the next one. In my own trials, I've applied it at 14-day intervals without any sort of tank mix and obtained virtually complete control every year, even in very wet seasons such as 2000, where nearly 70% of the berries on unsprayed vines became diseased. However, I haven't scrutinized these trials to determine just when the various infection periods occurred with respect to the timing of applications.

PA is so popular in Australia because it is quite cheap there (just a few dollars per acre). Since ProPhyt is not yet sold in NY, I don't know what the price will be locally (probably more than in Australia!). IF they are priced right, this and other PA formulations that may come along could certainly find a place in eastern vineyards, particularly if an otherwise-desirable disease management program is weak on downy mildew control. They're worth getting some experience with, provided they make economic sense. (A note on rates: The ProPhyt label that I've seen specifies a concentration of 0.3%, but this assumes a sufficient water volume for complete coverage. Thus, we've used 1.2 pints per acre prebloom [assuming a spray volume of 50 gal/A for complete coverage] and 2.4 pints per acre postbloom [assuming 100 gal/A spray volume]).

Aliette is a product that has been around for many years, but just received registration on grapes last summer. It breaks down into PA once sprays have entered the plant, so basically does the same thing as PA products but at a much higher cost (about $30-50 per acre at the recommended rate for grapes). Patent issues protected Aliette against cheaper PA products in the past, but the patent has now expired.

Nationally, there are additional products containing PA that are being sold as nutritional supplements or "plant conditioners", without claims for their disease control activities. Of course, they're effective nevertheless. One such product that we worked with last year is Prudent Plus, a mixture of PA, monopotassium phosphate (which is labeled for powdery mildew control as Nutrol), and various organic compounds that are claimed to improve plant growth and health. In our trials last year, treated vines were virtually free of downy mildew and powdery mildew control was fair to good (better than Nutrol, worse than conventional fungicides).

Messenger. Messenger is a unique and interesting product now registered for control of grape diseases. It is a nontoxic protein that stimulates natural defense responses in some plants, thereby providing variable levels of resistance to disease-causing organisms. The only problem is, there is no convincing evidence that this occurs in grapevines. On the contrary, such an "induced resistance" response is notoriously difficult to elicit in grapes, although many people (including a graduate student in my own program) have tried to do so using various techniques and products. Furthermore, I have obtained poor disease control in previous grape trials where Messenger has been used without additional fungicides; however, these were conducted a few years ago and it's possible that the formulation has improved by now. Results from several grower demonstrations that I helped evaluate last year in cooperation with a juice grape processor could best be described as "inconclusive". Although my experience with the product is limited, it is not consistent with some claims in recent advertising. Those interested in the product may wish to evaluate it for themselves on a limited, trial basis.

Serenade. Serenade is a product whose active ingredient is a soil bacterium (*Bacillus subtilis*), which is registered for biological control of powdery mildew and Botrytis. In two trials last year (light disease pressure) we got fair to good control of powdery mildew when Serenade was rotated with Sovran on both the hybrid variety Rosette and on Concord. In a Botrytis trial in 2000 (moderate pressure), four applications of Serenade alone (no other fungicide) provided zero control of that disease. We're continuing to evaluate it this season. Limited experience causes me to still view it as an experimental product; on a commercial crop, I'd be more comfortable experimenting to control powdery mildew rather than Botrytis. A formulation being sold in NY is certified for organic production.

Other "alternative" products for powdery mildew. As discussed last year, a number of non-traditional products have been registered recently to control powdery mildew on grapes. They work, to variable extents, but it helps to understand why. Powdery mildew (PM) is an unusual disease, since the fungus that causes it lives almost entirely on the surface of infected leaves and berries (the powdery stuff you see when control breaks down). Thus, it is "naked" and subject to (temporary) eradication following topical treatment with a range of products that don't affect other disease-causing fungi, which do their dirty work down inside the plant tissues where they're protected from such treatments. Some such products are listed below.

- *Nutrol (monopotassium phospha*te). We've been working with this dual purpose material (foliar nutrient plus powdery mildew fungicide) every year since 1996, with moderate results. In greenhouse tests, we've found that Nutrol provides no significant control when applied before plants are inoculated with powdery mildew spores. In contrast, it provided significant control when applied within 3-7 days after exposure to the spores, i.e., when applied directly to the developing PM colonies.

  This scenario suggests that Nutrol should be more effective when applied relatively frequently (repeated knock-downs), rather than relying on residual protectant activity between sprays. Indeed, we've gotten significantly better control in 2 seasons of field trials when applying 4 lb/A every 7 days rather than 8 lb/A every 14 days. I strongly suspect that this same general principle (one-shot knock-down against young colonies, with little subsequent protective activity) will apply to most of the "alternative" PM control products. Thus, they may need to be applied more frequently than many traditional products.

- *Kaligreen, Armicarb 100 (potassium bicarbonate*). We haven't worked with Kaligreen, but Armicarb 100 has performed similarly to Nutrol in field trials. Photos in the trade press showing dead PM fungus on treated plants also is consistent with the activity we've seen from Nutrol (topical, eradicative effects with no evidence of residual protectant activity).

- *Oxidate (hydrogen peroxide*). Registered for control of powdery mildew and Botrytis. We haven't worked with it. I believe the claims for PM control, but doubt those for Botrytis (see above). Will probably require frequent applications.

Finally, remember that the activity of these topical materials is entirely dependent upon their contact with the PM fungus. Don't waste your time and money if you can't provide thorough coverage.

Strobilurin fungicides. These materials (Abound, Sovran, Flint) have been discussed at length for the last 2 years. Thus, just a few updates and reminders:

- The "strobies" are retained primarily in the waxy cuticle of treated leaves and berries. Thus, they

are excellent protectant fungicides when applied before an infection period begins but have only limited postinfection activity against most diseases (can't get down into the deeper tissues where the fungus gets established). Although they appear to have additional postinfection activity against powdery mildew (which lives mostly on the surface, remember), over-reliance upon such activity increases the risk that the fungus will become resistant to these materials.

- Resistance development is a very real and serious threat. Although nobody understands why, it appears that the risk and speed of this happening may be significantly different for different disease-causing fungi. For instance, several specific diseases on grasses and grains, cucumbers, and melons can no longer be controlled with strobies in some production regions, after only a few years of use. In contrast, similar problems have not yet surfaced with respect to control of powdery mildew on grapes, despite considerable worldwide use, although there have been some overseas reports of problems with downy mildew. These products still work for us, but there's no guarantee that will continue indefinitely. Because of their current importance to producers throughout the Northeast, they should be used conscientiously in order to reduce the probability of resistance developing, so that they will continue to be effective.

- The only sure-fire way of reducing the risk of resistance is by reducing the number of sprays applied. Use the strobies when they're really needed, but don't overdo it. The seasonal limit for wine grapes is four applications, but two or three is better. Juice grape growers may make up to three applications per season, but they should be sure to rotate with other fungicides to control the two mildews and black rot, even if they're only applying two or three such sprays in total. And trying to "put out a fire" with these materials if disease gets out of hand is just asking for trouble. This is a simple numbers game: the more fungal individuals that are present, the greater the chance of selecting a resistant one when you spray.

- In addition to the numbers game cited above, recent research suggests that resistance is more likely to develop when strobies are applied to a growing fungus (i.e., postinfection) rather than in a protectant mode which prevents spore germination and infection to begin with. Other than avoiding deliberate postinfection applications, this means that excessive spray intervals (>14 days) also should be avoided. For powdery mildew, in particular, almost every day in the late spring and summer is a potential infection period (rain not necessary, temperatures very favorable). Thus, whenever a new (unsprayed) leaf emerges after a given fungicide application, the next spray will be "reaching back" to provide postinfection control of whatever mildew may have started after that leaf emerged. Thus, the longer the spray interval, the more infections that may have occurred and the longer the necessary reach-back activity will be.

Finally, consider these factors but keep them in perspective. The sky isn't falling. These materials do work. But be responsible and keep it that way.

Mancozeb and mites. This has been talked about quite a bit the last few years. Trials supervised by Jan Nyrop and Greg English-Loeb in the Entomology Department have consistently shown that fungicide programs that include regular mancozeb sprays will reduce the level of predatory mites (those that eat the spider mites), by an average of about 50% relative to programs where captan was substituted instead. In a few cases, this encouraged the buildup of spider mites, but not in the majority of trials. In an experiment last year, there was no effect on predators when mancozeb was limited to two sprays prior to bloom.

These effects are real. As with so many things, the risk (incompletely defined) and benefits (broad spectrum and economical disease control, 24 hr REI) need to be balanced. How to, specifically, is a personal decision. My feeling is that mancozeb still has a place, but that it should not be used indiscriminately. We're still working on trying to supply you more specific details than that.

Powdery Mildew (PM) News and Reminders

To control PM on the berries, use best materials, full rates, and thorough spray coverage (every row!) from immediate prebloom through 2 weeks (Concords) to 4 weeks later. You all know that fruit are highly susceptible from the start of bloom through fruit set, then become highly resistant to immune fairly quickly thereafter. If you try to cheat during this period and get caught, don't say you weren't warned.

Failure to control inconspicuous PM infections on the berries can increase the severity of berry rots (Botrytis and sour rot) at harvest. In each of the last 4 years, David Gadoury has shown that when unprotected berries of several V. vinifera cultivars were inoculated with PM spores about 4 weeks after bloom (near bunch closing), very little visible PM developed. However, such berries did develop a fine network of nearly microscopic infections and had much higher levels of rot at harvest when compared with berries that were protected against infection at that time. Furthermore, even when the inoculated berries didn't rot, they supported much higher levels of spoilage microorganisms, and wines made from these berries (by Thomas Henick-Kling's program) had noticeable off-flavors compared to the PM-free control group.

Bottom line: This isn't the only cause of berry rots and wine spoilage, but it's one that's very easy to avoid. Good PM control 4 weeks after bloom is a cheap and important safeguard of wine quality.

A quick review of PM biology with respect to management considerations.

- 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're protected. Thus, the amount of fungus capable of starting disease this year is directly proportional to the amount of disease that developed last year (we even have numbers to prove the obvious). One consequence of this is that PM sprays during the first few weeks after bud break are likely to be far more important where PM was a problem last year, compared to blocks where most of the foliage remained clean through leaf fall.
- Although leaf wetness isn't required for PM to spread once it's established, the first infections of the season do require rain to get started. Thus, the relative lack of spring rains last year may have contributed to the relatively low levels of PM that were observed in many vineyards throughout the region. Cluster disease severity over a number of years also has been correlated with the number of rain events during the period of maximum fruit susceptibility. Although PM is not influenced by water to the same degree as other fungal diseases, the relative need for control will be influenced by the frequency of rain events, particularly those during the first half of the season.
- Once PM gets started, disease spread is influenced primarily by temperature. Below is a table summarizing work conducted in California during the 1950's, showing how (constant) temperature affects the number of days from the time a spore lands on a leaf until it produces a PM colony with a new generation of spores to cause disease spread.

Temp. (°F)	Days
46	25
54	12
61	7
73	6
81	5
90	not active

This is the "guts" of the current University of California PM model, which allows growers to back off their spray program when temps consistently stay in the 90's. In our region, these data may be most useful as a reminder that PM is relatively slow to develop when spring temps are cool, but can spread rapidly once we get warm days and nights.

- Many observers have noted that PM "hot spots" often develop close to bodies of water or in other humid sites. Recently, our research (conducted under controlled conditions) has confirmed that disease severity increases significantly as the relative humidity increases. Thus, the higher average humidities associated with wet years appears to be more conducive for disease development (tighter spray program needed) than the lower humidities associated with dry years.

Don't overly-rely on either the strobilurin or the SI fungicides. Just another reminder of the need for resistance management, in case you missed the sermon above.

Fungicides. Flint is the best thing out there (A+), but is weak against downy mildew; Sovran also is excellent, more of an "A" than an "A+", but is stronger on downy; Abound is an "A-" , but is excellent against downy, significantly better than the other two under pressure situations. Everybody knows that the SI fungicides have slipped, but they still have their place in rotational schemes; most growers no longer rely on them very heavily during the critical period from the start of bloom through early berry development. Sulfur is cheap and effective. Newer non-traditional products are discussed above.

Black Rot (BR) News and Reminders

As fruit mature, they become increasingly resistant to infection AND infections take longer to show up. This is old news by now. 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 about 2 more weeks. Not surprisingly, this acquisition of age-related resistance happens a bit more quickly (faster by a week or so) in warm summers relative to cool ones. As often noted, we've regularly obtained excellent control with sprays applied at the start of bloom plus 2 and 4 weeks later, which provide protection during the period of peak susceptibility and most or all of the remaining susceptible time. Some growers get good control with just the first two of these sprays. Some try to and don't. Obviously, inoculum availability and weather have a lot to do with how far you can push things.

We've also found that clusters infected within a 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. In contrast, clusters infected near the end of their susceptible period showed virtually no symptoms 21 days later, and those symptoms that did develop failed to appear until 23 to 33 days after infection. Significance: Black rot that begins to show up in early- to mid-August is probably the result of infections that occurred in early- to mid-July. This fact should be considered when trying to determine "what went wrong" should such disease occur.

The SI fungicides are most effective in "reachback" activity, whereas the strobilurins are most effective in "forward" activity. In field experiments last year, we inoculated young berries at various intervals both before and after sprays with Nova and 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.

BR pressure is extremely dependent on overwintering inoculum levels. We, and many growers, have grown accustomed to ignoring the consequences of BR infection periods that occur before the start of bloom. Research and experience has shown that this is possible when overwintering inoculum levels are low, as they are in most commercial vineyards, since the spores produced from any early leaf infections are few and far between. Thus, they are easily controlled by the critical sprays applied as fruit begin to form. Scarce overwintering inoculum also reduces the chance that fruit will become infected from this source before such spores are depleted in the early postbloom period, thereby allowing BR sprays to stop early if the vineyard is clean. In contrast, heavy disease carryover from the previous year may require protection of the foliage 2 or more weeks before bloom along with protection of the fruit until they are highly resistant.

Mummies retained in the canopy provide significantly more pressure for BR development than those dropped to the ground. Once again, this concept is getting to be old history. Few growers got much black rot last year, and even fewer left their mummies in the canopy. Those that did usually had their reasons. Nevertheless, don't forget how much additional control you can provide by the simple practice of dropping mummies to the ground during hand pruning or follow-up.

Fungicides. Nova and Elite remain the "kings". Unfortunately, the most important time to control black rot (bloom and early postbloom) is when we're trying to substitute strobilurin fungicides to control PM. As with so many other things, there are trade-offs, it just depends which disease is more important to you. That being said, Abound, Sovran and Flint do provide very good to excellent control, equal to mancozeb, ziram, and ferbam under moderate pressure and superior to them under heavy rains (they're less likely to wash off). Of course, mancozeb, ferbam, and ziram are old standards and will provide good control under most commercial conditions. Captan, Rubigan, and Procure are fair. Copper is poor.

Downy Mildew (DM) Reminders

Disease biology. Recall that primary infections can occur from about 2-3 weeks before bloom until fruit set, so this is the critical time to prevent DM from

getting established. The disease has a complex biology, requiring rain splash to get the first spores from the fungus' overwintering sites in the soil up into the canopy, then humid nights followed by rainy days to get it to spread. Nothing happens unless all of these "stars are in alignment", but spread can be explosive with a 4-5 day generation time when everything is right for the fungus (or wrong for the grower). Spread is most rapid at temps of 65-77°F (no activity over 86°F), although it can occur down into the 50's. A current threshold for determining the time of the first possible infection is (i) a temperature of at least 52°F, accompanied by (ii) at least 0.1 inch of rain, after (iii) vines have reached a growth stage corresponding to 5-6 unfolded leaves with fruit clusters clearly visible.

The disease typically "goes on vacation" once warm, dry weather hits in the summer, and it can take some time for it to reactivate 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 (see below). No need to spray for it when it isn't there, but don't let it get rolling if it's active. A weather-based computer model to provide guidance on such decisions is currently being refined.

Fruit susceptibility. Clusters of some varieties are highly susceptible to infection as soon as the fungus becomes active during the prebloom period. However, recent research indicates that berries become highly resistant to infection as quickly as 2 weeks after the start of bloom, although berry stems remain susceptible for a few additional weeks. 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. Recommended materials consistently provide excellent control of fruit and cluster stem infections using this schedule, on the worst possible variety under high inoculum pressure. Ongoing research is designed to more precisely identify the critical periods for control within this window of vulnerability.

Fungicides. Ridomil remains the best downy mildew fungicide ever developed for use on grapes, but its cost and lack of activity against other diseases limit its general usage. It's also highly prone to resistance development. .Abound has provided excellent control every year since we began testing it in 1996. Phosphorous acid formulations (see beginning section) have typically been equivalent to Abound in my trials on Chancellor. Sovran is marginal, 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.

Botrytis News and Reminders

Biology. The Botrytis fungus is a "weak" pathogen that primarily attacks highly succulent, dead, injured (e.g., grape berry moth), or senescent (expiring) tissues such as wilting blossom parts and ripening fruit. The fungus thrives in high humidity and still air (optimum temperature range is 59-77°F), hence the utility of cultural practices such as leaf pulling and canopy management to minimize these conditions around the fruit zone. Young fruit can become infected through attached blossom parts, with the infections remaining latent (dormant) until some resume activity and rot the berries as they start to ripen. Although latent infections can be common following a wet bloom period, the vast majority remain so through harvest (i.e., the fruit stay healthy). Factors that cause latent infections to activate or not are poorly understood, although high humidity and tissues with excessive nitrogen content (how high, specifically, is not defined) appear to be two factors that promote this process. Botrytis is a disease that is governed by complex interactions between the grapes, the weather, and the fungus itself, many of which remain poorly understood.

Susceptibility. There is a long-running debate about when berry infection is most likely to occur, and thus, when protective sprays are most beneficial. One school of thought is that most fruit rot is simply due to the preharvest activation of early latent infections, i.e., disease symptoms at harvest are merely the expression of infections that were initiated back during bloom. By this thinking, sprays through late bloom should provide all the benefit that any fungicide program can, and later sprays would be unnecessary. This has NOT been our experience in New York, nor of colleagues in France.

A second school of thought is that early, latent infections do indeed account for some proportion of the rotten berries seen at harvest, but that berries are actually most susceptible to acquiring infections from veraison onwards. By this model, activated latent infections are perhaps most important as a source of Botrytis spores within the clusters, which can then spread the disease to other berries as they

become highly susceptible during the post-veraison period. Thus, sprays at or after veraison should be very important since they protect berries when the fruit are most prone to infection, although early sprays also can provide significant benefits by reducing the opportunity for the fungus to establish itself within the clusters. Our research and experience supports this second model.

Varieties and clones with tight clusters also appear to be at increased risk of developing Botrytis. In order to examine the effects of both cluster architecture and berry age on disease development, we inoculated Botrytis spores onto berries of a tight- and loose-clustered clone of Pinot Noir (PN29 and Mariafeld, respectively) at late bloom, pea-sized berry stage, bunch closure, and veraison. Also inoculated were PN29 clusters that had been thinned after fruit set to approximate the looseness of Mariafeld. Two findings stood out in both years of the experiment:

- *Although the incidence of latent infection was similar among all three clonal treatments, significantly more berries developed gray mold in the tight PN29 clusters than in the Mariafeld or unthinned PN29 clusters*. Thus, cultural, mechanical, or chemical practices that loosen clusters should aid in control of Botrytis. Unfortunately, there are no easy recommendations, although various options are being tried.
- *Inoculations at veraison produced significantly more disease than did inoculations at any other time*. For instance, inoculations from bloom through bunch closure produced virtually no rot in Mariafeld or thinned PN29 clusters (despite the existence of latent infections), and only 4-15% of berries in the unthinned PN29 clusters became diseased. In contrast, inoculations at veraison resulted in 6, 16, and 41% berry rot within the Mariafeld, thinned-, and unthinned PN29 clusters, respectively.

In a different experiment on Chardonnay, we inoculated fruit to provide 0-5 moldy berries per cluster 2 weeks before harvest. Not surprisingly, there was a direct relationship between the number of initial infections and subsequent disease spread: 1, 10, 24, and 40% of all berries eventually became diseased following inoculation of 0, 1, 3, and 5 berries per cluster, respectively. Thus, the establishment of only a few early infections led to significant spread as the berries ripened.

Despite these theoretical issues, the real question is, What kind of spray program works? To examine this, we've conducted spray-timing trials for the last 6 years in a Finger Lakes vineyard of the susceptible hybrid 'Aurore'. Conclusions from the 4 years in which significant disease developed are:

- in two of the years, equivalent control was provided by applying either two early sprays (bloom, bunch closing) or two late sprays (veraison, 2 weeks later), with no additional benefit from applying all four;
- in the two other years, sprays at veraison plus 2 weeks later provided good control but was improved further by adding applications at bloom and bunch closure;
- in one of those years, the two early sprays provided little control by themselves, although they did improve the activity of the two late sprays when all four were applied. Thus, it appears that the late sprays always provided benefit (about 50-90% control relative to the unsprayed vines), that this control was sometimes improved when the early sprays were applied first, and that early sprays by themselves provided inconsistent results.

Fungicides. Cultural procedure (especially promoting good air circulation and avoiding excessive nitrogen) are perhaps more important for controlling Botrytis than for any other fungal disease of grapes. Recognizing this, the availability of new Botrytis fungicides provides significant new tools to complement (not replace) the cultural control tools.

Vangard has been our most consistent performer. It's absorbed by the blossoms and fruit, thus should have limited reachback activity and doesn't wash off. It's highly prone to resistance development, so shouldn't be the only fungicide used over a period of time. The label allows two sprays per season, some European countries allow only one (resistance management). DO NOT rely on this single fungicide year after year.

Elevate has been a bit less consistent in our trials, although it appears to be a good fungicide and others have had more better results. It is a protectant fungicide that doesn't enter the blossoms or fruit, but is quite rainfast. It should be a component in rotational strategies.

Rovral has a long and well-discussed history. Although primarily a protectant fungicide, it does

enter sprayed tissues; 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 over-use led to resistance development and erratic activity in some vineyards. The good news is that, unlike other fungicides, resistance to Rovral declines over time if it is withdrawn from the spray program. Many growers have given it a "vacation" for the last couple of years, thus it is possible that Rovral might be safe to use in such situations for a maximum of one application per year. I see Rovral's place as a potential component in a rotational package, but don't think it should be the primary component in vineyards with a long history of use.

The strobies have performed well for us under moderate pressure. In limited trials, they have provided benefit when applied at bloom and bunch closing when followed with a Botrytis-specific fungicide at veraison and preharvest (we've used Vangard and Rovral). This strategy has the obvious benefit of taking resistance pressure off the other options while getting additional Botrytis control for free if using the strobies then anyway, but hasn't been tested thoroughly enough that I'm confident in recommending it. Appears promising enough that some may wish to experiment with it themselves if they're interested.

Control programs. Veraison appears to be the most important (but not only) time for fungicide applications, so near this time is when the best materials (Vangard or Elevate) should be used. Decisions about a subsequent preharvest application should be guided by weather, variety, current disease levels, and nerves.

Unless it's very dry, additional protection at bloom and/or bunch closure will probably improve the control provided by the later sprays. The negatives of doing so are cost and the desire to limit sprays to reduce the risk of developing resistance to the Botrytis fungicides. Whether to go with a strobies, one of the Botrytis-specific materials, or nothing should be influenced by weather, susceptibility and value of the particular variety/clone, and aversion to risk.

Phomopsis (Ph) Reminders

Early sprays control 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 three different fungicide trials, we have found that the early, traditional Ph sprays (early shoot growth, as clusters first become visible) provide excellent control of these infections

Canopy architecture and management. Phomopsis spores are rain-splashed onto susceptible tissues from their overwintering sites within old wood, spurs, and pruning stubs in the canopy. Gravity makes them go down. Thus, we tend to see much worse problems in native American varieties (pendulous growth, usually drooping beneath these inoculum sources) rather than upright-growing V. vinifera and hybrid varieties. The latter aren't necessarily more resistant, but they do escape many of the potential infections that natives don't. And of course, management systems that retain a lot of old wood (e.g., mechanical hedging) increase the inoculum load and associated disease pressure within that vineyard.

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

Abound, Sovran, and Flint have all been mediocre in my trials. We have had only one good test of the strobies against rachis infections; they provided significant control, but not as good as that provided by the traditional (and cheaper) protectant fungicides. Trial results from Michigan have shown good control of fruit infections by Abound. The jury's still out on the strobies, in my opinion, but there's no reason to use them early. Let's hope they're adequate during the bloom and early postbloom period (fruit rot control) when they're most likely to be used for other diseases.

Spray application technique. Many growers like to spray alternate rows in the very early season,

assuming that sufficient spray will blow through the target row and impact on vines in the "middle" row. Last year, in cooperation with Andrew Landers, we examined this issue. A commercial 'Niagara' growers applied 25 gal/A to part of his block by spraying every row, and with another machine he sprayed 25 gal/A using alternate rows. Spray deposition was measured and disease was rated. In the first spray (a few inches of shoot growth), both systems delivered the same average amount of fungicide to the canopy, but the alternate-row depositions were much more variable. In other words, some leaves were plastered whereas others were missed. In the second application (prebloom), vines in the middle row captured less spray than their every-row counterparts. Although dry weather limited disease development, there was some rachis infection in the alternate-row treatment but virtually none in the every-row.

Don't fix it if it ain't broke, but if you're having trouble controlling Ph and are using alternate-row spraying, the suggested remedy is obvious.

Putting It All Together

We all know that there are many good programs for controlling these diseases. Here are a few considerations. As always, just because it isn't listed here doesn't mean it's a bad idea. Only products currently labeled in NY State are listed.

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

3-5 INCH SHOOT GROWTH. A traditional time to control **Ph** shoot infections. Perhaps more importantly, our recent evidence indicates that this also is an important time to control rachis infections, which can occur once clusters emerge. 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. It's a hard thing to prove, but I'm not so sure this spray is that important in vineyards that were "clean" last year (little overwintering inoculum). If you're spraying anyway for Ph, it won't hurt to add something for PM, but this is probably the least important PM spray of the season. More likely to be important under relatively warm conditions (>65°F), less important if cool. BR control is seldom justified unless you're trying to clean up a real problem block AND weather is wet. Option A: Nothing. Option B: Mancozeb (BR, Ph). Option C: Captan (Ph). Easier on predator mites than mancozeb (or ziram), but not as effective against BR (which seldom matters at this time). Option D: 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 tank rates. Option E: Rubigan (PM). At 2 fl oz/A (minimal labeled rate), cost is only about $4. Cheaper than Nova and Elite, especially if BR control isn't an issue. Option F: Sulfur (PM). Not very active at temps below 60°F, but neither is the PM fungus. Doesn't control other diseases. Option G: JMS Stylet Oil (PM). Should eradicate young infections IF thorough coverage is provided. Can use with mancozeb (or ziram), but not with captan (phytotoxicity). Option H: Nutrol (PM). Should eradicate young infections IF thorough coverage is provided. Option I: Serenade, if you want to experiment with minimal risk. Option J: One of the PM products plus mancozeb or captan for Ph.

10-INCH SHOOT GROWTH. Traditionally, we've recommended not to wait any longer to control **BR**. Continued experience tells us that this recommendation is conservative (the spray generally isn't needed) unless BR was a problem last year (inoculum levels are high) and weather is wet and warm. Don't wait any longer to control **PM** on susceptible varieties (but wait until immediate prebloom on Concords). One of the best times to use an SI, also a possible time to experiment with "alternative" materials. **DM** control will be needed on highly susceptible varieties if disease was prevalent last year and rains of at least 0.1 inches at temps >52°F occur. Rachis infections by **Ph** are a danger in blocks with a history of the disease. Option A: Abound, Sovran, or Flint (PM, BR, some Ph; also, variable DM). Legal, but not the most efficient time to apply these materials. Expensive and increases resistance pressure if you intend to use them later, when they're really needed. Option B: Mancozeb (BR, Ph, DM). A broad spectrum, economical choice if PM isn't a serious concern. Or tank mix with a PM material. Excessive use sometimes leads to mite problems by suppressing their predators. Option C: Nova or Elite (PM, BR). Option D: Rubigan (PM). Poor BR (usually not a problem if effective materials are applied in the next three sprays) but cheaper than Nova and Elite. Option E: 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. At a retail cost of $11/gal, a use rate of 1% (1 gal oil /100 gal water), and 50

gal/A spray volume, cost is about $5.50/A. But don't waste your money if you can't cover thoroughly. Also may help with mites. Option F: sulfur (PM). Reduced activity (of both the sulfur and fungus) at low temperatures can still be an issue at this time of year. Option G: Mancozeb (BR, Ph, DM) + a PM material (SI fungicide, sulfur, JMS Stylet Oil, Nutrol). Choose PM material based on previously-discussed characteristics and cost.

IMMEDIATE PREBLOOM TO EARLY BLOOM. **A critical time for PM, BR, DM, and Ph (fruit infections).** A good time to use a strobilurin on PM susceptible varieties. **This and the first postbloom spray are the most critical sprays of the season--DON'T CHEAT ON MATERIALS, RATE, OR COVERAGE!** Option A: Abound, Sovran, or Flint. Abound is very good to excellent against PM, DM, and BR, although the other two are a bit stronger against PM. Sovran is marginal against DM under pressure. Flint is outstanding against PM, inadequate against DM. All are equivalent against BR. The best choice in most Finger Lakes vineyards where SIs have been used for a number of years against PM, particularly if multiple disease control is needed. Should also provide some Botrytis control if a wet bloom period. Option B: Either Nova, Elite, or Rubigan PLUS mancozeb (PM, BR, Ph, DM). 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 first choice if significant unprotected infection periods occurred within the previous week. Rubigan is (was?) cheaper that Nova or Elite, but doesn't provide nearly the same BR control; however, mancozeb 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 (processor restrictions and poor BR control with captan). Option C: Mancozeb + sulfur (PM, BR, Ph, DM). Cheap and reasonably effective but not the strongest choice at a time when the strongest choice is most justified. Potential mite problems.

MID to LATE BLOOM. Vangard or Elevate for Botrytis control may be beneficial in certain years, particularly in problem blocks if weather is persistently wet. Abound, Sovran, or Flint applied recently may be adequate.

FIRST POSTBLOOM (10-14 days after immediate prebloom spray). **Still in the most critical period for PM, BR, DM, and Ph (fruit).** 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 still advisable under wet conditions and important if infections are evident on the vine. Fruit are less susceptible to **PM** now, but *vinifera* varieties (and susceptible hybrids?) still need PM protection, particularly to guard against fruit rots and promote wine quality. New foliage remains highly susceptible to PM. Avoid SI and strobie fungicides if more than a little PM is easily visible. **Ph** danger is mostly over unless very wet. Primary **DM** should be over, but continued protection may be needed on susceptible varieties if weather is wet, especially if disease already is established (look and see) Option A: Abound, Sovran, or Flint. Provides good residual control of the listed diseases if used now, but avoid overuse to promote resistance and wallet management. Should provide some Botrytis control. Option B: Nova or Elite (BR, PM) + captan or mancozeb (66-day preharvest restriction, mites) if DM and Ph control are needed. Option C: 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). Option D: Sulfur (PM) + either (a) mancozeb (if still allowed, mites have been considered) or (b) captan. In most years, lessening disease pressure makes this economical option increasingly practical as the season progresses. Option E: Copper + lime (some PM, DM). Adequate PM control for Concords, not enough for *vinifera* and susceptible hybrid varieties.

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; SIs and strobilurins are options if they haven't been overused earlier AND little disease is evident. Both provide the advantage of longer residual activity than sulfur, especially in wet weather. For DM, copper + lime or captan are economical standards; Abound is a viable option if general disease pressure or other conveniences justify its cost; Ridomil can be used in case of emergency. BR should not be an issue after the second postbloom spray, except in 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. See previous discussion for Botrytis at veraison, and preharvest.

UPCOMING EVENTS

May 23. Spring Pest Management Field Day and Barbecue. 3-6 PM Lance Fullager Farm, Penn Yan. Look for details elsewhere in this Vineyard Notes.

June 26-28. *National meeting of the American Society for Enology and Viticulture.* Portland Oregon. Portland, the site of the American Society for Enology and Viticulture's (ASEV) 53rd annual meeting, is the gateway to one of the world's premier wine producing regions. Traveling along a smoother roadthan the pioneers who brought the original grapevines to Oregon in the mid-1800s, the enologists, viticulturists, exhibitors and academic community will set up ASEV camp at the Oregon Convention Center from June 26th to 28th. The meeting will be proceeded by a special workshop, Pinot noir & 4th Joint Winemaking Symposium on June 25, 2002. For more information: http://www.asev.org

July 10-12. *American Society of Enology and Viticulture – Eastern Section (ASEV-ES) 27th Annual Meeting.* Meeting topic: Meeting theme: *A Focus on Red Varieties for the East: Merlot, Cabernet Franc, Chambourcin and Syrah.* Sheraton Baltimore North, Baltimore, Maryland. For registration information contact our office 315-536-5134 or http://www.nysaes.cornell.edu/fst/asev

July 15-17 2002, Hobart and William Smith College, Geneva New York *Wine Marketing, Branding and Wine Tourism Seminar.* Featuring Dr. Johan Bruwer and Rob van Zanten, from the Adelaide University, Australia. Sponsored by the Finger Lakes Wine Council. The Finger Lakes Wine Council (FLWC) is an association of Finger Lakes wineries and growers dedicated to the production and promotion of quality wines from the Finger Lakes Region of New York State. The FLWC promotes Finger Lakes wines and tourism in markets beyond the Finger Lakes wine region. For more information contact Scott Osborn at 315-536-4616.

Correction - In the April Vineyard Notes article entitled 'New Publications' the number listed for the Michigan State University Bulletin Office was incorrect. The correct number to call is **517-355-0240.**

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