Vineyard Notes

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GRAPE DISEASE CONTROL, 2012

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Operating from a "better late than never" perspective, here's the annual update and review on controlling fungal diseases of grapes in our eastern climate. As always, I'd like to acknowledge the outstanding team of grape pathologists here in Geneva, including faculty colleagues (David Gadoury and Bob Seem); research technicians (the now officially–retired Duane Riegel, Judy Burr); and graduate students and post-docs too numerous to mention. It's the combined research efforts of all of these people that serve as the basis for most of the following.

FUNGICIDE CHANGES & NEWS

1. New products. There are two important entries that fit this description, depending on whether you farm in NY or not.

a. Vivando is a product that was available in 49 states last year and is now approved for use in NY. It's a fungicide that controls powdery mildew only, but it has two important things going for it: (1) Vivando represents a new class of chemistry, so there are no cross-resistance issues with anything else currently on the market. In other words, we're starting with a clean slate in terms of what resistance might already be out there from previous sprays of materials in the same family (since there aren't any). And for the same reason, it can be rotated with anything. (ii) This has been a top performer in all of the trials that I've run where it's been included (as an example, see Table 1).

For both of the above reasons, Vivando is likely to become one of our "big guns" for powdery mildew control, and it appears to be priced in the category of "what the market will bear, short of chasing you away". Note that it is labeled at a range of 10 to 15 fl oz per acre (OK, 10.3-15.4 fl oz to be exact). In our trials, we've seen little difference in efficacy between the 10- and 15-fl oz rates--even on Chardonnay--when applied with thorough spray coverage at 2-wk intervals, and rumor has it that this lower rate is about 1/3 cheaper than the higher. However, the higher rate will provide a longer duration of residual protection (it's labeled for use at up to 3-wk intervals, which is something you can get away with in California where powdery mildew is the only disease you're spraying for most of the time). The higher rate will also help to compensate for "suboptimal" spray coverage, which nobody ever seems to provide but is a problem that somehow manages to hit a lot of their neighbors.

So, where might this product fit? The quick and easy answer is that it fits into the same niche that Quintec has occupied since its introduction. (Since you asked, in a head-to-head matchup, I'd give the nod to Quintec on cost and to Vivando on efficacy). The label restricts use to a maximum of three applications per year, but I like two per year even better: we have no resistance now, and we'd like to keep it that way. The two times of the year where I see the best bang for the buck are (i) during the period of maximum fruit susceptibility, i.e., around the start of bloom until 2 or 3 weeks later—in other words, where we are right now; and (ii) mid- to late summer, when you'd like to put your final PM spray on, and would like to see it provide good activity for as long as possible (and, perhaps, would like to think about pulling back on sulfur). Depending on a whole host of factors (disease pressures usceptibility, crop value, etc.), a desire for maximum duration of residual activity might be a time to consider the high end of the rate range at the end of the season. The product has a 12-hr re-entry interval (REI) and a 14-day pre-harvest interval (PHI).

"The Group 7 materials are the next wave of modern fungicides. They tend to have excellent activity against powdery mildew and Botrytis, but little to none against downy mildew and black rot."

There are not a lot of publicly-available data on specific modes of action, but it appears that Vivando has meaningful "backward" (post-infection) activity in addition to "forward" protective activity (Quintec is protective only). Both of these materials also seem to have meaningful levels of vapor activity, i.e., some of the active ingredient "evaporates" from treated tissues and moves short distances (inches to a couple of feet) in the vapor phase to provide a degree of control on otherwise-untreated portions of the vine. Assessing just how much control this translates to under real-world conditions is difficult to do.

b. Luna Experience. Luna Experience is another "combination product" composed of two different active ingredients: (i) fluopyram, a new fungicide in the "SDHI" (don't ask) or "Group 7" category of materials, as discussed below; and (ii) tebuconazole, a traditional sterol-inhibitor or DMI (Group 3) fungicide, originally sold as Elite and now off patent and marketed as a generic under several different trade names. Luna Experience is currently registered for use by the US-EPA and the appropriate local agency in 49 of these 50 United States, with New York's regulators still reviewing the application for registration and unlikely to make a determination in time for use this growing season. Note that even where it is registered, Luna Experience can be be used only on wine grapes, and the labels prohibits use on grapes that may be used "for purposes other than for wine", calling out Concord (and Thompson Seedless) by name. This has nothing to do with the potential for vine injury but is based on how many food crops can be treated with the product and the potential dietary intake if you ate all of them with the maximum allowable residues present.

So now for the details: The Group 7 materials are the next wave of modern fungicides, with two new ones in addition to fluopyram already labeled on some crops and likely to hit grapes in another year or so. They tend to have excellent activity against powdery mildew and Botrytis, but little to none against downy mildew and black rot. We already have some experience with a "first generation" member of the modern group of these materials, boscalid, which is the non-strobie component of Pristine. The next generation of these materials seem to be a bit more active than boscalid (Table 1).

Luna Experience is labeled for powdery mildew control at a rate of 5.0 – 8.6 fl oz/A, and for Botrytis and black rot control at 8.0 – 8.6 fl oz/A (for the record, it's also labeled for control of Phomopsis at this higher rate, but is most likely to be effective against this disease if it doesn't rain). This rate range provides a dose of tebuconazole (DMI component) equivalent to 2.3 – 4.0 oz of the former Elite 45DF; in case it's not on the tip of your tongue, the label rate of Elite was 4.0 oz/A. Thus, if you are looking for black rot control from this spray, you do need to be in the upper rate range as per the label, since all black rot control is coming from the tebuconazole. Furthermore, if you are hoping for any benefit in terms of resistance management for powdery mildew (i.e., hoping that the tebuconazole component will control any powdery mildew individuals resistant to the Group 7 materials), the tebuconazole dose provided by the 5–fl oz rate is not much more than a placebo, you need the higher rate for this as well.

OK, but what if you just want control of powdery mildew and Botrytis now? In our tests, we've looked at a rate of 6 fl oz/A over the past few years and have obtained excellent control of both diseases with this rate. We have more experience with powdery mildew, but did get excellent control of Botrytis using it in 2011, as shown in Table 1 below. Which isn't to say

FUNGICIDE CHANGES & NEWS (cont.)

that this will always happen, I'd still feel more comfortable using the "full" Botrytis rate against this disease, at least once I hit veraison.

Because Pristine has been a popular material for some years now, our pathogen populations are no longer "virgins" with respect to their exposure to Group 7 fungicides, and there are unpublished reports of detecting boscalid-resistant Botrytis isolates in both the eastern and western US last year. These are excellent fungicides, but it won't be hard to burn them out if we're not careful. For example, don't plan on controlling Botrytis with Pristine at bloom and with Luna Experience at veraison and preharvest; although both are dual-fungicide mixtures, it's the Group 7 component that's providing most of the Botrytis control in each. You've got to mix and match, rotate among different fungicide groups for control of the different diseases. As fungicide companies keep coming out with new mixture products, this is getting more complicated all the time. But such is the world we live in.

Table 1. Control of powdery mildew on Chardonnay grapes; Geneva, NY 2010

	Leaf infection		Cluster infection	
Treatment, rate/A*	% Leaves	% Lf area	% Clusters	% Clstr area
None	100	70.2	100	99.5
Revus Top, 7 fl oz	64	1.7	27	3.2
Inspire Super, 16 fl oz	67	2.1	16	2.0
Inspire Super, 20 fl oz**	39	1.1	6	0.2
Vangard, 7 oz	100	27.4	100	91.4
Rally (Nova), 5 oz	100	33.2	100	96.7
Vivando, 10 fl oz	12	0.3	12	0.4
Vivando, 15 fl oz	6	0.1	0	0.0
Luna Experience, 6 fl oz	80	2.4	16	0.8

***** Seven sprays applied at 14-day intervals.***

***** Inspire Super, 20 fl oz contains the same dose of difenoconazole as the Revus Top treatment plus the same cyprodinil dose as the Vangard treatment.***

2. Downy mildew-specific fungicides. Several relatively new ones and the reason for their proliferation were discussed in last year's volume of this treatise, reprinted verbatim with minor updates below:

The downy mildew (DM) organism belongs to a group of critters (oomycetes) that are so biologically different from "true" fungi that they are no longer even considered fungi by those who make such classifications. Although there are a lot of similarities and relationships between the two groups, one practical consequence of their biological differences is that they don't always respond similarly to the same toxicants. Hence, some chemicals that poison oomycetes don't do much to true fungi, whereas others that control true fungi don't even touch oomycetes (the sterol inhibitor fungicides fall into this latter category).

DM is Public Enemy #1 throughout a couple of million acres of European viticulture, with growers in many locations spraying a dozen or more times per year to control it. Hence, it's a very attractive market for fungicide development even if a material doesn't control other grape diseases, and many of the final products make their way to us. A few of the DM-specific materials that have hit here recently, in alphabetical order:

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• ***Forum (dimethomorph; Group 40)***--Same active ingredient as Acrobat, which has been registered for many years in the U.S. on vegetable crops. Not much experience with it here on grapes as a solo product. It will be combined with a new active ingredient to form another product (Zampro), which is now registered in Canada (!) and is still being considered for registration by the US-EPA.

• ***Presidio (fluopicolide, Group 43)***--Unrelated to any other grape product on the market. It has had EPA registration for several years, and was registered in New York before the start of the 2011 season. It has locally systemic properties, hence some post-infection activity, although this is not well characterized. It has consistently provided excellent control in our trials but is quite expensive.

• ***Ranman (cyazofamid, Group 21)***--Also unrelated to any other grape product. Primarily a protectant fungicide, it has provided good to very good control in our trials when used alone, very good to excellent control when tank-mixed with a phosphorous acid product to add post-infection activity.

• ***Reason (fenamidone, Group 11)***--Different from, but same biochemical mode of action as, the strobies. Hence, it is classified with them as a Group 11 material for resistance management purposes (i.e., you can't rotate among the same group, resistance to one is resistance to all). One important difference from the strobie products in that it has a much narrower spectrum of activity, i.e., it only controls DM. Reason has been outstanding in our trials, and it's cheap. There's just that small matter of resistance/rotation for these "Group 11" fungicides, discussed below.

3. Switch. While we've been using Vangard (cyprodinil) to control Botrytis since the end of the previous millenium (!), most of the international viticultural world has been using Switch, a mixture of cyprodinil + a second active ingredient called fludioxanil, which has a wide spectrum of activity that includes Botrytis and a number of other fungi. The upside of this mixture is that it not only helps limit the potential for developing resistance to cyprodinil (Vangard), but it also provides some activity against the grab bag of fungi in the "sour rot" complex. The down side is that fludioxanil is expensive to manufacture, so the per-acre cost of Switch is significantly more expensive than that for Vangard. IT'S ALSO NOT LABELED FOR USE ON LONG ISLAND.

Switch is labeled at a per-acre rate of 11 to 14 oz, which provides the same amount of cyprodinil as 5.5 to 6.8 oz of Vangard (recall, the Vangard label rate is 10 oz/A). In our trial on Vignoles last year, Switch outperformed Vangard significantly; whether that was a fluke or indicates that we're finally building up some resistance to the AP (Group 9) fungicides, of which Vangard and Scala are members, remains to be seen.

Table 2. Control of Botrytis bunch rot on Vignoles grapes, 2011 (Geneva, NY)

	% Botrytis disease[b]	
Material, rate/A[a]	Incidence	Severity
Unsprayed................	82	26
Vangard, 7 oz[c]...........	50	9
Vangard, 10 oz...........	43	8
Switch, 14 oz[c].............	25	4
Luna Experience, 6 fl oz..	19	2
Pristine, 19 oz..............	58	9

[a] ***Sprays applied late bloom; bunch closure; veraison; 2 wk post-veraison.***

[b] ***Incidence = % of clusters with any Botrytis disease; severity = % berries (cluster area) diseased.***

[c] ***14 oz of Switch provides the same dose of cyprodinil as 7 oz Vangard plus one additional fungicide (fludioxanil).***

4. RIP. (a) Rubigan/Vintage. The first of the DMI fungicides on grapes, it finally outlived its utility. (b) Adament. Apparently, the buying public wasn't any more enamored of this combination product than I was.

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FUNGICIDE RESISTANCE

A number of fungicides that were once highly active have lost their efficacy against certain pathogens in some vineyards as the result of that fungus developing resistance to them. It is extremely likely that this phenomenon will continue to increase in importance into the future, as modern fungicides are almost always more prone to resistance development than the old traditional, multi-site products like mancozeb, captan, ziram, sulfur, etc. Paying attention to basic resistance management principles and practices will be essential to sustaining the utility of virtually any new product that we are likely to see and want to use.

Simply put, anything new that's going to get registered now and into the future has to be squeaky clean in the tests used to assess any possible effects against what are euphemistically termed "non-target organisms " (i.e., you, me, and other life forms that we don't wish to harm beyond disease-causing fungi). To get the ideal, rare mix of deadly to target fungi and (nearly) benign to everything else, it generally comes to pass that the compound affects a single process in the fungal metabolism, and often a single specific site in one specific fungal enzyme that's involved in this process. This is the so-called "lock and key" analogy, where the fungicide molecule "key" physically fits into the fungal enzyme "lock" and prevents it from functioning, thereby killing the pathogen. The upside to such activity is that these materials are often very effective at controlling disease and very non-toxic to (most) non-target organisms; the downside is that the fungus only has to make a subtle change to that one lock so that the key no longer fits and the fungicide becomes ineffective; if this happens and the change does not significantly impair the functioning of the enzyme, the fungus survives treatment and reproduces to form progeny that also have the altered "lock". The result is that we end up with resistance to the fungicide and all related materials that worked by fitting into the same original lock.

Within an agricultural context, fungicide resistance is a classic example of evolution, i.e., it is the result of the selection of specific individuals from within the entire pathogen population that are best able to survive and reproduce when exposed to that material. When such individuals reproduce preferentially and their proportion of the population increases to the point that the material no longer provides an acceptable level of disease control even when it is applied at the proper time, with good coverage and the recommended rate, a condition termed "practical resistance" is reached. The risk of this occurring is a function of both the fungicide itself (the biochemical basis of the resistance response and its probability of occurring) and the individual disease involved.

Diseases at greatest risk for practical resistance development are those caused by pathogens with the potential for multiple generations per year (short incubation and latent periods) that also produce large number of spores that can be widely dispersed by air currents (spread the love!); powdery and downy mildews are prime examples, and Botrytis isn't too far behind. In contrast, diseases at least risk are those with a limited number of annual disease cycles, caused by pathogens with limited potentials for dispersal; Phomopsis cane and leaf spot is a prime example, having but one disease cycle (fungal generation) per year and spores that are distributed only short distances by splashing rain. Black rot lies somewhere in the middle, having a generation period that's several times longer than those of the mildews, a limited period of susceptibility for the host tissue that is likely to perpetuate the fungus between years (berries), and a type of spore to spread the disease that is distributed only a short distance by rain splash.

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When resistance to a fungicide is qualitative, i.e., individuals within the population are either sensitive to the typical range of doses encountered in the field or are virtually immune to even 100 or 1,000 times those levels, shifts in the makeup of the population can occur quickly ("disruptive" shift), with the resistant individuals becoming predominant within just a few years and control failures occurring suddenly.

Examples of fungicides to which qualitative resistance among grape patogens has occurred in the eastern US include the benzimidazoles (e.g., Benlate, Topsin-M), with resistance among powdery mildew common in many locations; the QoI or strobilurin fungicides (e.g., Abound, Flint, Sovran, one component of Pristine), where downy mildew resistance is common in the mid-Atlantic and southern states and appears to have shown up in at least a few NY locations, although the extent of potential problems in NY is not well characterized; powdery

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mildew resistance to the QoI fungicides, a problem in some NY vineyards since 2002 and one that Anton Baudoin at Virginia Tech has been documenting with some regularity in the mid-Atlantic region; and the phenylamides (e.g., Ridomil), where downy mildew resistance is common in regions where these materials have been used intensively.

When resistance is quantitative, individuals poorly controlled by one dose (or rate, loosely speaking) of the material may be controlled by incremental increases in that dose or substitution of a similar dose of a related material that has greater intrinsic activity (i.e., 1 mg of Fungicide B provides more control than 1 mg of Fungicide A). In this case, the sensitivity distribution within the pathogen population shifts incrementally after repeated use of the same class of materials, with progressively greater proportions of the fungal individuals requiring progressively higher doses of the material for a given level of control ("displacement" shifts).

A well-characterized example of quantitative resistance is that to the demethylation inhibiting (DMI) fungicides among populations of the powdery mildew fungus, which we have been discussing for years. A recent, very practical illustration of the importance of the concept of spray "activity" (a function of both the dose of a particular fungicide and its intrinsic activity) is provided by our experiences with difenoconazole, which will be reviewed below.

Given the preceding, basic resistance management strategies include:

• Limit the number of selection events, i.e., limit the number of applications of an at-risk fungicide and related products having the same biochemical mode of action, made easy to recognize by the Resistance Group number now on the front of each label.

• Limit the size of the pathogen population from which you may be selecting resistant individuals, thereby limiting the potential number of resistant survivors. Basically, try to avoid using a material at high risk of resistance development as a "rescue" from a severe outbreak of the target disease. Of course, you might wonder about the wisdom of maintaining the future utility of a material for an operation that might no longer be in business if the disease isn't brought under control, but look to see if there are other acceptable fungicide options before taking this plunge.

• Limit the reproduction (i.e., buildup and spread) of resistant individuals that have survived exposure to the at-risk fungicide. This can be accomplished several ways:

(i) Utilize appropriate cultural practices to limit disease development (pathogen reproduction).

(ii) Rotate with effective, unrelated fungicides; the fewer sequential applications of an at-risk fungicide, the less opportunity for reproduction of resistant individuals before they are controlled by something else. A conservative recommendation is to never apply products in the same Resistance Group twice in a row, always alternate with a different type of material; a liberal approach (and some label requirements) would be to never apply them more than two times in a row before rotating.

(iii) Apply at-risk materials in combination with another unrelated fungicide, either through tank mixing or use of a pre-packaged product containing two or more active ingredients. Be aware that resistance management efforts dependent upon rotation and/or combination with unrelated fungicides are only as effective as the companion materials themselves; a weak companion material or low use rate will have a limited effect on slowing the reproduction of resistant individuals that have survived exposure to the at-risk ingredient. Refer to the example given earlier, where the low label rate of the new Luna Experience does not provide an adequate rate of the mixing partner (tebuconazole) to provide good control of any powdery mildew fungi that might arise with resistance to the new, at-risk component of this mix (fluopyram).

• An additional strategy appropriate to fungicides subject to quantitative resistance (e.g., DMI materials) is to reduce the proportion of the pathogen population that is resistant to any given application of them. This can be done by increasing the activity of the application, either by increasing the rate of the product to a legal maximum or substituting a related fungicide having greater intrinsic activity.

Data presented in Table 1 illustrate this concept

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FUNGICIDE RESISTANCE (cont.)

vividly. Note that in this particular trial, Rally (active ingredient = myclobutanil) provided virtually ZERO control of powdery mildew on clusters. In contrast, the different difenoconazole treatments (Revus Top, Inspire Super) provided 97-100% control of disease severity, even though the per-acre rates of the two DMI active ingredients were equivalent. Why? Our tests showed that difenoconazole is, on average, nearly 40 times more active than myclobutanil on an ounce-by-ounce basis. Quite simply, the population of the PM fungus in this vineyard has shifted to the point that the maximum label rate of Rally does not provide a high enough dose of myclobutanil to control most individuals on clusters, yet these same fungal individuals are controlled by a

POWDERY MILDEW (PM) NEWS AND REMINDERS

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

(i) The fungus overwinters as minute fruiting bodies (cleistothecia) that form on leaves and clusters during late summer and autumn, then wash onto the bark of the trunk where they survive the winter. Spores are produced within them, and in New York, those of any consequence are discharged between bud break and bloom (more or less) to initiate the disease, after which it can spread rapidly via the millions of new spores produced from each of these "primary" infections. Thus, the amount of fungus capable of starting disease this year is directly proportional to the amount of disease that developed last year. An important consequence of this is that disease pressure will be higher, and PM sprays during the first few weeks of shoot growth are likely to be far more important, in blocks where PM control lapsed last year than in blocks that remained "clean" into September. (In much of the Northeast, cleistothecia initiating from infections that occur after Labor Day are unlikely to mature before temperatures become limiting and/or frost kills the leaves and eliminates their food source.)

The annual illustration of what this means: Several years ago, we conducted an experiment in a Chardonnay vineyard where we either (a) sprayed up through Labor Day, maintaining a clean canopy the entire season; (b) quit spraying other vines a month earlier, to represent a planting with moderate levels of foliar PM by the end of the season; or (c) quit spraying in early July, to represent a planting where PM control broke down for one reason or another. 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 a hypothetical case where 20% of the overwintering spore load is discharged during the first couple of weeks after bud break (a reasonable scenario, based on published studies). But 20% of what? In the clean treatment (a), this number might be relatively inconsequential; in dirtier treatment (b), it's equal to the entire seasonal supply on the clean vines; and in treatment (c), it's four to five times greater than the entire seasonal supply on the clean vines. Not surprisingly, this makes a difference--the degree of control provided in one season can affect the success of the control program (or its required intensity) the following year. When we intentionally waited until the immediate prebloom period to apply a minimal spray program to these same vines the year after inducing our variable foliar disease levels, the resulting cluster disease severities were (a) 11%, (b) 22%, and (c) 48% cluster area infected, respectively, even though all were sprayed exactly the same during the second season. Conclusion: Higher disease in Year 1 = More primary infections to start off Year 2 = Many more new ("secondary") spores by the time the fruit were formed and highly susceptible to infection = Much heavier disease pressure to "overwhelm" the fungicide spray program.

(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 (a high "interest" rate). The

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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 Fahrenheit (more details are provided in 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 provide ideal conditions for the fungus 24 hr a day. Conversely, a very cold night or two can seriously set the fungus back, as discussed a little farther below.

"Powdery mildew is a unique disease in that the causal fungus lives almost entirely on the <u>surface</u> of infected tissues, sending little "sinkers" (haustoria) just one cell deep to feed."

(iii) High humidity also increases disease severity, with optimum conditions for development about 85% RH. Although there is no practical threshold level necessary for the disease--PM develops to some extent over the entire range of humidities that we experience--research has shown that disease severity is twice as great at a relative humidity of 80% versus an RH of 40%. Vineyard sites (and canopies) subject to poor air circulation and increased microclimate humidity, and seasons with frequent rainfalls, provide a significantly greater risk for PM development than their drier counterparts. Thick canopies and frequent rainfall are also associated with limited sunlight exposure, which greatly increases the risk of disease development in its own right. Collectively these appear to be important environmental variables that distinguish between "easy" and "challenging" PM years (see below).

(iv) Berries are extremely susceptible to infections initiated between the immediate prebloom period and fruit set, then become highly resistant to immune about 2 weeks (Concord) to 4 weeks (*V. vinifera*) later. This is when you use the good stuff and don't cut corners in terms of spray frequency and application technique. Your annual reminder.

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

(vi) Powdery mildew is a unique disease in that the causal fungus lives almost entirely on the <u>surface</u> of infected tissues, sending little "sinkers" (haustoria) just one cell deep to feed. This makes it subject to control by topical treatment with any number of "alternative" spray materials (oils, bicarbonate and monopotassium phosphate salts, hydrogen peroxide, etc.) that have little to no effect on other disease-causing fungi, which live down <u>inside</u> the infected tissues. Recall that there are two primary limitations to the aforementioned group of products, which need to be considered if you want to use them effectively: (a) they work by physical contact with the fungus, so can only be as effective as the spray coverage that you provide; and (b) they work primarily in a post-infection/curative mode by killing the fungus right after they hit it, with little (JMS Stylet Oil) to no (potassium salts) residual activity against any spores that spores that land on the vine after these materials have been applied. This means that they need fairly frequent re-application, or should be tank-mixed with something that provides good protective (forward) activity in order to lengthen effective spray intervals.

Sort-of new research I: Effect of sunlight exposure

As noted in previous missives, "it has long been known" that PM is most severe in shaded regions of the vineyard (canopy centers, near trees, etc.), but until recently there was very little work done to determine either the magnitude or cause(s) of this effect. Former graduate student, Craig Austin (now gainfully employed and paying taxes), completed a thorough study of the phenomenon a couple of years ago and showed just how profound this influence can be. To recap:

One Craig's first experiments was conducted in a Chardonnay vineyard near the Finger Lakes village of Dresden, NY where a small portion of the easternmost row was bordered by a group of 50-foot tall pine trees. In previous years, we had seen PM completely destroy the clusters on

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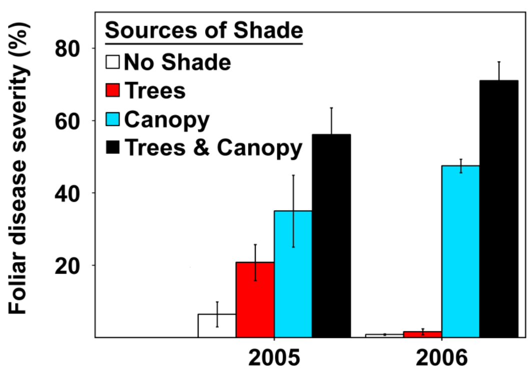
POWDERY MILDEW (PM) NEWS AND REMINDERS (cont.)

the three panels of vines immediately next to the trees, despite a spray program that controlled the disease adequately on all other vines in the block. These panels were shaded during the morning and it wasn't until the sun crested over the treetops just before noon each day that the vines received their first direct exposure to sunlight. So, we initiated a trial in which Craig inoculated leaves on either (a) the outer (exposed) or (b) inner (shaded) portions of vines, which were located either (i) immediately next to or (ii) 200 feet away from these trees, thereby providing a total of four levels of natural shade. The resulting disease severity increased substantially with each increasing level of shade, becoming 8 to 40 times more severe on the most heavily shaded leaves (interior of vines next to the trees) compared to the unshaded



leaves on the exterior of vines away from the trees (Fig. 1). Although shading could potentially change air temperature or relative humidity within the vine canopy, our measurements did not show this. However, they did show that UV radiation levels and leaf temperatures were dramatically different among the different treatments. Within the shaded regions, UV levels were (as one would expect) a mere fraction of those in the sun, and temperatures of leaves in the sun were as much as 10° to even 30°F higher than those of leaves in the shade. As we later found out, both elevated leaf temperature and UV radiation are responsible for the inhibitory effects of sunlight on PM development.

Figure 1. Percent leaf area diseased on Chardonnay leaves receiving (i) full solar radiation, on the outer canopy edge of vines away from trees (No Shade); (ii) morning shade from an adjacent grouping of pine trees but otherwise exposed to the sun, i.e., leaves on the outer canopy edge of these vines (Trees); (iii) shade provided by the vine itself, i.e., located within the center of the canopy of vines away from the trees (Canopy); or both tree and the internal canopy shading (Tree & Canopy).

Sunlight characteristics influencing powdery mildew development. UV radiation from the sun can damage the cellular structure of virtually all forms of life. However, powdery mildew is uniquely vulnerable to such damage: as noted previously, the PM fungus lives primarily on the outside of infected tissues, whereas nearly all other pathogens live and grow within infected organs where they are protected from UV. On top of that, the PM fungus is white--it has no pigment ("suntan") to protect against this radiation.

Direct sunlight heats up exposed leaf surfaces, as it does anything else it hits--as we all know from the difference between standing in the sun or taking two steps away into the shade. On warm days, this additional heat can suppress or even kill PM colonies on sun-exposed leaves and berries. Recall that powdery mildew grows best at temperatures near 80°F, but stops growing at temperatures above 90°F and will start to die at temperatures above 95° F, depending on how hot it is and for how long. On a hypothetical spring or summer day in the 80's, temperatures of shaded leaves and clusters will remain near that of the air--i.e., at or near the optimum for PM development. However, nearby vines or portions thereof that are fully exposed to sunlight often have temperatures elevated to a point where PM growth will stop or even "go backwards".

Surface Temperature and UV: Field Experiments. In order to separate these two specific sunlight components, we suspended a Plexiglas "roof" over Chancellor and Chardonnay vines in Geneva, NY and Chardonnay vines in a vineyard at Washington State University's Irrigated Agriculture Research and Extension Center in Prosser, WA (grateful acknowledgement to Dr. Gary Grove and staff for their contributions to this trial). Plexiglas blocks UV radiation but permits passage of the sunlight wavelengths that elevate surface temperature. At

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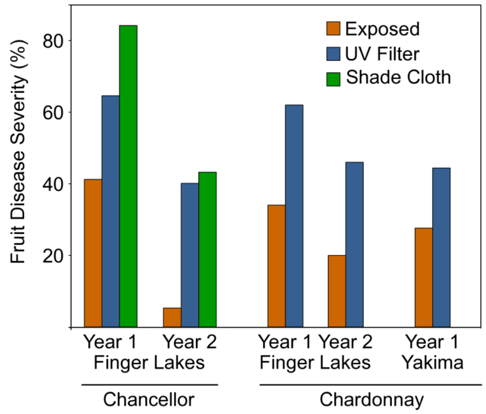

Figure 2. Percent cluster disease severity on cv. 'Chancellor' and cv. 'Chardonnay' vines receiving: full solar radiation (Exposed); sunlight from which 95% of the UV radiation had been filtered (UV Filter); or sunlight reduced to 20% of ambient via neutral density shade cloth, (Shade Cloth),. Vineyards were located in Geneva, NY (Finger Lakes) or Prosser, WA (Yakima)

Sunlight Manipulation in the Vineyard. Given that UV radiation and sun exposure reduce PM, how can we use this information to better manage the disease? We examined this question in a young Chardonnay vineyard in Geneva, NY by comparing two training systems, Vertical Shoot Positioning (VSP) and Umbrella-Kniffen (UK), and removing basal leaves around clusters to provide different levels of light exposure in the fruiting zone. UK provided more shoots per linear foot of row than VSP, hence more potential for canopy shading in the fruit zone. Within each training system, we removed basal leaves at two dates: 2 weeks post-bloom (fruit set) and 5 weeks post-bloom. We inoculated clusters with PM spores at bloom and rated disease severity in each treatment.

We found that both factors affected PM severity (Figure 3). First, powdery mildew severity was lower in the VSP than in the UK training system, regardless of leaf pulling treatment. Second, leaf removal at fruit set significantly reduced the amount of disease in both training systems, but leaf removal 5 weeks after bloom had no effect. The benefits of the early (versus late) leaf removal once again illustrates the critical nature of those first few weeks following the start of bloom--this is when you want to hit the fungus not only with your best spray program but also with the cultural control tools you have available. *Bottom line: simply by utilizing a VSP training system and basal leaf removal at fruit set, we were able to reduce fruit disease severity by 35% relative to UK-trained vines with no leaf removal.* It should be noted that in 2009, a summer during which it sometimes seemed that there was no direct sunlight reaching the state of NY, we did not see the same effect of training system in this vineyard but did see the same effect of early leaf pulling.

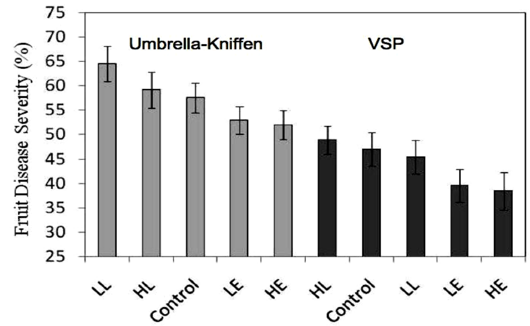

*Figure 3. Powdery mildew severity on Chardonnay clusters subjected to five different leaf-removal treatments in each of two vine-training systems. Leaf-removal code: **First letter** is leaf removal severity, H = heavy, L = light (either two leaves or one leaf above and below each cluster, respectively); **Second letter** is leaf removal timing, E = early, L = late (2 and 5 wk post-bloom, respectively). Each data bar represents the mean for 30 clusters per treatment.*

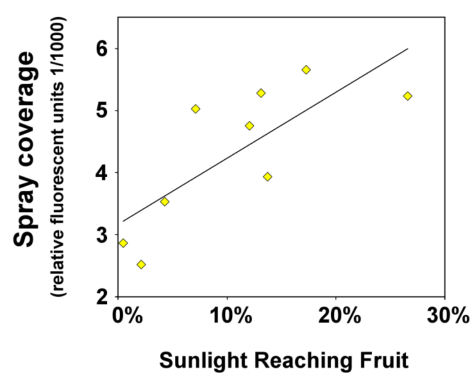

Figure 4. Effect of canopy density on deposition of sprays onto clusters of 'Chardonnay' vines treated in mid-July with a conventional airblast sprayer.

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Exposure of fruit to sunlight and pesticides. It's common sense that canopy management practices that increase sunlight penetration into the fruiting zone should also increase the penetration of sprays applied to control pests and diseases. With the assistance of Dr. Andrew Landers, we were able to quantify the effect that canopy density can have on spray coverage. Vines in our 'Chardonnay' planting subjected to the above canopy manipulations were sprayed with a conventional air blast unit and deposition on clusters from each vine was assessed in the lab. As expected, we found a direct relationship between the quantity of spray deposited on each cluster and the sunlight exposure level (Figure 4), with well-exposed clusters receiving approximately twice the deposition as those with poor exposure.

Management Implications. In all vineyards, in all seasons, for all experiments at all locations, increasing sunlight exposure on leaves or fruit reduced the severity of powdery mildew on those tissues – independent of spray coverage. And when improved spray coverage is factored in, the benefit of canopy management for PM control is not only compounded but extends to other diseases as well. However, a central concept associated with quality viticulture is "balance". Zero sunlight exposure might lead to diseased berries, but absolute maximum exposure can lead to sunburned berries instead. It's all about balance.

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

Cornell graduate student Michelle Moyer, working in the lab of Drs. David Gadoury and Bob Seem, also completed her thesis research not too long ago (before becoming gainfully employed as well!), in which she examined some other aspects of powdery mildew biology. Michelle focused on trying to define just what makes a "bad" PM year while it is occurring, so that growers might take action to prevent damage rather than conduct a post-mortem after it's too late.

A few highlights:

• Severe fruit infection is much more likely if the disease become well established on the foliage pre-bloom, providing abundant new spores to infect the adjacent fruit while they're highly susceptible. This is logical, but she demonstrated it very convincingly.

• Relatedly, after analyzing over 25 years worth of climate and disease severity data, Michelle showed a significant association between severe disease one season and accumulated degree days the previous autumn. This goes back to the earlier discussion concerning formation and maturation of the overwintering fruiting bodies of the PM fungus (cleistothecia) during late summer and autumn of one growing season and disease pressure the following. That is, a long, warm autumn allows more late-season infections an opportunity to form mature cleistothecia with viable overwintering spores than does a shorter and cooler fall period.

• We know that PM is favored by warm temperatures, cloudy weather (reduced UV), and high humidity, but is there an easy way to integrate these factors for measurement purposes? Yes. Michelle found a strong relationship between PM severity in any given year and the "pan evaporation" measurements during the critical prebloom through fruit set period that year. Pan evaporation is a figure reported by some weather stations that measures--surprise!--the depth of water that evaporates from an exposed pan over a given period of time (I love high-tech gadgetry!). It's main purpose is to help schedule irrigations but, conveniently, it also integrates the three major environmental variables that govern PM development--temperature, relative humidity, and solar radiation. A simple decision tree has been suggested for assessing PM severity risk, based upon a combination of post-veraison degree-day accumulation the previous year and pan evaporation data during the critical part of the current growing season.

We're still working on how to bring this out of the conceptual realm and into a format that growers and advisors can utilize as part of their disease management decision-making process, but here are a couple of specifics:

• Of the two factors (pan evaporation and heat units the previous fall), the more important is pan evap. Over the past quarter century, our worst years for PM development have been 1986, 1992, and 2003, with 46, 50 and 47% of the cluster area of unsprayed Rosette vines covered with mildew (a moderately-susceptible

"Increasing sunlight exposure on leaves or fruit reduced the severity of powdery mildew on those tissues – independent of spray coverage. And when improved spray coverage is factored in, the benefit of canopy management for PM control is not only compounded but extends to other diseases as well."

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hybrid, not to be confused with highly-susceptible *V. vinifera* cultivars such as Chardonnay). In those years, the average pan evap values were 5.2, 4.5, and 5.4 mm/day from June 1 to July 31. In contrast, two of the years with the least mildew were 1988 with <1% disease severity on unsprayed clusters (!) and 2001 with 3%; corresponding pan evap values were 6.9 and 5.9 mm/day in these respective years. Last year (2011), another mild year for powdery mildew, the mean value during this period was 6.7 mm/day.

So, what does this mean in practical terms? It appears that years with pan evap values > 6 mm/day are likely to be "light" PM years and those with values < 5 mm/day will be killers. And where do find pan evap data, should you want it? Some weather networks provide this and some weather stations provide a value for a related parameter called "ETO" (potential evapotranspiration); should you want it, you can get pan evap by multiplying ETO x 1.25. Or, you can simply use the computer on top of your neck and factor these general principles (sunny and dry = good for you; cloudy and wet = good for mildew) into your disease control program.

• Another interesting fact: cold nights (below 40°F) throw PM for a loop. After as little as 2 hr at 36°F, portions of existing colonies are killed, new infections take longer to form colonies with the secondary spores that spread the disease, and the colonies that do form are reduced in size (hence, fewer new spores in addition to later). Thus, cold nights during the period between early shoot growth and bloom have the potential to restrict the ability of the PM fungus to produce new spores capable of infecting the young, highly susceptible berries. Or seen another way, lack of such nights can give the disease a running start relative to a "normal" year. Note that prolonged cloudy conditions that otherwise favor PM by increasing humidity and limiting exposure to direct sunlight also keep us from getting those really chilly spring evenings. Something to keep in mind should such conditions come to pass.

A note to Concord growers who are still managing a crop: Remember that the value of mid-summer control on Concords is very strongly influenced by the combination of crop level and ripening conditions (heat, sunlight), and that foliar PM can be a significant limitation on the vine's ability to photosynthesize and ripen the crop, particularly under otherwise-challenging conditions. When the vine's capacity to do so is not being pushed (moderate crop size, plenty of water and sunshine, few other stresses), research has shown that it can tolerate a lot of foliar PM without significant negative consequences. However, this same research also has shown that at high cropping levels (there are still a couple out there), good PM control can be necessary to get the fruit to commercial levels of ripeness. And in cloudy, rainy years--those that give you a double whammy, lousy for ripening and ideal for mildew development—even moderate crops can be affected. Unfortunately, there is no simple formula to tell you how much control is cost effective, and every case is likely to be different, depending on disease pressure, growing conditions, vine vigor, fruit prices, etc. But keep the general concept in mind.

The minimal two-spray Concord PM program of pre-bloom and 10-14 days later will keep the berries clean and often appears to be good enough in "average" vineyards in a "typical" year, but it certainly is minimal. And it's probably all that I would put on if I were carrying a small crop such as many growers are, especially in the Lake Erie region. However, a second or even third post-bloom shot may be warranted in blocks or regions fortunate enough to have a hearty crop. You don't get all of that extra fruit for free.

New research III: Update on spray deposition versus canopy management.

As a follow-up to a previously-discussed trial, last summer we (Andrew Landers, Nicole Landers, and yours truly) looked at the effect of canopy density on spray deposition upon grape clusters in five different Finger Lakes vineyards (cvs. Chardonnay, Vignoles, Cabernet Franc, GR-7, and Rosette) subjected to

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POWDERY MILDEW (PM) NEWS AND REMINDERS (cont.)

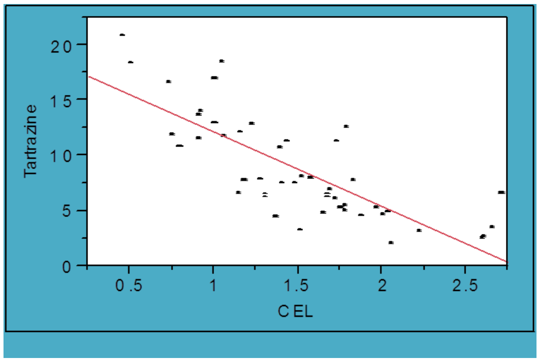

Figure 5. Effect of canopy density (cluster exposure layers = CEL) on deposition of a spray tracer (tartazine) onto grape clusters in 5 Finger Lakes vineyards. Vines were treated in early July with a conventional airblast sprayer applying 50 gpa.

Although individual data points show the typical variability around the "average" line indicated in red, the relationship between spray deposition and canopy density is clear. For example, clusters blocked from the sprayer by one layer of objects (leaves; CEL = 1.0) received approximately twice as much spray as those blocked by two layers (CEL = 2.0).

Obviously this has implications for the management of all diseases and arthropod pests against which you spray, not just PM.

Fungicides

Sulfur. *Another summary of the major findings and conclusions from our studies on sulfur activities a few years back:*

• 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, control was the same at 59°F as it was at 82°F when we sprayed with the equivalent of 5 lb/A of Microthiol. Workers from Australia also reported no differences in control at 59°, 68°, or 86°F when used at this rate, although there was a slight decrease in activity at 59°F when the rate was reduced to the equivalent of 1.7 lb/A. It appears that the potential detrimental effect of low temperature on sulfur efficacy has been over-emphasized in our region, particularly in light of the fact that the PM fungus itself is not all that active at cooler temperatures. Which we'd better be through with for this PM season!

• Sulfur provides very good protective activity on sprayed tissues, but not on new leaves that emerge after the last application. Stop the presses. Bet you're glad you have guys from the University to figure that out for you.

• *Sulfur provides excellent post-infection control when applied up through the time that young colonies start to become obvious*. Although it does have some eradicant activity against raging infections (see below), it's significantly stronger against the younger ones. Practically speaking, this means that when a PM spore lands on a new, unprotected leaf that was produced after the last application (see above), there's still time to hit it with the next spray in a post-infection mode if that's applied early enough. Which is up through about 1 week after infection is initiated if temps are mostly in the 70's and 80's, a few days longer if there are significant cooler periods mixed in.

• Post-infection sprays applied to heavily-diseased tissues are much less effective than those applied to incubating or very young colonies. Sulfur is not the material of choice as an eradicant if you reach the "Omigod!" stage. That would be Stylet Oil or the similar Pure-Spray Green (or even Oxidate, but at a much higher cost). And remember that once the leaf or berry cells beneath a well-established mildew colony have been sucked dry by the fungus, nothing's going to bring them back to life even if the mildew is eradicated. The best that an eradicant spray can do is to keep things from getting much worse, it can't raise the dead. And for the 1,001st time, the results you get will only be as good as the spray coverage you can provide. These materials work by contact, and they won't affect any mildew colonies that they don't contact.

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

• Rainfall of 1 to 2 inches decreases sulfur's protective activity significantly.

• This effect is more pronounced with generic "wettable" formulations than with so-called "micronized" formulations (e.g., Microthiol), which have smaller particle sizes so adhere better to tissue surfaces. (We didn't look at a liq-

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uid formulation, but I would guess it to perform similarly to Microthiol). These latter formulations cost more for a reason.

• The negative effects of rainfall can be somewhat compensated for by adding a "spreader-sticker" adjuvant to the spray solution and/or increasing the application rate (from 5 to 10 lb/A in our field experiments, or their equivalents in the greenhouse). Both increasing the rate and adding the adjuvant have an effect, and these effects appear to be additive. See Table 3 below for field data, standardized across years to reflect % disease control relative to the unsprayed check vines in the relevant experiment.

Table 3. Powdery mildew control on Rosette (2004-06) and Chardonnay (2007-10) grapes as affected by sulfur rate and adjuvant (Geneva, NY)

	Foliar disease control, severity (%)*							Cluster disease control, severity (%)						
Treatment, rate/A	2004	'05	'06	'07	'08	'09	'10	2004	'05	'06	'07	'08	'09	'10
Microthiol, 5 lb……….	68	67	86	97	76	70	61	47	76	70	89	90	4	16
Microthiol, 5 lb +														
Cohere, 0.03% (vol)…	84	80	89	97	83	73	64	64	73	79	90	96	4	37

* % reduction of the diseased area on leaves and clusters, relative to the unsprayed check treatment.

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

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

• There was a wide range in the performance of these materials for keeping foliar disease down in the summer. A few materials (Nutrol, Kaligreen, and Prev-Am) were nearly as efficacious as the standard program, which relied on sulfur to finish the season (albeit at 14- rather than 10-day intervals). These may have interest for growers who are trying to avoid sulfur in late-season sprays.

• Kaligreen is a potassium bicarbonate product, as are several other similar, labeled products not examined here (e.g., Milstop, Armicarb). Nutrol is monopotassium (or, "dihydrogen potassium") phosphate. This was the fourth consecutive trial that we ran in which Nutrol and the bicarb products provided almost exactly the same degree of control

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POWDERY MILDEW (PM) NEWS AND REMINDERS (cont.)

when used at recommended rates. Prices among these materials have sometimes differed dramtically, even though their activities are basically the same. Be aware that unlike the bicarbs, which are formulated with a surfactant, you'll need to add one with Nutrol to get optimal coverage of the entire surface of the leaves and berries. Also, Nutrol is not certified "organic", if that's important to you philosophically or commercially

BLACK ROT (BR) NEWS AND REMINDERS

1. *As fruit mature, they become increasingly resistant to infection.* Another annual reminder. Remember that under NY conditions, berries are highly susceptible to black rot from cap fall until 3-4 weeks (Concord) or 4-5 weeks (Riesling, Chardonnay) later. Then, they begin to lose susceptibility, finally becoming highly resistant to immune after an additional 2 weeks. Note that this means that Concords can become infected up to 6 weeks after the last cap has fallen, and *V. vinifera* varieties up through 7 weeks post-bloom. In the mythical "average" year, most growers won't need to be too concerned towards the end of these susceptible periods, since the overwintering spore load is long gone by then and nearly all leaves and berries on the vine are clean. However, protection will need to continue throughout the entire period of susceptibility if infections got started in the vineyard for one reason or another, unless you either know or want to gamble that the weather is going to stay dry until the fruit become fully resistant.

Recall that in most vineyards, mummified berries are far and away the main (and oftentimes, only) overwintering source of the BR fungus. Spores from mummies on the ground--which is where they should be unless somebody screwed up and didn't prune them off the vine during the dormant season (see below)--are typically depleted by a week or two after bloom. (Now for the CYA fine print: remember that these spores are liberated from the mummies during rains. So, if it doesn't rain from bloom until 3 or 4 weeks later, as occasionally happens, the last shot of them will just sit and wait until the rains finally do arrive). Thus, if the disease has been very well controlled by the time the overwintering spores are depleted, there should be no source for new infections even though fruit may still remain susceptible, and additional sprays are not likely to be necessary. In contrast, if new black rot infections are established (and producing spores right within the clusters), protection will need to continue so long as fruit retain any susceptibility.

As often noted, we've regularly obtained excellent control with sprays applied at the start of bloom plus 2 and 4 weeks later. Such a program provides protection throughout the period of peak susceptibility and during most or all of the time remaining before berries become highly resistant. But as noted above, you get away with stopping sprays before berries are fully resistant when there are few to no active infections present and/or the weather is dry, but growers routinely get nailed when they quit too early and there are active infections present. Also, waiting until the immediate prebloom period is a lot safer in a vineyard that was clean last year than in one with more than a touch of disease and the relatively high overwintering spore load that this will entail. Recognize when you can cut corners and when you can't.

2. *Mummies retained in the canopy provide significantly more pressure for BR development than those dropped to the ground.* Mummies in the canopy produce many more spores than those on the ground (as in 10 to 20 times as many) and continue to produce them throughout the period of berry susceptibility, whereas spores from ground mummies are finished shortly after bloom. Furthermore, spores from mummies in the canopy are much more likely to land on and infect susceptible berries than are those produced from mummies on the ground, since they are released right next to the new clusters. As often noted, when I go into a vineyard and find a BR "hot spot", the first thing I do is look for

Photo by Tim Martinson

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last year's mummies still hanging in the trellis near the current zone of activity. I almost always find them.

3. The incubation period for BR can be very long. Under upstate NY conditions, we've found that clusters infected during the first few weeks after bloom show symptoms about 2 weeks later and that all diseased berries are apparent within 21 days after the infection event. However, clusters infected near the end of their susceptible period do not develop symptoms until 3 to 5 weeks after infection. (Note that since the fungus is responding to accumulated heat units rather than accumulated risings of the sun, these periods will be a tad shorter in significantly warmer climates). 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 (OK, move that clock back a week or two this year), depending on the cultivar. This fact should be considered when trying to determine "what went wrong" should such disease occur.

4. The SI [DMI] fungicides are most effective in "reach-back" activity, whereas the strobilurins are most effective in "forward" activity. Just a reminder of how these materials work (along with supporting data), and why mixing a DMI + protectant fungicide (mancozeb, ziram, strobie) gives such good

Table 4. Protective and post-infection activities of a strobilurin (Abound) and sterol inhibitor (Nova = Rally) fungicide in control of black rot under field conditions

	% Disease control[c]	
Protective (days)[a]	Abound	Rally
5	90	65
8	93	39
11	66	0
Post-infection (days)[b]		
3	39	95
7	42	87
10	15	39

[a] Sprays were applied at label rates to Concord vines in the field at indicated number of days before infection with black rot spores.

[b] Sprays were applied at label rates to Concord vines in the field at indicated number of days after infection with black rot spores.

[c] Percent reduction in the number of diseased berries relative to unsprayed clusters.

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BLACK ROT (BR) NEWS AND REMINDERS (cont.)

5. *Fungicides.* Nova/Rally and Elite were always the kings in our trials, which haven't been run since we lost our BR test vineyards a few years back. Elite is no longer marketed as such, although I'd assume that the generic tebuconazole products do the same thing if used at an equivalent rate to supply 1.8 oz/A of active ingredient. Trials run by colleagues in Ohio and PA show that Mettle (perhaps never to be labeled in NY) and the difenoconazole products have similar levels of activity (note that all four of the abovementioned fungicides belong to the same chemical family within the DMIs, the triazoles). In many of our trials, the strobies were right up there at a similar level. Of course, the most important time to control black rot (bloom and early postbloom) is also the critical time for controlling PM on the clusters, and diminishing levels of PM control with most DMI fungicides make them potentially problematical at this critical part of the season in many vineyards. However, if BR is a greater concern than cluster PM (which could be true of many native and hybrid cultivars, and all cultivars in some production regions well to the south of NY), this may not matter so much. And it may be even less of a factor given the superiority of PM control provided to date by the difenoconazole products, although I'd still use them gingerly on *V. vinifera* cultivars during this period.

All of the strobies appear to be equivalent to one another and provide very good to excellent control, equal to mancozeb and ziram under moderate pressure and superior under very wet conditions, since they're more rainfast. Of course, rainy conditions are when superior performance against BR is most necessary. (FYI, the non-strobie component of Pristine provides virtually no control of black rot). Mancozeb and ziram are old standards and provide very good control under most commercial conditions. Captan is only fair, and likely to be inadequate if there's any pressure. Copper is discussed below. Sulfur is poor.

6. *Special considerations for "organic" growers.* Black rot is perhaps the "Achilles heel" for organic grape production in the East. In the only good trial that we've run with copper, it provided 40% disease control when applied at 2-week intervals, versus essentially 100% control with Rally/Nova. (I recently found an old report from a trial that Roger Pearson ran in the mid-1980's, where he got a similar level of control with a copper product). That being said, towards the end of the wet 2006 season I visited an organic grower who had suffered severe losses from BR in several previous wet seasons, anticipating that I'd see more of the same. But I had to search to find a black rot berry. What had he done? He'd implemented a rigorous program to remove mummies during pruning, and sprayed copper once a week throughout much of the growing season. This was hard on some of the hybrid vines and runs counter to the thinking of many with a "sustainable" orientation (after all, copper is a metallic element that by definition doesn't break down into anything else, so it accumulates in the soil forever), but it did control the disease in a manner that conforms to the letter of the organic law.

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

Therefore, the simple fact remains that sanitation and cultural practices form the <u>absolutely critical</u> first (and second and third….) line(s) of defense against BR for growers who wish to produce grapes organically. So if this means you, you'll need to pay <u>strict</u>, bordering on religious, attention to limiting inoculum within the vineyard. Ideally, this would include removing or burying (tillage, mulch) all mummies that you might encounter at the site; the next best option is do this to as many of them as you can. 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 or portions thereof before they allow the disease to spread, even

"All of the strobies appear to be equivalent to one another and provide very good to excellent control, equal to mancozeb and ziram under moderate pressure and superior under very wet conditions, since they're more rainfast. "

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DOWNY MILDEW (DM) NEWS AND REMINDERS

Recall that the DM organism persists in the soil as resting spores (oospores) that originate within infected leaves and berries. Hence, the more infection last year, the more oospores this year. And I doubt if there are more than one or two (if that many) vineyards in the east that didn't have above-average levels of DM by the merciful end of last season.

The first "primary" infections, originating from overwintering oospores in the soil, require a minimum rainfall of approximately 0.1 inch and a temperature of 52°F or higher to "activate" them and splash their infectious progeny into the canopy or onto nearby sucker growth. 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 humid nights to form the sporangia (warm and humid is even better) with rain following soon thereafter to allow germination and infection. Without rain, most of the ungerminated sporangia will die the next day if exposed to bright sunshine; however, they can survive for several days between rainfalls if conditions remain cloudy, which helps to keep the epidemic running.

Spread is most rapid with night and morning temps of 65-77°F, although it can occur down into the 50's. With an incubation period (generation time) of only 4 to 5 days under ideal conditions, disease levels can increase from negligible to overwhelming in very short order if the weather remains favorable for long stretches of time--repeated humid nights, frequent rains, and extended periods of cloudy weather. See: Summers of 2008 and 2009, August and September 2011.

The erratic development of DM coupled with its explosive and potentially devastating nature makes 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 allow it to get rolling once it is. Keep an eye on the vineyard to see which of these possibilities you might be able to avoid. For additional guidance, my colleagues, Bob Seem and David Gadoury, have developed a computer model (DMCAST) that integrates a number of weather and crop development factors to advise when infections are likely to occur. This model can be accessed via the NYS IPM Program website (www.nysipm.cornell.edu/newa/).

Fruit susceptibility. Clusters of some varieties—including all *V. vinifera* cultivars--are highly susceptible to infection as soon as the fungus becomes active during the prebloom period (in Geneva, our first infections typically occur about 2 to 3 weeks before the start of bloom). Recent research indicates that berries become highly resistant to direct infection within 2 weeks after the start of bloom, although losses due to berry stem infections can occur under some poorly-defined conditions for at least 2 additional weeks after that.

When berry stem infections occur, the DM organism follows that pipeline into the fruit and causes the aptly-termed "leather berry" symptom (hard and dry berry, no DM spores produced upon it). There was a bit of that around in 2008 and 2009, likely due to inadequate protection as people prematurely let their guard down a couple of weeks after bloom. The past two years have been dry during that 2- to 4-wk postbloom period, which makes it easy to forget how these things can happen. But don't.

For many years, the standard fungicide test protocol on hyper-susceptible Chancellor vines at Geneva has been to start spraying about 2+ weeks prebloom and continue through approximately 4 weeks postbloom. The best materials consistently provide virtually complete control of fruit and cluster stem infections using this schedule, even in bad years and on perhaps the worst possible variety for cluster infections, under abnormally high inoculum pressure. But remember that vines with susceptible foliage remain vulnerable to defoliation from DM right

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into the fall if disease-conducive weather persists (as if you could forget after last year!), even long after the fruit have lost their susceptibility. Which is something we'd all rather avoid.

Fungicides. Ridomil remains the best downy mildew fungicide ever developed, but cost and lack of activity against other diseases have limited its use. But if you get to the point that you're ready to call in the big guns, this is the Howitzer. Those in regions where potential ground water residues are an issue (that means you, Long Island) should also be aware that Ridomil is especially prone to this problem due to its unusually high solubility in water, and be prepared to address the issue. Although it's highly prone to resistance development, this has never been detected on grapes in the U.S., probably due in large part to its somewhat limited use. Nevertheless, it's a real concern, and all resistance-management precautions should be followed in order to keep it a viable part of our arsenal against DM. Remember that the PHI on Ridomil Gold Copper is 42 days versus 66 days for Ridomil Gold MZ.

Note the discussion regarding DM resistance to the strobie and related materials at the beginning of this tome: use them with caution in regions where resistance has not yet become a problem, and think of use in regions where it has developed as a disease-management form of Russian roulette. Within this context and without resistance, Abound (or Quadris Top) is very good, Pristine is even better, and over the past 2 years year the new product, Reason, has given excellent control in our trial; Sovran is marginal; and Flint is poor. Copper, mancozeb, and captan are old standards because they work, but are prone to wash-off under heavy rains and may need to be reapplied more frequently in wet years. Ziram is much better than nothing, but it wouldn't be your first choice if good materials were an option. In addition to Reason, several other new DM fungicides (Presidio, Revus, Ranman) are discussed under the New Fungicides section at the very beginning of the treatise.

Which brings us to the phosphorous acid (also called phosphite and phosphonate) products once again. We've discussed these *ad nauseum* for the past few years, so will only review the main points this time around. Recall that these are excellent materials for anyone consciously seeking a "least toxic" or "sustainable" approach to growing grapes, due to their low toxicity (4 hr REI, exempt from US-EPA residue tolerances) and minimal environmental impact. They're also very good for anybody who wants a DM fungicide that's easy to use, price-competitive, and pretty effective. Although there are occasional reports and testimonials alluding to the ability of these materials to control other grape diseases, I have not found this to be so in several different trials that we've run. In general, these are very good and reliable fungicides against downy mildews and some other closely related diseases on a variety of crops (DM is the only one that's important on grapes), but control of anything else is erratic at best. If you do get control of another disease, think of it as an unanticipated bonus. I certainly wouldn't encourage you to even hope for it, unless you're the type of person who starts shopping for a new house after you buy a lottery ticket.

You know by now that there are several phosphonate products labeled for control of DM, and a number of other "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 don't do so on purpose. Whether this seems fully rational or not, remember that the law requires any material applied for a pesticidal purpose to be labeled for such, and you can still be cited for breaking a law regardless of what you think about it.

From 2003-05, we ran a series of field experiments designed to determine the so-called "physical modes of action" of phosphonates in control of downy mildew. These results and conclusions have been reported in detail in previous years, but a quick review of the major points:

• Phosphonates generally provided good but limited (3 to 8 days) protective activity, depending on the rate used, as well as the particular trial and which leaves were being evaluated. Protective activity in the older leaves sometimes declined significantly after 3 days,

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particularly at lower label rates, as phosphonates are "shipped" out of them.

• Phosphonates provided excellent "kick-back" activity against new infections. When applied 3 or 4 days after infection, few lesions developed at either rate and spore production was greatly to totally inhibited. When applied 6 days after infection (small lesions just starting to become visible), lesions continued to expand but production of spores was greatly inhibited. Control was better at the higher label rates, and when an initial application was repeated 5 days later (waiting for 7 would probably be OK). If you truly need some significant kick-back activity, don't go cheap and do keep an eye on things; if it looks like lesions are starting to come through, hit it again.

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

• **CAUTION**: The phosphonate products have become very popular, for the good reasons cited above. But they're not miracle drugs, and some people like to push them past their limits in terms of both spray intervals and rates. Furthermore, there can be a subconscious tendency to think that these aren't "real" fungicides, for various reasons having to

BOTRYTIS NEWS AND REMINDERS

Although there are a number of fungi that can cause bunch rots, especially in warmer regions, Botrytis is still king in the cooler or more moderate summer climates of the East. A review of what makes it tick.

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

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

• Serious Botrytis losses result from rampant disease spread during the post-veraison/ pre-harvest period, after berries begin to ripen and become highly susceptible to rot by the fungus. Thus, latent infections established at bloom can be important if only a few of them become active and provide the initial "foot hold" from which subsequent spread can occur during ripening.

Because relatively few of these early infections typically do become active and turn into rot, controlling them at bloom provides only modest benefit if the post-veraison season is dry

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and doesn't support further disease spread. However, it can be critical in a year with a wet pre-harvest period (especially if the mid-summer was wet as well), which favors both the increased activation of latent infections and their rapid spread. So in one sense, bloom sprays are an insurance policy against the future unknown. Sometimes they pay huge dividends, sometimes not (data below). What's your risk (and tolerance of it) of not being insured?

• The pronounced impact that cluster compaction has on Botrytis development appears to be due largely to its effect on the berry-to-berry spread that occurs at the point of their contact with one another. In one experiment with a tight-clustered Pinot Noir clone, a single diseased berry in a cluster, first showing symptoms 2.5 weeks after veraison, spread the disease to over 50 (!) berries in that same cluster by harvest. In contrast, spread was reduced by 90% (!) in the same group of vines where clusters had been loosened by removing some berries by hand right after set. Note that this single diseased berry per cluster (produced by inoculation) was meant to simulate the post-veraison activation of just one latent infection initiated at bloom, and vividly illustrates the particular importance of controlling blossom infections on tight-clustered cultivars and clones, so that they can't spread.

Loosening clusters by hand thinning was possible on a small scale in a research trial to demonstrate a principle but unfortunately, there are few practical, foolproof ways of achieving the same effect on a commercial scale other than through clonal and varietal selection. The watchword here is foolproof. Over the years, several workers have experimented with prebloom sprays of gibberellic acid for this purpose, with some success. (Most recently, Bryan Hed and colleagues at Penn State have published an in-depth paper on their positive results with Chardonnay and Vignoles). And there are now some GA formulations (e.g., ProGibb 4%, which is even OMNI approved) that are labeled for use on wine grapes. These labels contain warnings about possible yield reductions during the current and/or following years and a range of rates specific to different varieties. Nevertheless, some growers and investigators have been able to get the benefit of such treatments without noting negative effects. IMHO, loosening cluster compactness represents the "holy grail" for Botrytis management. And GA treatments just may have their place. But this technology is not foolproof, we do not have all the answers yet, and there are risks involved. I would caution anyone interested to still view it as an experimental technique, to do their own experiments on a small scale for awhile, and to keep their eyes and ears open with respect to the experiences of others.

• There is no single "correct" timing regimen for fungicide applications in a Botrytis management program. The standard "full" program used in fungicide trials, provided on many fungicide labels, and employed by some growers of highly susceptible and valuable cultivars consists of four sprays: at bloom, bunch closure, veraison, and 2-3 weeks pre-harvest. We have looked at the

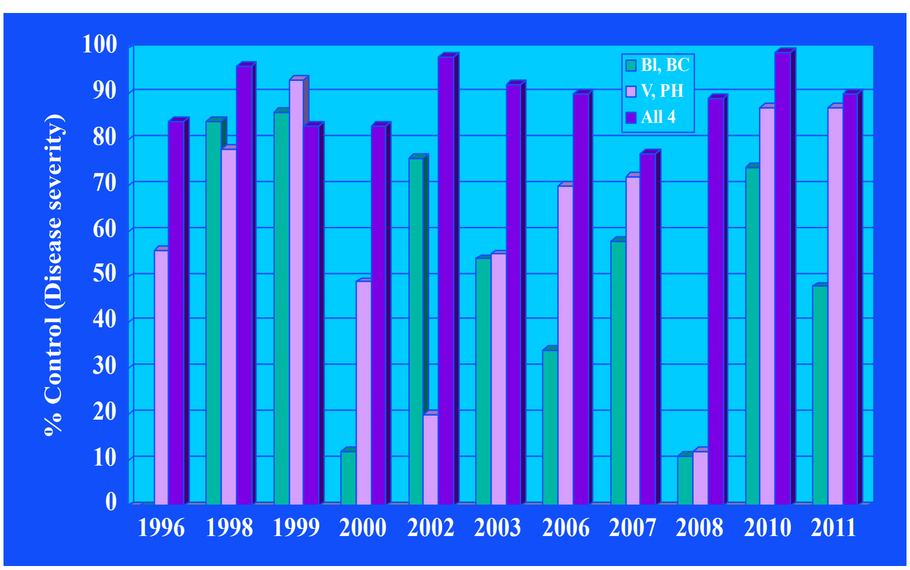


Figure 6. Influence of spray timing on the control of Botrytis bunch rot in Geneva, NY (cv. Aurore, 1996-2000; cv. Vignoles, 2002-2011). Sprays we applied at (i) Bloom + bunch closure (Bl, BC); (ii) Veraison and 2-3 wk later (Ve, PH); or (iii) at all four of these stages. Data are expressed as percent reduction of diseased berries relative to vines receiving no Botrytis fungicides.

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

New research: Effects of cultural control practices on Botrytis and sour rot control. In 2011, I participated in a trial conducted in a commercial 'Vignoles' block in the Finger Lakes region, organized by Tim Martinson, Justine vanden Heuvel, and Hans Walter-Peterson. Although originally set up a couple of years ago to examine the effect of canopy management practices on fruit quality, it became obvious that these treatments were also affecting fruit rot, so we decided to give it a hard look in 2011. What a good year to do so!

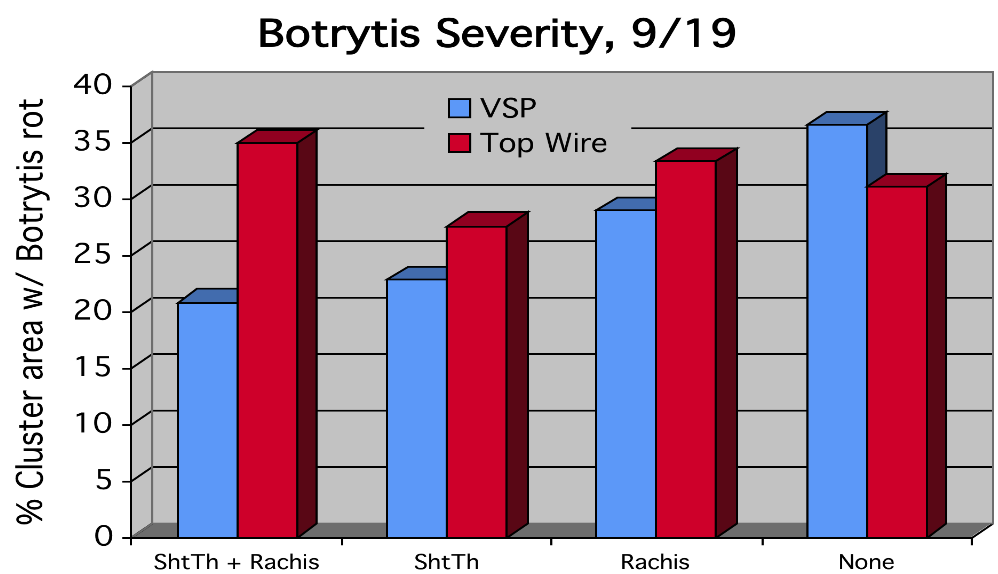
The treatments involved were:

• Training system (Top Wire Cordon and VSP)

• Shoot thinning (thinned to 5 shoots per linear foot of row versus unthinned = approximately 7 per foot of row)

• Removal of old rachises (source of Botrytis inoculum) at the time of thinning versus no removal

The grower maintained his crop via standard practices, which included a Botrytis spray regimen. We rated the plots for incidence and severity of both Botrytis and sour rot at harvest on September 19; the VSP treatment was also rated 10 days pre-harvest. A few sets of data and interpretations/notations are provided below.



• Positive effect of canopy manipulation treatments in VSP, not in TW
• In VSP, Shoot Thin + Rachis Removal was best, 43% reduction versus check treatment

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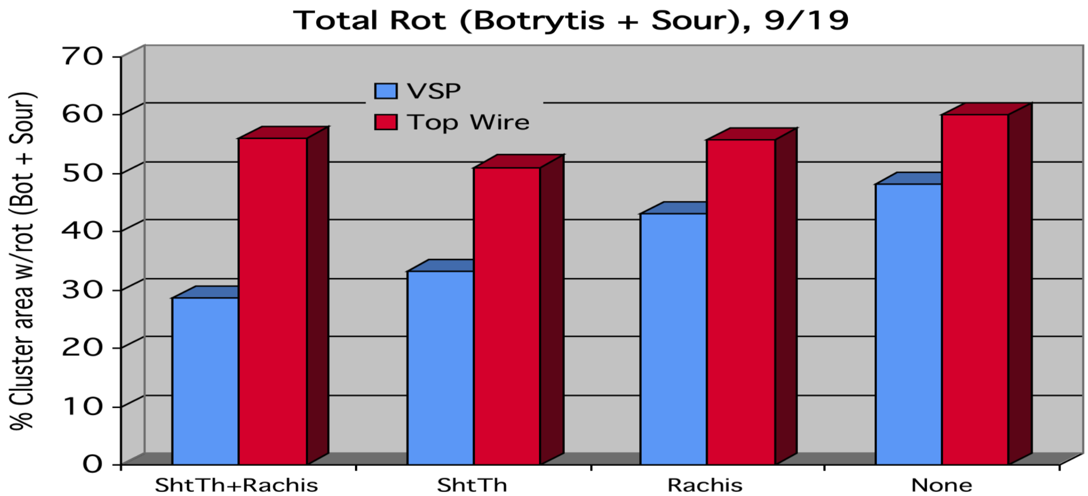
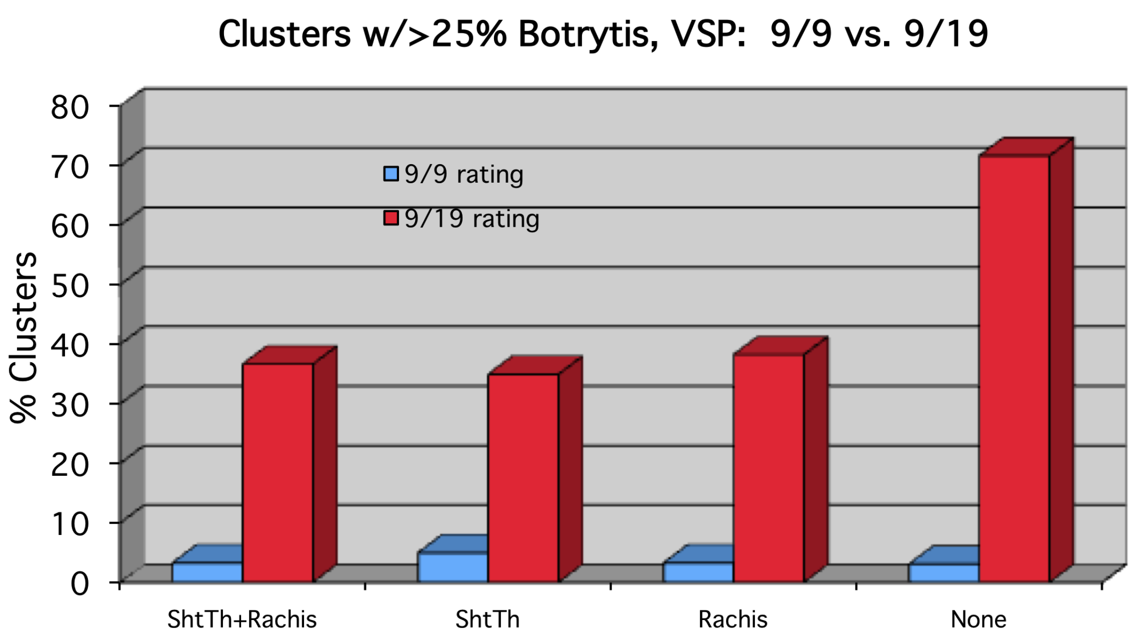
BOTRYTIS NEWS AND REMINDERS (cont.)



- Effects of training system and canopy manipulation were additive:
    - With no canopy manipulation (check), effect of going from TW to VSP was modest: 20% reduction in average % rot.
    - Within VSP, thinning shoots and removing rachises reduced rot by 40% relative to the check
    - Going from TW to VSP and thinning shoots + removing rachises reduced rot by 52% relative to the TW check



- Major jump in percentage of clusters with heavy Botrytis over last 10 days preharvest in all categories, but nearly twice as bad when no canopy manipulation

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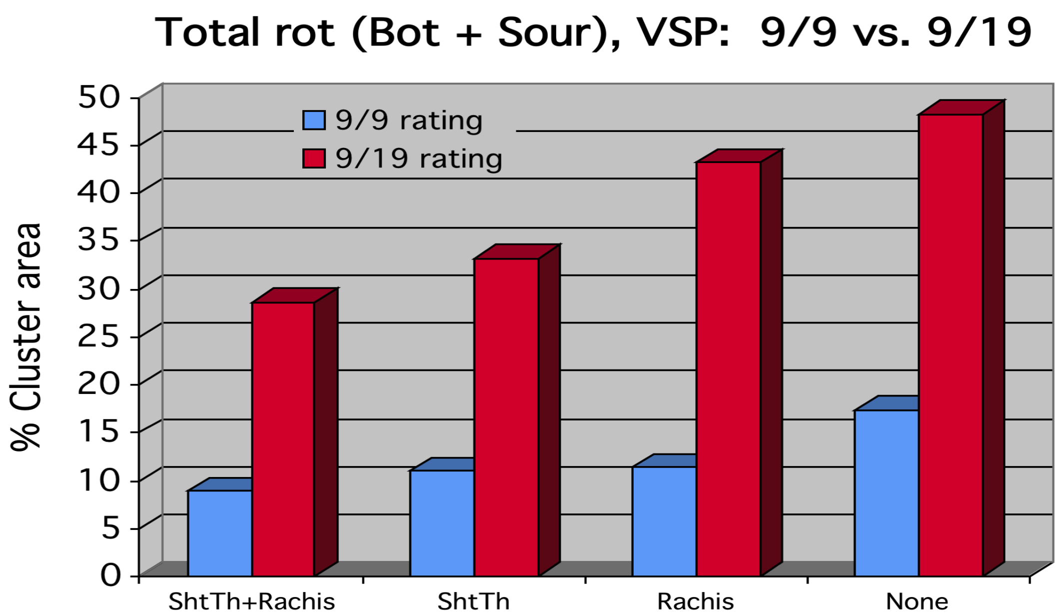

• Modest differences among treatments in amounts of total rot became greatly amplified the final 10 days before harvest.

2a. Fungicides, physical modes of action. Over several years, we looked at the various "physical modes of action" of the available Botrytis fungicides, to get a better idea of some of their specific characteristics and differences. Following is a repeat of previous summaries of the major findings and conclusions for this project:

• In one set of tests, we examined the ability of the fungicides to protect the **internal** berry tissue against infection from spores that might be deposited inside them following mechanical damage, such as that from rain cracking, berry moth feeding, etc. Chardonnay clusters were sprayed at pea-sized berries, bunch closure and veraison, then a hypodermic needle was used to inject berries with Botrytis spores 2 weeks after the last spray. Scala, Vangard, and Elevate provided excellent control, and Rovral was close. Pristine (19 oz/A) was comparable in preventing rot, but was less effective in limiting spore production from the limited number of berries that did develop symptoms. Flint and Endura provided the least protection of the internal berry tissues. However, all fungicides completely prevented spread to the neighboring berries when inoculated berries became diseased; in contrast, such spread occurred in two-thirds of the unsprayed clusters.

• In 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 Botrytis spores were applied to the surface of the unwounded berries 2 weeks after the final application. As we would hope, all fungicides provided virtually complete control.

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

- Take home-messages and cautions:

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

  - The so-called AP fungicides (Vangard and Scala) and Elevate also provided very good protective activity within the berries. This was anticipated for the AP’s, since such fungicides are known to be absorbed by plant tissues, but Elevate was long sold as a surface protectant. However, this appears to have more to do with the company's marketing strategy than with science.

  - Similarly, the same three materials provided very good curative activity against latent infections initiated at bloom, even when applied 2 months after infection. Nevertheless, as shown in Figure 5, we often get better control in our field trials when these fungicides are sprayed at bloom and bunch closure in addition to veraison and 2 weeks later. This suggests that the level of curative effect from the later sprays doesn’t replace the need for earlier applications when conditions favor infection at bloom, although it probably contributes to the overall level of control obtained.

2b. Fungicides, Pristine and Flint. For biological reasons, most common fungicides provide relatively little control of Botrytis at the rates used for other diseases and, conversely, most good Botrytis fungicides provide relatively little control of fungi other than Botrytis and a few close relatives affecting crops other than grapes (Rovral, Vangard, Scala, and Elevate fall into this category). Two striking exceptions to this general rule are Pristine and Flint.

Recall that both components of Pristine provide some control of Botrytis, although the non-strobie ingredient is the significantly more active of the two. This non-strobie component is not very active against any grape diseases other than Botrytis and PM, but the strobie part picks up the erratic “summer rot” diseases and helps a bit with some of the secondary “trash” fungi that are sometimes considered as part of the “sour rot” complex (plus PM, BR, and DM in the absence of resistence, of course). This same broad spectrum of activity also applies to Flint (minus the DM), which had consistently provided good to excellent Botrytis control at its higher (3 oz/A) rate in my trials, prior to some slippage in 2011.

“All of the current “standard” fungicides registered for Botrytis control provided excellent protective activity on the surface of the berries.“

"OTHER" ROTS

SOUR ROT is sometimes used as a catch-all term to describe the "snork" that takes over injured clusters during the pre-harvest period if the weather becomes good and wet. Although such berries are often colonized by a mix of various wound-invading fungi, "true" sour rot is caused by a couple of genera of acetic-acid forming bacteria, which produce the classic vinegar smell from which the disease gets it name. In humid regions, these are frequently accompanied by several species of wild yeats, which convert grape juice into ethyl acetate (nail polish remover aroma), which can be very difficult to contend with at the winemaking end of things. Diseased berries drip juice and spores or cells of the sour rot microorganisms onto nearby healthy berries, which in turn become infected through any wounds that might be available. Damage from Botrytis, rain cracks, and bird or insect punctures are common points of entry for these beasties.

"Excellent control of powdery mildew, and, especially botrytis, are two additional measures that will significantly minimize sour rot development"

Although it is almost impossible, under wet conditions, to stop sour rot once it has become established, controlling the aforementioned causes of injury will greatly reduce the probability of it getting started in the first place. And as noted in the graphs above, canopy management practices that promote drying in the cluster zone can be of significant benefit. (Dr. Wendy McFadden-Smith across the border in Ontario has also been getting some very encouraging results using some experimental cluster-loosening techniques).

Excellent control of powdery mildew and, especially, Botrytis are two additional measures that will significantly minimize sour rot development. And as mentioned above, there is some indication that Pristine and Flint used for Botrytis control may provide *some* additional control of the "snork" fungi that invade these wounds, but they won't do anything about the vinegar-forming bacteria (potential activity against the ethyl acetate-forming yeasts is not clear).

SUMMER ROTS is a term sometimes used for two similar diseases (ripe rot and bitter rot) common in more southern, humid (and quite warm) production regions. Those beneath the Mason-Dixon line and in the lower Midwest deal with these diseases on a regular basis and they occur sporadically to the north. Bitter rot, in particular, seems to pop up with some regularity on Long Island, particularly on Chardonnay. Those of us to the north should probably start being more aware of these diseases, especially in very wet years. It's not a threat to be over-emphasized in our region, but neither is it one to be flat out ignored. Particularly if our summers do continue to heat up.

Bitter rot appears to be the more likely threat in our "marginal" northern areas, as it doesn't have quite the need for heat that ripe rot does. Usually, symptoms first occur after veraison, as the bitter rot fungus moves into the berry from the berry stem and turns the diseased portion brown (on white varieties) or a dull purple. Once the berry is completely rotted, it becomes absolutely <u>covered</u> with <u>numerous</u> prominent, raised black pustules (the fungal fruiting bodies). You can't miss 'em. More details on the appearance of symptoms and how to distinguish them from Phomopsis and BR symptoms can be found in the 2012 Pest Management Guildeline (hard copy and on-line).

Ripe rot tends to predominate as you keep moving south, although it has been documented as far north as New England. Symptoms do not develop until after veraison and become increasingly prevalent the closer you get to harvest (whoda thunk it with a name like that?). Infected fruit initially develop circular, reddish brown lesions on their skin, which eventually expand to affect the entire berry. Under humid conditions, small "dots" of slimy, salmon-colored spores may develop across the rotten berry as the lesions become depressed, and serve to spread the disease to healthy fruit if rains continue. Infected fruit shrivel and mummify, and may either remain attached or fall to the ground. No foliar symptoms are produced.

Both diseases are favored by abundant, warm rains (77° to 86°F is optimum) between fruit set and harvest. Infections occurring before veraison typically remain "dormant" until fruit begin to ripen. Captan and the strobilurin fungicides are the go-to materials for control of these diseases in regions where they occur regularly (as is mancozeb, within its PHI restriction).

Cultural practices, such as pruning out dead spurs, removing overwintered mummies, and removing weak or dead cordons, are important to help reduce the inoculum in the vineyard. Turner Sutton at NC State, who has done more work with these diseases than anyone, has demonstrated this nicely by showing that they even tend to be worse in spur-pruned blocks, where some old (previous) fruit-

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"OTHER" ROTS (cont.)

ing wood is always retained. Both diseases are frequently controlled in the early- to mid-summer by sprays containing mancozeb, captan, or a strobie product directed against other diseases. However, with the exception of Flint and Pristine, fungicides used for Botrytis management (Elevate, Scala, Rovral, Vangard) provide very little control of bitter rot or ripe rot, and their exclusive use during wet preharvest seasons can lead to outbreaks of these diseases in regions where they are not routine and, therefore, are not consciously managed.

Sprays targeted against bitter rot and/or ripe rot may be needed in the late season if the weather is warm and wet, especially if the diseases are observed in the vineyard or have occurred there in the past. In southerly regions where they are consistent problems, it is typically necessary to apply protectant fungicides on a 2-week schedule from bloom until harvest, except during periods of drought. Because fruit are especially vulnerable in their final stages of ripening, pre-harvest sprays can be particularly useful when these diseases are active, to avoid rapid secondary spread. This potential utility must be balanced against wine makers' concerns about the effects of such sprays on fermentation (of course, they also love fruit with bitter rot, another aptly named disease). That legal preharvest restrictions on fungicide labels must be followed is a given.

PHOMOPSIS (Ph) NEWS AND REMINDERS

At this point in the season new Phomopsis infections are just about finished, although symptom development can continue through harvest. So, for the record:

1. Early sprays are the most important for control of rachis infections. Your annual reminder that in multiple spray-timing trials over a number of years, we found that applications during the early shoot growth period (as clusters first become visible, about 3 inches of shoot growth or so) are the most important for controlling disease on the rachises. Rachis infection by the Phomopsis fungus is among the most common causes, if not *the* most consistent cause, of economic disease loss that I see on Concord grapes, and is even worse on Niagaras since it seems to move more readily into the fruit of this cultivar (not to say that DM can't kick Niagaras pretty hard in some years as well). Note that early sprays also provide the greatest control of shoot infections, which serve as sources of Ph spores in subsequent years if retained as infected canes, spurs, or pruning stubs.

2. Early sprays also provide significant control of berry infections. In a trial conducted several years ago in a problem block of Niagaras, we were surprised to find that sprays applied before and just after cluster emergence (the important sprays for controlling rachis infections) also provided nearly 70% control of berry infection. In retrospect, this shouldn't have been too surprising, since it's common to see rachis infections expand into the berry stem and then into the berry itself, especially on this variety. But it was an eye opener nevertheless.

In a subsequent trial in a different high-inoculum Niagara vineyard, we documented a gain of over 2 tons/A in two particularly bad Phomopsis years, simply as a result of applying a single mancozeb spray during the early "3- to 5-inch" shoot growth stage. The quotes are to stress that this timing is approximate; the point is to get something on the young clusters soon after they emerge.

Thus, a minimal Ph spray program should include at least one application during this period. Research has repeatedly shown that waiting until the immediate prebloom spray is far too late if there is any significant disease pressure going on (inoculum in the vineyard + rain). Commercial experience has consistently shown the same thing.

Table 5. Effect of a single well-timed Phomopsis spray on yield. In both years, the single spray ("1x") was applied 2 weeks after the first spray (1- to 3-in shoots) in a comparison treatment that received three applications in total ("3x").

PHOMOPSIS: EFFECT OF EARLY CONTROL ON YIELD (cv. Niagara; Fredonia, NY)

Phomopsis program	Yield (tons/A) 2006	Yield (tons/A) 2008
None	7.7	13.2
Mancozeb, 1x	10.0	15.5
Mancozeb, 3x	10.8	16.4

Mancozeb at 1- to 3-in shoots; + 2 wk; + 2k

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

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

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

6. Spray application technique. Many growers like to spray alternate rows in the early season when it's the critical time for controlling Ph, assuming that sufficient spray will blow through the target row and impact on vines in the "middle" row. For 3 consecutive years, Andrew Landers helped us examine this issue in a commercial Niagara vineyard. Consistently, vines in the middle row received less spray than vines subjected to every-row spraying, and perhaps more importantly, the coverage on them was much more variable. I recognize that the benefits of alternate-row spraying are obvious and am a firm believer that there's no reason to fix things if they ain't broke. However, I'm also a firm believer in seeing things how they are rather than how you want them to be, so if you've had trouble controlling Ph while using alternate-row spraying, the suggested remedy is just as obvious.

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WOOD CANKERS

Eutypa dieback has been on the radar of eastern grape growers for many years; in fact, it is standard practice to cut through a piece of cankered trunk or cordon, see a wedge-shaped area of dead tissue, and diagnose it as Eutypa. However, work conducted for more than a decade now at the University of California, primarily in the lab of Dr. Doug Gubler at UC Davis, has shown that there are a number of different fungi that cause canker diseases in the west, each with its own specific biology and, potentially, appropriate management program. In the east, we (understandably) tend to preoccupy ourselves with the whole panoply of fruit and foliar diseases found in humid climates, which can destroy a crop in a single season if not adequately controlled. Nevertheless, we also have canker diseases, and although less flamboyant than our usual rots and mildews, they are "silent but deadly" robbers of production and profit in the east as well. We continue to see signs that they will become increasingly visible and important as our newer and higher-value vineyards continue to age. Thus, it seems time to start paying more attention to these diseases, and a good place to start would be to determine just which organisms are responsible in our region.

We were very fortunate to have Dr. Philippe Rolshausen--a 10-year veteran of Doug Gubler's lab at UCD, with a wealth of experience in this field--working on the problem at the University of Connecticut while he was there on a temporary appointment, and to continue working in our region from his base at UC Riverside after returning there. Philippe has sampled cankered tissues from multiple eastern vineyards, determined the identities of the fungi associated with them, and done field trials with them in a Chardonnay vineyard at Geneva and a Concord vineyard in Portland, NY. I hope to be able to give some final results from the study in this space next year.

In the meanwhile, suffice it to say that Philippe's results to date confirm that canker diseases are a larger problem in the East than is commonly acknowledged. Many of the organisms that he found are well-known causes of disease in California and Europe (including those responsible for esca and "black goo" syndrome). Although management options are limited, at the very least it appears that we need to do a better job of getting dead wood out of the vineyard and putting it to the torch before the fungi within make spores and attack new pruning wounds, thereby spreading the disease. There may also be options for chemical control, where appropriate.

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As I preface this section every year, we all know that there are as many good disease control programs as there are good growers and advisors. The following are some considerations among the many possible alternatives. As always, just because it isn't listed here doesn't mean it's a bad idea. **Please note that this section has only been edited for 2012 for the period from immediate prebloom onwards**, due to the lateness of the document's preparation. And as always, 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 pruning/training system (significant inoculum retention) or block history suggests high risk. Option A: Nothing. Option B: Captan, mancozeb, or ziram. The best one is whichever is cheapest and most convenient.

3- to 5-INCH SHOOT GROWTH. A critical time to control **Ph** rachis infections if it's raining or likely to be soon, especially in blocks with any history of the disease. Early is better than late if it looks like some rain is setting in. Late is much better than nothing if those are the only two options. This spray can provide significant benefit against fruit infections as well, since many of them originate from movement into the berries from infected rachises and berry stems. Also an important time to control basal shoot infections, since this is where the fungus will establish itself for the future if infected tissue is retained in canes, spurs, or pruning stubs.

Now is the time to start thinking about control of **PM** on *vinifera* varieties if temperatures remain above 50°F for long stretches of the day. This spray is much more likely to be important in vineyards that had significant PM last year (we're talking late season foliar disease more than fruit infections here) than in those that were "clean" into the fall; however, it may be beneficial even in relatively clean blocks of highly susceptible cultivars, particularly in cloudy, wet years when temperatures aren't severely limiting. And if you're already spraying for Ph, why not include something for PM on highly susceptible (and valuable) varieties while you're at it.

In NY, spending extra money for **BR** control is almost never justified this early unless you're trying to clean up a severe problem block AND weather is wet and reasonably warm. In general, the farther south you go, the more important early sprays can become. Still too early for **DM**.

Option A: Nothing. Option B: Mancozeb or ziram (BR, Ph). Option C: Captan (Ph, some BR). Easier on predator mites than mancozeb or ziram, probably good enough against BR this early, but 3-day REI issue. Option D: Sulfur (PM). As discussed above, historical pronouncements concerning reduced activity of sulfur at temps below 65°F appear to have been significantly exaggerated. It should be good enough, and is a cheap insurance option. With thorough coverage, sulfur sprays can eradicate incipient infections initiated during the previous week or 10 days (depending on temps since then). Option E: Rally, tebuconazole generics, Mettle [except NY] (PM, BR). In theory, one of the difenoconazole (DFZ) products (Revus Top, Inspire Super, Quadris Top) should fit here, too, since they should all give PM control superior to that from the preceding materials and are equivalent against BR. The problem with any of the DFZ products so early in the season comes down to resistance management issues: We're trying to limit the use of all DMIs (combined) to a total of three applications per season. And all of the DFZ products are mixed with something that we'd rather not apply now because pressure from the target organism for the mixing partner doesn't justify its use yet and we're trying to limit the number of applications of these materials. (This is especially critical for Quadris Top, since it contains a strobie). Did I already mention the critical nature of dosage with the DMI products, how dosage is a function of spray coverage in addition to the amount of product in the tank, and the coverage problems with alternate row spraying? Option F: Rubigan/Vintage (PM). An economical option, especially if BR control isn't an issue, and it usually isn't at this time. But the same issue with the need for limiting DMI applications and superior coverage at the low rates used early in the season. Option G: JMS Stylet Oil (PM). Should eradicate young infections that have already occurred IF thorough coverage is provided, and can provide a few days of limited forward activity, although much of this protective capability washes away with less than ½-inch of rain. Can use with mancozeb or ziram, but not with or near captan or

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"biocontrol" products while disease pressure is low (PM; maybe BR if there's a spore or two flying around). Option J: One of the PM products plus mancozeb, ziram, or captan for Ph.

10-INCH SHOOT GROWTH. We once recommend not waiting any later than this to control **BR**. Continued experience tells us that we can get way with withholding a BR spray at this time under most commercial conditions in NY unless this disease was a problem last year (inoculum levels are high) and weather is wet and warm. DO NOT wait any later than now to control **PM** on susceptible varieties. On Concord and other "moderately susceptible" cultivars, we normally recommend waiting until immediate prebloom. However, there have been seasons where we started seeing PM on Concords around the 10-in shoot growth stage, and uncontrolled early infections spread to the clusters and really caused havoc. And I've had excellent Concord growers tell me that when they wait until prebloom, they see a little PM already established, which puts them behind the 8-ball right from the start. So, get out in the vineyard and see what's happening. No need to spray before you need to, but if you already see PM, or you have experience with early disease development and weather conditions are forecast to favor PM, it might be a good idea. Remember, as crop load goes up, so does the need for good PM control and the ability to pay for it. Now is one of the best times to use a DMI, and a possible time to experiment with "alternative" materials if you're so inclined. It's also one of the best times to use an oil or other eradicant material against young "primary" infections that might just be getting started, particularly if the PM program up until now has been marginal or absent. **DM** control should be provided on highly susceptible varieties, especially if disease was prevalent the last year or two and rains of at least 0.1 inches at temps >52°F are anticipated or have occurred recently. Rachis and fruit infections by **Ph** are still a danger in wet years, particularly in blocks with some history of the disease.

Option A: Mancozeb (BR, Ph, DM). A broad spectrum, reasonably economical choice for everything except PM; tank mix with a PM material to complete the picture if necessary. Excessive use can lead to mite problems by suppressing their predators. You can substitute ziram if necessary or desired but will give up some DM control for in the process, although that might not be too significant this early. Option B: Captan (Ph, DM, some BR). An alternative to mancozeb if you're trying or are forced to avoid it. The limited BR activity should still be sufficient if the disease was controlled well last year (limited inoculum) and good BR materials will be used in the next three sprays. Toss in something for PM where needed. Option C: Sulfur (PM). Historical concern about reduced activity during cool weather is going down as we look at experimental data and temps should going up now as we look at the calendar going forward. Post-infection activity may be useful against new "primary" infections before they have a chance to form new spores and spread to developing clusters. Option D: Revus_Top (PM, BR, DM). Superior PM control relative to anything else recommended at this stage of the season other than Quintec or Vivando [no Vivando in NY yet]. BR and DM control, and all at a highly competitive price. A combination that's pretty hard to beat if that's what you're looking for. Except on Concord and a few other cultivars (likely to cause injury). Option E: Quintec or Vivando [Vivando still not registered in NY at the time of writing] (PM). Both are Cadillac PM material that should be limited to two applications per season each (they are unrelated to one another) for resistance management purposes. You'll get even more bang for your buck with a Cadillac PM material in another week or two, but if you feel that you need or want to start throwing the kitchen sink at it now, these are viable options. Option F: Rally, tebuconazole generics, Mettle [outside NY] (PM, BR). Option G: Rubigan/Vintage (PM). Limited BR activity usually is not a problem if effective materials are applied in the next three sprays, and is a non-issue if tank-mixing with mancozeb or ziram. Cost may be attractive, but higher 4-oz rate might be necessary where DMIs are starting to poop out. Option H: JMS Stylet Oil (PM). If (and only *IF*) coverage is **thorough,** this spray should eradicate early PM colonies that may have started, should previous PM sprays have been omitted or incompletely applied. But don't waste your money if you can't cover thoroughly. Also may help with mites. Will provide a few days protectant activity going forward in addition to the eradicant action, although much of that residual activity will disappear after a rain. Mix with something offering forward protective activity if your next spray won't be for much more than a week from now. The petroleum-based PureSpray Green should have similar effects if you can find it, whereas the botanically-based oils are generally less effective. Option I: Nutrol, Armicarb, Oxidate, Kaligreen. (PM).

Should eradicate young infections IF thorough coverage is provided, but no forward activity. Option J: Serenade or Sonata, if you want to experiment with OMRI-certified "biological" products before entering the critical period for disease control.

IMMEDIATE PREBLOOM TO EARLY BLOOM. **A critical time to control PM, BR, DM, and Ph on the fruit! Just stating to enter Bot season, too. This and the first postbloom spray are the most critical sprays of the entire season--DON'T CHEAT ON MATERIALS, RATES, SPRAY INTERVALS, OR COVERAGE!!** Option A: Quintec or Vivando for PM control, plus mancozeb (for BR, DM, and Ph). Effective and no current resistance concerns in the real world, but let's keep it that way by avoiding over-use (no more than 2 applications per year of each one). Option B. Pristine (PM, DM, BR, some Bot and Ph). We'd like to keep this one down to 2 applications per season, too, especially with the increasing risk of DM resistance the longer that we keep using it. The 12.5-oz rate of Pristine will also provide significant protection against Botrytis, I wouldn't spend the extra money on the higher "Botrytis control" rate (18.5-23 oz/A) this early unless Botrytis pressure was really high and/or I was really worried. On highly susceptible cultivars, where DMI resistance is usually an issue to at least some extent and strobie resistance has occurred or is deemed risky, Quintec, Vivando), or Pristine (plus sulfur) would be the materials of choice for PM, but don't forget about DM and BR. With Pristine especially, I'd toss in some sulfur, particularly in blocks where PM has already developed strobie resistance, just for additional insurance at this critical time. Option C: Luna Experience [not yet registered in NY!] (PM, Bot, variable BR depending on rate) + mancozeb (DM, BR, Ph). Refer to discussion at the beginning of the tome for specifics regarding Luna Experience, including rotational considerations if using Pristine. Option D: Revus Top (PM, BR, DM), Inspire Super (PM, BR, Bot), or Quadris Top (PM, BR, DM). Discussed in detail under "New fungicides" earlier. Worth reviewing, especially if you're considering use at this time. If using Inspire Super, you'll need to add something for DM. I can't overemphasize the fact that the excellent PM control we've seen with difenoconazole is due to its high "intrinsic" activity, and that this is rate dependent so you'll start losing it--especially on the clusters!--if you get spotty spray coverage (i.e., only put a partial rate on your spray target). Option E: Abound or Sovran [plus sulfur, on cultivars where it can be used] (PM, BR, DM [only moderate DM for Sovran]). Still an effective option in some plantings, particularly on native and certain hybrid cultivars that have seen limited use over the years, although the scuttlebutt is that they're slipping in some of these vineyards, too. As with most rumors, recognize this one for what it is and then apply your own experience in determining how much credence to give it. Nevertheless, I think it's fair to say that these materials' best days are behind them, although they're not dead yet (sounds uncomfortably familiar). Refer to the discussion on strobilurin resistance in the "Fungicide Changes and News" section at the beginning of this epistle. Option F: Flint plus sulfur (PM, BR, Botrytis at the 3-oz rate) plus one of the many options for DM. Option G: Rally, tebuconazole generics, or Mettle [no Mettle in NY] (PM, BR) PLUS mancozeb (DM, BR, Ph) or captan (DM, Ph). IMHO, you'd choose this option only if you couldn't use difenoconazole as a DMI. One of the new DM-specific fungicides could also be used for DM control, but they may give more bang for the buck after bloom unless there's heavy DM pressure early (clusters are highly susceptible now, after all). Add sulfur on *vinifera* and PM-susceptible hybrids (unless "sulfur shy"). Like the difenoconazole products, Rally, the tebuconazoles, and Mettle provide excellent postinfection activity against BR, which can make them especially valuable if significant unprotected infection periods occurred over the last week or 10 days. 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 H: Mancozeb + sulfur (PM, BR, Ph, DM). Used to be cheap and effective, particularly if used at shorter spray intervals; it's no less effective than before. Neither material is as rainfast as the strobies or SI fungicides, so shorter spray intervals can be both necessary and difficult in wet years. Of course, this is precisely when their activity is needed the most. Potential mite problems, as this mixture is hard on mite predators.

BLOOM. Vangard (or Inspire Super), Scala, Elevate, Flint (3 oz rate), Endura, Pristine, or Luna Experience [not yet labeled in NY] for Botrytis control will probably be beneficial sometime around now on susceptible varieties, particularly in wet years. It's certainly easier to use or include

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one of these materials for Botrytis purposes in the "immediate prebloom/early bloom" or "first post-bloom" spray, and from what we know of these materials' activities, they should be effective when applied then, although we've never directly compared these timings (results would likely be different from year to year anyway, depending on if and when rains fall through the pre- to post-bloom period). One problem with tank-mixing Botrytis-specific materials like the AP's and Elevate is that you'll be distributing them throughout the entire canopy, whereas the only place they're effective is on the clusters.

Also, if sulfur was the only PM material in the previous (immediate pre-bloom) spray, reapply about now on highly susceptible *viniferas*, especially if it's been raining since then or will soon.

FIRST POSTBLOOM (10-14 days after immediate prebloom/early bloom spray). **Still in the critical period for controlling PM, BR, DM, and Ph on the fruit. And we're well into the start of Bot season. This and the immediate prebloom/early bloom spray are the most critical applications of the entire season--DON'T CHEAT ON MATERIALS, RATES, SPRAY INTERVALS, OR COVERAGE!!** Shorten the spray interval and/or jack up the rate or PM material quality on PM-susceptible varieties if weather is warm and cloudy. For Botrytis-sensitive cultivars/blocks/seasons, make sure that this application has some Bot activity if you haven't used anything at for it yet. Same considerations and options as detailed under IMMEDIATE PREBLOOM. Juice grape growers can substitute Ziram (very good BR and Ph, only fair DM) for mancozeb or captan if necessary, or just go with Abound or Sovran for everything if they're still working. Captan, mancozeb, or the strobies will protect against bitter rot and ripe rot, if/where those are concerns.

SECOND POSTBLOOM. **BR** control is still advisable under wet conditions and is should be considered critical if infections are evident on the vine, unless you're willing to bet part of your crop that it's not going to rain within the next few weeks; however, BR sprays can often be skipped from here on out on natives and hybrids if the vineyard's clean. Fruit are less susceptible to **PM** now, but those of *vinifera* varieties (and susceptible hybrids?) still need good PM protection, particularly to guard against later bunch rots and colonization by wine-spoilage microorganisms. Of course, new foliage remains highly susceptible to PM throughout the season, and it behooves you to keep it clean for purposes of leaf function in addition to reducing primary inoculum for next year. Concords can withstand a lot of foliar PM unless the crop is very large and/or ripening conditions are marginal. Minimal programs can stop now on this cultivar if the preceding crop/ripening conditions don't apply, although one more PM spray now is often justified. Try to avoid DMI and, particularly, strobie fungicides if PM is easy to see without trying. **Ph** danger is basically over unless very wet and a problem block. Clusters are still susceptible to **DM** and should be protected on susceptible varieties if weather is wet, especially if disease already is established (take a look and see). Foliar DM will remain a potential threat throughout the rest of the season, depending on the weather, and can quickly turn into an epidemic on susceptible cultivars if we get into a prolonged set of summer rains or thundershowers. Option A: Pristine, Abound, Sovran, or Flint. See previous discussions on all of these. They provide good residual control of the listed diseases if used now, but strictly limit their use to maintain viability. And if you think they might not be working against DM, don't wait for somebody from the university to confirm that before you switch to something else. Pristine and Flint will provide good Botrytis control when used at the appropriate rate as a pre-bunch closure spray. Option B: Quintec or Vivando for PM control + captan (DM, Ph) or mancozeb (BR, DM, PH, but 66-day preharvest restriction and mite issues) as needed for these other diseases. If DM is the only other issue, Ridomil (in a bad year), a phosponate, copper, or one of the new DM-specific materials (see Chapter 1 of this book) are additional options. Quintec, Vivando, and Pristine shouldn't be applied in more than two consecutive sprays. You may want to save one of your two Pristine shots for veraison or later, to pick up Botrytis and other rots. Option C: Luna Experience [not yet labeled in NY] for excellent PM + Botrytis control + add something for DM control. See Luna Experience comments under Immediate Prebloom section. Option D: Revus Top (PM, BR, DM), Inspire Super (PM, BR, Bot), or Quadris Top (PM, BR, DM). Remember, these are discussed in detail under "New fungicides" earlier. Inspire Super will provide Bot control when applied pre-bunch closure, the low cyprodinil (Vangard) rate that it provides might or might not be adequate, depending on pressure. If using this, you'll need to add something for DM on susceptible cultivars. Option E: Rally, tebuconazole generics, or Mettle [no Mettle in NY] (PM, BR) PLUS mancozeb if still within the 66-day PHI limit (DM, BR) or one of the many DM options (captan, phosphites, new DM-specific materials discussed previously). Like the difenoconazole products, all of these DMI products provide excellent postinfection activity against BR, although they're not as effective against PM. Option F: Sulfur (PM) + the options listed above for BR and DM. In most years, lessening PM pressure makes this economical option increasingly practical as the season progresses. Option G: Copper + lime (DM, some PM). A good PM option at this time for Concord and other native varieties in blocks where a spray is justified, generally not good enough for *vinifera* and susceptible hybrid cultivars.

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

On *vinifera* and other cultivars requiring continued **PM** control, use sulfur as an economical choice. However, this can be a problem as you approach veraison, as some wineries are setting fairly long withholding intervals. For the past 3 years, we have been involved in a very extensive project led by Dr. Gavin Sacks and graduate student Misha Kwasniewski investigating the effects of various vineyard sulfur programs on residues and resultant off-aromas in wines. Details will be provided in a separate communication later in the summer, but for now the bottom line is: White wines that are settled and clarified, little concern. Red wines, reasonable cause for concern from applications approximately 6 weeks (maybe more) or closer to harvest.

DMIs, particularly the difenoconazole products, also are options; Revus Top is particularly attractive for the combined reasons of PM/BR/DM efficacy and cost (except on Concords, of course). But pay attention to previously-discussed maximum number of applications for all of these materials. Quintec or Vivando will certainly provide outstanding control if you need/want it and haven't used up your seasonal allotment yet. Ditto for Pristine and Luna Experience [no LE in NY, etc.] (save for later against Bot and perhaps other rots in the case of Pristine). All of these materials provide the advantage of longer residual activity than sulfur in addition to the lack of concern about potential off-aromas. 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, Regalia, Oxidate, Serenade, and Sonata can have their place during this period, especially if you're trying to avoid sulfur, although they generally need to be sprayed more frequently and most of them are not cheap. The well-documented ability of oils to decrease photosynthesis and consequently decrease Brix accumulation makes me wary of recommending these products once the crop nears veraison, although a single application should be OK. For **DM**, there's the whole raft of products discussed previously. **Summer rots** are controlled with mancozeb, captan, and strobies; the peak period of susceptibility appears to be near veraison. Strongly consider an "insurance" application against **Botrytis** at or soon after veraison (depending on the weather), then determine the need for a subsequent preharvest spray based on weather and the need to limit spread of the disease, should it be revealed by scouting. **BR** should not be an issue after the second postbloom spray, except in very unusual circumstances (disease is established in the clusters of *vinifera* varieties, wet weather is forecast, and it's possible to direct sprays onto the clusters). **Ph** should not be an issue, period.

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Upcoming Events

You can also check out our Calendar on the FLGP website for information about upcoming events as well.

Grower Tailgate Meeting

Tuesday, July 10 5:00 – 6:30 PM

Harry Humphreys

5266 Lakemont Himrod Road, Dundee NY

(click here for a map)

Our next grower tailgate meeting will be held at Harry Humphreys' farm on Lakemont Himrod Road, just north of Glenora Wine Cellars. Mike and Hans will bring some timely topics and information to discuss at the meeting, but there will also be time to talk about whatever else is on growers' minds. Hope to see you there!

Schedule for Remaining Grower Tailgate Meetings:

- July 24—Arbor Hill, 6259 Hawks Road, Bath, NY.
- August 7– Sawmill Creek Vineyard, 5587 State Rte. 414, Hector, NY.
- August 24– Sheldrake Point Vineyard, 7448 County Road 153, Ovid, NY.

American Society

of

Enology and Viticulture – Eastern Section Annual Meeting and Conference

July 16-19, 2012

Traverse City, MI

Join us for the 37th annual American Society of Enology and Viticulture Eastern Section (ASEV-ES) Conference and Symposium July 16-19, 2012 in Traverse City, Michigan. On Monday, July 16 we will have a preconference tour of NW Michigan wineries and vineyards. The conference will begin with technical/research presentations on Tuesday and Wednesday, July 17-18 and include Tuesday's Oenolympics Grazing Dinner with Wines of the East and Wednesday's Sparkling Wine Reception and Grand Awards Banquet.

The conference will be followed by the International Symposium on Sparkling Wine Production on Thursday, July 19. The Symposium, designed for vineyard managers and winemakers, will feature national and international experts in sparkling wine production.

Visit http://www.asev-es.org for more information.

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2nd North East Vineyard Equipment Show and Demonstration

July 25-26, 2012 9.00 am until 4.30pm

Anthony Road Vineyards, Penn Yan, NY

Andrew Landers of Cornell University is hosting a vineyard equipment show and demonstration in the heart of the Finger Lakes grape growing region on July 25th and 26st 2012, at Anthony Road Vineyards, 1020 Anthony Road, Penn Yan, NY 14526 on Route 14, between Geneva and Penn Yan (by kind permission of John and Peter Martini).

Come and meet equipment manufacturers and dealers and see their machines working in a vineyard. Equipment to be shown includes canopy and weed sprayers, electronics for spraying, canopy hedgers and trimmers, tractors, mechanical weeders, leaf pullers/removers, hilling machines and trellis supplies.

A special theme for 2012 is the "Use of engineering methods to improve pesticide application" to match the SWCD grants in Seneca, Schuyler and Yates Counties.

Pre-registration is required. Contact Gemma Osborn via email at gro2@cornell.edu or by telephone at (315) 787-2248 stating **which day** you will be attending.

Lunch will be available and 4 pesticide credits will be awarded by NY DEC.

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