Cornell University
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Lake Erie Region Grape Program

PennState Extension

Newsletter April 2019

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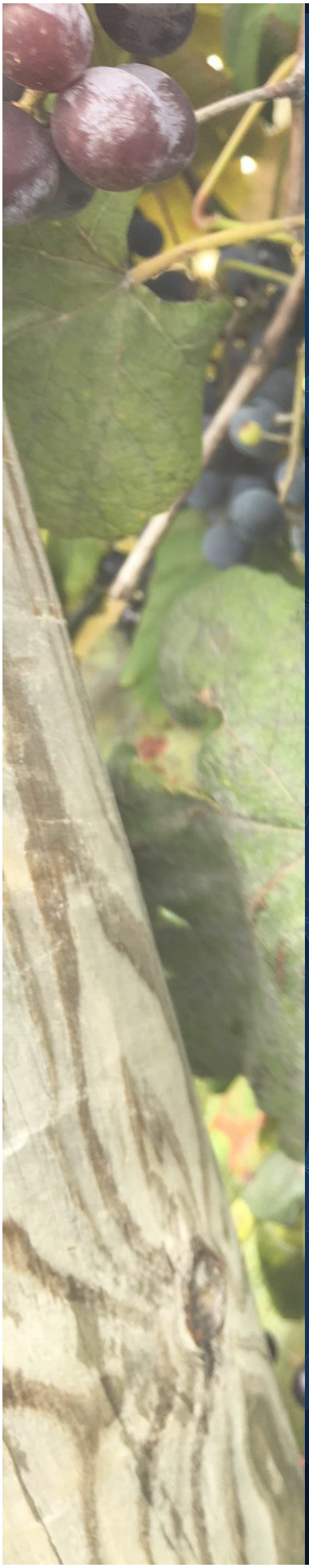

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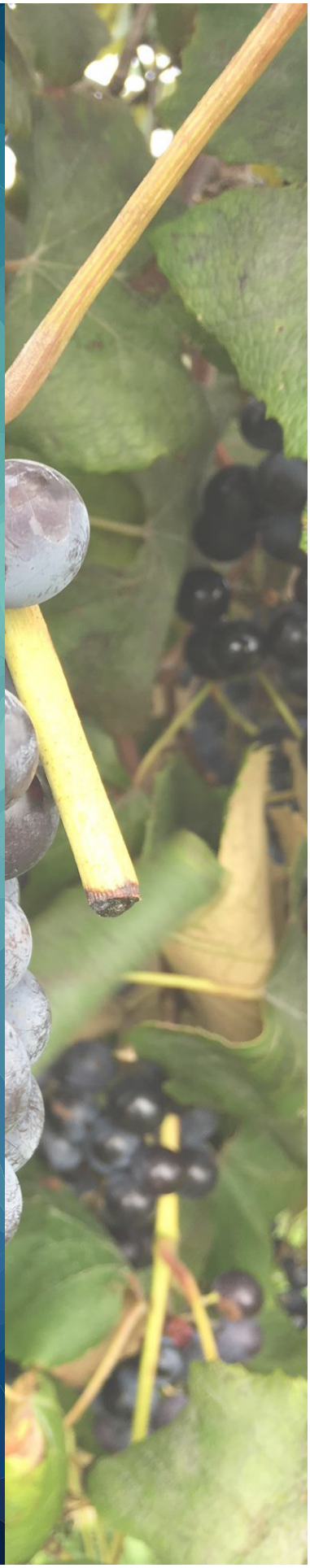

LERGP
2019 COFFEE POT MEETING SCHEDULE

Date	Time	Location	Address
May 1, 2019	10:00am	John Mason Farm	8603 West Lake Rd. Lake City PA 16423
May 8, 2019	10:00am	Sprague Farms	12435 Versailles Rd. Irving NY 14081
May 15, 2019	10:00am	Paul Bencal	2645 Albright Rd. Ransomville NY 14131
May 22, 2019	10:00am	Arrowhead Winery	12073 East Main Rd. North East PA 16428
May 29, 2019	10:00am	Militello Farm Supply	2929 Route 39 Forestville NY 14062
June 5, 2019	10:00am	North East Fruit Growers	2297 Klomp Rd. North East PA 16428
June 12, 2019	10:00am	Thompson Ag - Corner of Hanover & Dennison	Silver Creek NY 14136
June 19, 2019	10:00am	Kirk Hutchinson	4720 West Main St. Fredonia NY 14063
June 26, 2019		NO COFFEE POT	
July 3, 2019	10:00am	Betts Farm	7366 East Route 20 Westfield NY 14787
July 10, 2019	10:00am	Jim Vetter	12566 Versailles Rd. Irving NY 14081
July 17, 2019	10:00am	Trolley Line Vineyards	11480 E. Main St. North East PA 16428
July 24, 2019	10:00am	Brian Chess	10289 West Main Rd. Ripley NY 14775
July 31, 2019	10:00am	Tom Tower Farm	759 Lockport St. Youngstown NY 14174

The Lake Erie Regional Grape Program is a Cornell Cooperative Extension partnership between Cornell University and the Cornell Cooperative Extensions in Chautauqua, Erie and Niagara county NY and in Erie County PA.

PA Update
Bryan Hed, Research Technologist, Lake Erie Grape Research and Extension Center

GRAPE DISEASE CONTROL, 2019

Bryan Hed, Department of Plant Pathology and Environmental Microbiology,
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Keeping with tradition, the following is a brief pre-season summary of some of the newer grape disease management materials that I hope will be useful for grape growers in the 2019 season. The majority of these materials are not "brand new" and have been out there for a year or two or three, but as the list of options gets longer and longer (and longer…) we need reminders to make us aware of all the materials at our disposal. To get this rolled out asap, some of the information below has been borrowed from previous newsletters by Wayne Wilcox and myself.

First, a brief word about the **succinate dehydrogenase inhibitor fungicides (SDHIs).** As Wayne pointed out a few years ago, this class of fungicides has been experiencing a sort of renaissance. Under development since the 1960s, the early SDHIs controlled basidiomycete fungi that caused important rust and Rhizoctonia diseases on some major crops. But the disease control spectrum of SDHIs was greatly enhanced by some creative tweaks in chemical structural complexity a little over 20 years ago and many of the big ag chemical companies began working on their versions of this breakthrough. This resulted in the release of a number of important products in the 21st century that enhanced disease control for many additional crops the world over, including grapes. The first was boscalid (BASF; the active ingredient in Endura and one of the active ingredients in Pristine), a 'new generation' SDHI that could now provide control of ascomycete fungi that cause diseases like powdery mildew and Botrytis bunch rot, making the SDHIs, for the first time, a very important chemical class for grape growers. That was around 2002. Then came fluopyram (Bayer Crop Sciences), the foundation of the "Luna" series of fungicides, also for powdery mildew and Botrytis. From that, grape growers have Luna Experience (2012?) and more recently, Luna Sensation. Syngenta has since released their SDHIs for grapes in even newer products addressed below (benzovindiflupyr in Aprovia, pydiflumetofen in Miravis Prime), that even include efficacy against black rot.

At present, all the SDHI products are very effective against grape powdery mildew; that is their consistent strength. Their high activity against this disease generally makes them great options for fruit protection around bloom (first 2-3 weeks after capfall), when the fruit of all varieties are highly susceptible to that disease. With respect to price, I have found Endura (the oldest one) to be the least expensive, Luna Experience to be a little more expensive, and the newer materials like Aprovia and Miravis Prime, to be the most expensive. The only ones I have tested side by side for powdery mildew control are Endura, Luna Experience, and Miravis Prime (oldest to newest). It was a single trial on Concord grape, and I found Luna Experience and Miravis Prime to be significantly more effective than Endura in terms of limiting powdery mildew incidence on fruit. However, they were all statistically equal in terms of limiting disease *severity* on fruit (87, 99, and 100% control of fruit powdery mildew with Edura, Luna Experience, and Miravis Prime, respectively).

The SDHI products vary somewhat in their efficacy against *Botrytis*; Endura (boscalid) and the Luna products (fluopyram) appear to be good *Botrytis* materials, but Aprovia (benzovindiflupyr) and pydiflumetofen in Miravis Prime appear to have relatively little *Botrytis* activity. Therefore, pydiflumetofen is combined with fludioxonil (an older, but effective *Botrytis* material) to add control of that pathogen in the product, Miravis Prime. Lastly, they also vary widely in their efficacy against black rot; to my knowledge, boscalid (Edura) and fluopyram (in Luna products) have little or no efficacy against that disease, benzovindiflupyr in Aprovia has some, and pydiflumetofen in Miravis Prime has a high level of efficacy against black rot.

With this flush of new SDHI products though, it's also important to remember that these chemistries all hail from the same FRAC group 7 and therefore share the same narrow, single site mode of action (the inhibition of succinate dehydrogenase, an essential enzyme in fungal respiration) which makes them a risk for the development of resistance by the fungi that cause powdery mildew and Botrytis bunch rot. In other words, all of these SDHI fungicides target the same essential, biochemical process that can be overcome by a single mutation in the fungal pathogen, making the SDHIs a moderate to high risk for resistance. To complicate matters, a variety of mutations have been found in various target fungal plant pathogens that seem to confer resistance to one or some of the new SDHI active ingredients, but not to all. For example, several mutations have been identified in the *Botrytis* fungus that enable it to survive an application of boscalid but not fluopyram. In other words, these mutations may successfully exclude boscalid and allow fungal respiration to continue, but they do not exclude fluopyram from binding and jamming up the site and killing the fungus (fluopyram may still control the fungus to a high degree!). This was documented in a study with *Botrytis* on strawberries in Spain (Fernández-Ortuño et al. 2017), where four resistance patterns to boscalid were observed, but only one conferred resistance to both boscalid and fluopyram (cross-resistance only observed for one of the four mutation scenarios). In another example, isolates of the fungus that causes early blight of potatoes in Idaho (*Alternaria solani*), were found to be resistant to boscalid or fluopyram, but none were resistant to both; there was no cross resistance for boscalid *and* fluopyram (Miles et al. 2014). This has also been documented among fungi that cause Corynespora leaf spot and powdery mildew on cucumber in Japan; fungal isolates highly resistant to boscalid were still sensitive to, and well controlled by, fluopyram (Ishii et al. 2011). And in one particular case, a boscalid resistant fungal mutant was actually hypersensitive to fluopyram!

What about the fungus that causes powdery mildew of grape (Erysiphe necator)? A recent paper in Microbiological Research (Cherrad et al. 2018) documents grape powdery mildew resistance to boscalid in French vineyards, but again, no cross resistance to fluopyram. To the best of my knowledge, there is no confirmed grape powdery mildew resistance to this chemistry in the eastern U.S. *yet.* However, a tank mix with sulfur on sulfur tolerant varieties would not be a bad idea, and it still makes good sense to limit the use of ANY of these products to two applications per year. But interestingly, the idea that resistance to one chemistry in FRAC 7, is resistance to all in FRAC 7, "ain't necessarily so". It seems the structural diversity that exists among different SDHIs allows for a variety of fungal mutations to confer a variety of resistance scenarios. In the words of Kramer; 'Mother nature is a maaad scientist, Jerry'!

With that background, we begin a review of some of the most pertinent fungicide product information for grape growers in 2019. Here are the main ones in alphabetical order…

Aprovia/Aprovia Top. The active ingredient in Aprovia is benzovindiflupyr. These fungicides first became available to PA growers in 2016 and then NY growers last year. The active ingredient in Aprovia is in the class of fungicides known as succinate dehydrogenase inhibitors (or SDHIs, introduced above) and belongs to FRAC Group 7, which also includes chemistries in products like Endura and Pristine (boscalid) and Luna Experience (fluopyram). Trials in NY have shown that the active ingredient in Aprovia is **very effective for the control of powdery mildew; that is its strength.** PA trials have shown some efficacy on black rot, but I would consider it more in line with "suppression" of this disease and I cannot recommend it for black rot control, especially on susceptible varieties and in wet seasons. Also, it should not be relied on for control of *Botrytis*. The label also lists control of Phomopsis and athracnose, but like Wayne Wilcox, I have not seen any strong proof of that in field trials. Limited trial work at Penn State last year indicated little or no control of Phomopsis shoot lesions but fair control of Phomopsis on cluster stems. Two years of crop injury testing on Concord has indicated no issues (no injury) with Aprovia to that variety. However, a quick check with our local ag products supplier has indicated that the cost of this product might be prohibitive for juice grapes (check with your local supplier for current prices).

Aprovia Top, on the other hand, is a mixture of two active ingredients: i) benzovindiflupyr, the active ingredient in Aprovia and ii) difenoconazole, a DMI fungicide with very good to excellent activity against powdery mil-

dew, black rot, and anthracnose. Aprovia Top is also labeled for control of Phomopsis, but again, local experience and published results of field trials with Phomopsis is lacking. The label rate for Aprovia Top is 8.5 to 13.5 fl oz/A; 13.5 fl oz of Aprovia Top provides about the same amount of benzovindiflupyr as 10.5 fl oz of Aprovia; it also provides about the same amount of difenoconazole as 18 fl oz of Inspire Super, but falls a little short of that found in 7 fl oz of Revus Top. Aprovia and Aprovia Top have a 12 hr REI and a 21 day PHI. As with all the products containing difenoconazole, **Aprovia Top should not be applied to Concord grape and other varieties on which difenoconazole injury has been reported.** This also includes Brianna, Canadice, Concord Seedless, Frontenac (minor), Glenora, Noiret (minor), Skujinsh 675, St. Croix (minor), and Thomcord. Both products are legal to use in New York, including Long Island.

Dexter Max. Dexter Max is a product that contains two active ingredients that I think everyone is familiar with: (i) azoxystrobin (the active ingredient in Abound), and (ii) mancozeb, the active ingredient in Dithane, Manzate, Penncozeb, and many other products (eg. Fortuna, Roper). This product should provide good control of powdery mildew, but only in the *absence* of resistance to strobilurins, which is becoming a rarer and rarer thing these days. It should also provide very good to excellent activity against black rot, downy mildew, and Phomopsis (by virtue of both active ingredients). But again, strobilurin resistance by the powdery mildew fungus is common in many grape growing areas of the east, and where present, will render this product ineffective against that disease. On varieties highly susceptible to powdery mildew and not sulfur sensitive, tank-mixing sulfur with this fungicide will give an extra measure of protection. Label rates for Dexter Max are 1.5 to 4.25 lbs/A. The 3.2 and 4.25 lb/A rates of this product contain the same amount of azoxystrobin as 10 and about 13.1 fl oz of Abound flowable (the low and mid-range of Abound rates for grapes, respectively), and the same amount of mancozeb as 3 and 4 lbs of the 75DF formulations of Dithane, Manzate, Penncozeb, and other 75DF mancozeb products. Dexter Max has a 24 hr REI and a 66 day PHI. Lastly, this product cannot be used in Erie county PA (contains azoxystrobin).

Flint Extra 500SC. Flint 50WG fungicide is a dry formulation of the strobilurin, trifloxystrobin, and has been available to grape growers for about 20 years. That dry formulation is being replaced by a liquid formulation trifloxystrobin called *Flint Extra*. You may recall that Flint was once known for outstanding activity against powdery mildew and was primarily used to control that disease as well as black rot. Unfortunately, with widespread powdery mildew resistance to the strobilurins, the use of this product is now considered risky for control of that disease. For rates of active ingredient applied, one fluid ounce of the new formulation is roughly equivalent to one dry ounce of the old formulation. However, the rates on the new label generally reflect a higher application of active ingredient for disease control, compared with those on the old label. For example, the old label listed a 1.5-2 ounce rate for powdery mildew control, whereas the new label lists a 3-3.5 fluid ounce rate for that disease; a substantial increase over the old rate of active ingredient. However, applying the higher rate of trifloxystrobin with Flint Extra will likely not overcome any resistance issues that may have developed. Like Flint 50WG, Flint Extra should be very good to excellent against black rot, fair against Phomopsis, and weak against downy mildew (suppression). The rates of active ingredient for black rot and Phomopsis have been bumped up as well, but the rates for downy mildew have remained about the same. Flint Extra also is labeled for control of *Botrytis*, although at a new rate of 3.8 fl oz/A, an increase in trifloxystrobin application of about 28% over the 3 oz rate on the old Flint 50WG label.

However, be warned that *Botrytis* resistance to the strobilurins is also common in regions where strobilurins have been used for some time. Flint Extra has a 12-hr restricted entry interval and a 14-day preharvest interval. Like Flint, Flint Extra is phytotoxic on Concord grapes and it's important to thoroughly rinse spray equipment before application of other products to Concord grapes, especially if you're using the higher rates on the Flint Extra label. Though Flint Extra replaces Flint 50WG, grape growers will still be able to legally use up old stock of Flint 50WG.

Intuity. This product is also relatively new, but the representative at Valent that I spoke to informs me there are no changes to make since last year. The active ingredient is mandestrobin, another strobilurin fungicide (FRAC

group 11). Intuity offers protectant and antisporulant activity against Botrytis, for which it is exclusively recommended, though it will provide suppression of powdery mildew, at least where strobilurin resistance has not yet developed. In limited NY and PA trials, Intuity has provided good to fair control of Botrytis equivalent to current standards like Elevate, Vangard, Scala, and Switch. The label rate is 6 fl. oz/A with a maximum number of three applications (two is recommended) and 18 fl oz per season. Do not make sequential applications; rotate with non-FRAC 11 materials (Elevate, Endura, Fracture, Inspire super, Rovral, Scala, Switch, Vangard) and allow at least 20 days between Intuity applications. Intuity is at risk for resistance development by the Botrytis fungus and it is essential that its use be limited to rotations with other, unrelated Botrytis fungicides both within and between seasons to reduce the development of resistance. Intuity is rainfast within 2 hours of application, has an REI of 12 hours and PHI of 10 days. Do not use Intuity on *V. labrusca, V. labrusca* hybrids or other non-*vinifera* hybrids. In our trials on Vignoles we have not observed any injury issues from this product. Avoid mixing with organosilicone surfactants. To the best of my knowledge, Intuity has not yet been cleared for use in New York at press time.

Luna Sensation. The Luna series of fungicides have been around since about 2011/2012, and for grape growers, started with the release of Luna Experience (a combination of fluopyram and tebuconazole). Just recently, Luna Sensation has become available for use on grapes as well. Bayer Crop Science, the source of these fungicides, informs me that, like Luna Experience, Luna Sensation will be for general use in PA but *Restricted Use* in NY and cannot be used in Suffolk and Nassau counties in NY. Like all fungicides in the "Luna" series, Luna Sensation contains fluopyram, a relatively new "SDHI" (Group 7) fungicide similar to boscalid (the non-strobie component of Pristine) benzovindiflupyr (Aprovia), and pydiflumetofen (one of the ais found in the new product, Miravis Prime, discussed next) which is active against powdery mildew and *Botrytis*. The second active ingredient in Luna Sensation is trifloxystrobin (just discussed above as Flint Extra), which provides good to excellent control of powdery mildew (in the absence of resistance to strobilurins) and black rot, and control of Botrytis at higher rates. As with Flint/Flint Extra, the label specifies that you do not apply or allow drift to Concord grapes or crop injury may occur.

Luna Sensation is labeled for control of powdery mildew at 4.0–7.6 fl oz/A, control of black rot, Phomopsis, and Botrytis at 5.0-7.6 fl oz/A, and suppression of downy mildew at the maximum rate of 7.6 fl oz/A. Activity against black rot, Phomopsis, and downy mildew comes from the trifloxystrobin component, whereas both active ingredients have activity against Botrytis and powdery mildew. For black rot and Botrytis control, the 5-7.6 fl oz rate of Luna Sensation should deliver enough trifloxystrobin for good to excellent control of these diseases (equivalent to about 2.5-3.8 fl oz of Flint Extra, that has about twice the concentration of trifloxystrobin as Luna Sensation). Of course, this level of *Botrytis* control would only apply in the absence of strobilurin resistance by this pathogen. The 7.6 fl oz rate for Phomopsis and downy mildew is about the same dose of trifloxystrobin as the 3.8 fl oz rate on the Flint Extra label for these diseases, still only providing for suppression of downy mildew. For powdery mildew control, the 4-7.6 fl oz label rate delivers a wider range of fluopyram than the 6-8.6 fl oz powdery mildew rate on the Luna Experience label, but they're *about* the same. For example, 6 and 8.6 fl ozs of Luna Experience actually delivers a dose of fluopyram equivalent to 4.8 and 6.8 fl ozs of Luna Sensation. That same 4-7.6 fl oz powdery mildew rate also delivers about the same amount of trifloxystrobin as 2-3.8 fl oz of Flint Extra. In the absence of strobilurin resistance, this should make for a very potent combination against powdery mildew. Like most modern fungicides however, the SDHI (Group 7) such as fluopyram and strobilurin (Group 11) materials such as trifloxystrobin are at high risk for resistance development. Indeed, with powdery mildew resistance to strobilurin fungicides becoming commonplace in many eastern grape growing areas, control of that disease with this product may come primarily or solely from the SDHI chemistry. Thus, it is recommended that use of this product and all other Group 7 and 11 products be limited to a maximum of two applications per season in total. Luna Sensation has a 12-hr REI and a 14-day PHI.

Miravis Prime. Miravis Prime is a combination of a new SDHI fungicide (pydiflumetofen, Group 7) and an

older phenylpyrrole active ingredient (fludioxonil, Group 12), introduced about 25 years ago. In NY and PA trials, Miravis Prime has shown excellent activity against powdery mildew and good to excellent activity against black rot and Botrytis. Miravis Prime is also labeled for control of anthracnose and Phomopsis cane and leaf spot, but there is little local experience with control of these other diseases using this product. A couple of trials we ran last year on Concord grape seemed to indicate that Miravis Prime could provide modest, but significant reductions in shoot and cluster stem infections of Phomopsis. But again, the strengths of this product are in the strong activity against powdery mildew and black rot (primarily from the SDHI component, pydiflumetofen), and the *Botrytis* control from the fludioxonil component (also found in another combination product called Switch). Miravis Prime is said to accumulate in the waxy cuticle and "translocate through the leaves". It has a 12 hr REI and a 14 day PHI. Miravis Prime has been registered for use on grapes in PA, but not in NY, at press time. However, this product has received a "reduced risk" classification and might receive NY registration as early as May 2019!.

Prolivo 300SC. Prolivo contains an active ingredient (pyriofenone) that is in the same FRAC group (U8) as the active ingredient in Vivando (metrafenone). In limited NY trial work on Chardonnay, it provided control of powdery mildew - at the 4 and 5 fl oz label rates - similar to that of Vivando at the 10 fl oz rate. To limit the risk of developing resistance to Prolivo, the label specifies a maximum of three applications per year, and no more than two applications in a row before alternating to a different material. I would recommend that you *always* rotate to another FRAC group after a Prolivo or Vivando application. Prolivo has a 4 hr REI and a 0-day PHI (compare this to the 12 hr REI and 14-day PHI for Vivando).

Rhyme and Topguard EQ. These products were registered in most states in 2016 and in NY in 2017. The active ingredient in Rhyme is flutriafol (a sterol inhibitor, FRAC 3). I have not personally had the opportunity to test these products but thorough testing in New York has shown that Rhyme provides good to excellent control of powdery mildew. Rhyme has tended to work better than the older SIs like Rally (myclobutanil) and tebuconazole, but not as good as difenoconazole (the newer, more potent sterol inhibitor in Revus Top, Inspire Super, Quadris Top, and Aprovia Top). It is available for use in PA and NY (except for Long Island). Rhyme also has been shown to have excellent activity against black rot. Topguard EQ is a combination of flutriafol and azoxystrobin (the strobilurin in Abound). While not available to Erie county PA grape growers (due to azoxystrobin), it is available to New York grape growers (except Long Island). The azoxystrobin adds downy mildew (and Phomopsis?) control to the product, that the flutriafol won't control (except where there is downy mildew resistance to the strobies). For powdery mildew, the azoxystrobin adds a second mode of action against that disease, unless (once again) there is powdery mildew resistance to the strobies in your vineyard. One thing is for sure; Topguard EQ provides two very effective materials for black rot control and should provide excellent control of that disease.

Trionic 4SC. Trionic contains the same active ingredient (and the same amount of that ai) as Viticure and Procure. The active ingredient (triflumizole) is a sterol biosynthesis inhibitor (SI), in the same class (FRAC 3) as tebuconazole and difenoconazole. It is also labeled at the same use rates as Viticure; 4-8 fl oz/A. However, it's important to remember that unlike most other SIs, triflumizole only controls powdery mildew on grapes, not black rot.

On the lighter side, there are some biopesticides about which we have been able to develop a fair amount of information through local field trials at Cornell and Penn State Universities, and can report on here. In my experience, most of the low impact, biopesticides I have tested over the years have been most useful for controlling powdery mildew, a disease caused by a fungus that grows primarily on the surface of the plant and is impacted by a whole host of oils, foliar fertilizers, plant based essential oils and fermentation products, etc. However, I am happy to report here on some materials that have tested quite well for additional diseases like bunch rots and downy mildew. Unfortunately, the one disease that still eludes control by this group of materials is black rot, a disease that has been one of the biggest challenges for organic grape growers in the

east. For most biopesticides and other low impact materials, it's important to remember that they generally work best under relatively low disease pressure, as part of a production system that also relies heavily on good vineyard sanitation and integration of cultural controls. Not all these products are OMRI approved, but all are characterized by low mammalian toxicity. I would also stress that where these products are desired as part of a low impact/conventional 'hybrid' disease management system, they are best utilized outside the critical fruit protection period (beginning of capfall to 3 weeks later for powdery and downy mildew, 5-6 weeks later in the case of black rot), especially in wet seasons and when growing very susceptible (*V. vinifera*) varieties. In other words, where production goals strive to reduce reliance on synthetic pesticides, apply the heavier hitting, conventional materials during bloom and early fruit development, and utilize the biopesticides during early season (lower disease pressure) or late season (after fruit are resistant to most diseases).

Fracture. In NY and PA trials, Fracture provides what I would consider modest control of powdery mildew. However, I think it has more appeal as a material for bunch rot control (Botrytis and sour rot) in wine varieties prone to that disease. For example, in two years of trials at Penn State, it has provided bunch rot control as good as a standard Botrytis fungicide program. Earlier NY trials showed similar results. Fracture has a 4-hr REI and a 1-day PHI, and the residue of its active ingredient is exempt from tolerance by the US-EPA (i. e., it is considered safe enough to humans that there is no limit on the allowable residue level in/on food products)". However, to my knowledge it is not OMRI approved for use in organic production. Fracture is expensive, but may appeal to growers looking to reduce reliance on synthetic fungicides for bunch rot control, especially if used in combination with strict sanitation and cultural controls like leaf removal (more on this later).

LifeGard. LifeGard is an OMRI listed biopesticide approved for use on grapes. It has provided really good results for the control of downy mildew in New York trials. I wish I had more to report on this product from our end at Penn State, but three years of testing along the Erie lakeshore of PA have been relatively unproductive due to very dry conditions and virtually no downy mildew in 2016 and 2017. We did have a *fair* test of this product last year, but with rather disappointing results for downy mildew control. But again, the results from 3 years of New York trials are very encouraging for downy mildew control and testing should continue. One year of New York trials also showed it to be effective against powdery mildew as well. LifeGard works by triggering a plants' natural defense mechanisms against pathogens, so the product should perform best after the vine has been 'primed' by an initial spray a few days before it is challenged with the pathogen. The label states that "initial triggering of plant defense response occurs within minutes of application, but 3-5 days are required to attain maximum level of protection". LifeGard is labeled for use in both PA and NY.

Polyoxin D zinc salt. Polyoxin D zinc salt (PZS) is a relatively new fungicide active ingredient with very low mammalian toxicity that has been classified by the U.S. Environmental Protection Agency (USEPA) as a "biochemical-like" pesticide. It also degrades rapidly in the environment with a soil half-life of 2-3 days. Production of PZS occurs through a fermentation process using the soil bacterium *Streptomyces cacaoi var. asoensis*. The active ingredient inhibits chitin synthase, an enzyme essential for the production of chitin, an important component of fungal cell walls. The product is being sold as Tovano and OSO5%SC and is marketed through Certis USA. Over the past two seasons, our results with OSO on Concord and Chambourcin grapes have shown good to modest efficacy against powdery mildew, but no practical level of activity against black rot. For powdery mildew efficacy on fruit, OSO, at the 13 fl oz rate, was equal to or better than BadgeX2 (fixed copper), and equal to a standard rotational program of Quintec/Vivando/Toledo. As with most of the biopesticide type fungicides, cost per application is generally going to be higher than that of the standard synthetic fungicides.

Regalia. *Some of this information is based on the fact finding of Amara Dunn, Cornell University.* Regalia is labeled for powdery mildew, Botrytis and downy mildew. In PA trials it provided modest control of powdery mildew. NY trials by Wayne Wilcox et al. were more extensive and testing examined activity on all three diseases, where it was only effective against powdery mildew and worked best where disease pressure was

moderate. Regalia works by activating the vine's defenses against pathogens and upon the first seasonal application, requires 48 hours to fully activate those defenses. Subsequent applications only require 3-4 hours for activation. Pay close attention to the manufacturer's instructions for best results; apply with a spreader-sticker, allow 3-4 hours of drying time prior to rain, adjust the pH of the spray mixture between 6 and 8. Regalia has a 4 hr REI and a 0 day PHI. A new formulation (Regalia CG) was registered in NY in Fall 2018 with the same active ingredient, REI and PHI. It lists powdery mildew, Botrytis, downy mildew, ripe rot, and sour rot on the label, but the efficacy of this formulation has not yet been tested in NY or PA.

DISEASES

Rather than repeat what is in the grape guidelines here for the majority of the common grape diseases, I am reporting on our recent work with grapevine leafroll virus and bunch rot.

Grapevine leafroll viruses and leafroll disease. The presence of grapevine leafroll-associated viruses (GLRaVs) in the phloem of grapevines can have serious consequences on yield, vigor, cold hardiness, and most notably fruit/wine quality (Naidu et al. 2014). The main physiological effect of GLRaVs is the impairment of leaf photosynthesis, which occurs as a result of phloem disruption (Almeida et al. 2013). This in turn results in a delay in ripening, often manifested as lower soluble solids content and elevated titratable acidity of the must, particularly in cool climate regions (Almeida et al. 2013).

These viruses are widespread throughout many grape growing regions of the world. In Pennsylvania, we have been investigating the two most economically important and widely distributed GLRaVs, which are GLRaV-1 and 3. After a two-year survey of 63 Pennsylvania wine grape vineyard blocks, about a third of the blocks we have sampled from have vines that test positive for leafroll viruses 1 and/or 3. Initial observations in two Pennsylvania vineyards, where we have taken a closer look at the effects of GLRaVs on *Vitis vinifera* 'Cabernet franc', indicated significant negative effects on fruit soluble solids and titratable acidity at harvest that could translate to reduced wine quality. However, these effects seem to depend on climatic variables which we hope to examine in closer detail next.

Currently, there are several species of GLRaVs reported in cultivated grapevines and there appears to be no plant resistance mechanisms to these viruses; they can infect many cultivated grapevine species and varieties. However, *V. vinifera* is most dramatically affected, with *V. labrusca* and interspecific hybrids of *Vitis* being much less affected or unaffected (Naidu et al. 2014; Bahder et al. 2013). GLRaV-1 and 3 have been spread across long distances (worldwide) through the sale and distribution of infected nursery material. Short distance spread of GLRaV-1 and/or 3 (within the vineyard or between adjacent vineyards) occurs through the movement of phloem feeding insect vectors, specifically mealybugs and scales.

In addition to the negative effects on vigor, yield, and hardiness mentioned above, the more obvious symptoms of the disease on some grape varieties are cupping and loss of chlorophyll in the leaves in late summer and fall, during the ripening period. On red-fruited varieties, like *Vitis vinifera* 'Cabernet Franc', leaves of infected vines can display red coloration of the interveinal tissue, while veins remain green. On white-fruited varieties like Chardonnay, symptoms are less noticeable and leaves tend to look yellowish and cupped. However, the presence of these symptoms does not automatically confirm the presence of GLRaVs, as symptoms associated with nutrient deficiencies, water stress, and crown gall are similar. Confirmation can *only be made in the laboratory* through serological or molecular analysis of phloem tissues in leaf petiole or dormant cane samples of suspect vines. For these reasons, V. vinifera vineyards should be scouted annually and tissue samples from suspect vines can be sent to a laboratory for confirmation.

Infection by GLRaVs is permanent, and management calls for removal or roguing of infected vines and replanting with certified virus-free material. Insecticide applications to control crawler stages of the vectors can

slow the spread of GLRaVs within and between vineyards. In our survey efforts we have seen the full range of incidence of infection in V. vinifera vineyards, from less than 1% to 50% or more. In vineyards with a very low incidence of the virus, the effects of immature fruit from a few vines will be minimal or insignificant to the overall quality of the crop. This is often what we encounter in relatively young vineyards, where little time has elapsed for local spread by vectors. In our experience, the really high incidence is most often encountered in older (20-30 years or more) infected vineyards where the original material may have been less "clean", and more time has allowed for greater local spread by vectors.

As the acreage of *V. vinifera* in the northeast continues to expand and become a larger part of the premium wine industry, our encounters and frustrations with GLRaVs will likely increase. It is therefore essential to create a growing body of information that will help vineyard managers reduce their spread and impact. Below are some references that I drew from for this bit on leafroll viruses and grapevine leafroll disease (GLD). The last reference is available free, online, and is a great review of GLD by some of the leading experts from New York, California, and Washington.

Almeida, R., K.M. Daane, V.A. Bell, G.K. Blaisdell, M.L. Cooper, E. Herrbach, and G. Pietersen. 2013. Ecology and Management of Grapevine Leafroll Disease. Frontiers in Microbiology, Vol 4, Article 94, pages 1-13.

Bahder, B., Alabi, O., Poojari, S., Walsh, D., and Naidu, R. 2013. A Survey for Grapevine Viruses in Washington State 'Concord' (Vitis x labruscana L.) Vineyards. Plant Health Progress, August 5, 2013. American Phytopathological Society (online).

Compendium of Grape Diseases, Disorders, and Pests. 2nd edition, 2015. Editors Wayne F. Wilcox, Walter D. Gubler, and Jerry K. Uyemoto. The American Phytopathological Society. Pp. 118-119.

Naidu RA, Rowhani A, Fuchs M, Golino D, Martelli GP. 2014. Grapevine leafroll: a complex viral disease affecting a high-value fruit crop. Plant Dis. 98: 1172–85. https://www.researchgate.net/publication/270339365_Grapevine_Leafroll_A_Complex_Viral_Disease_Affecting_a_High-Value_Fruit_Crop

A continuation of new developments in Botrytis bunch rot/sour rot control

Last season was a horrendously wet season for many grape growers in the eastern U.S. As a result, many growers have complained that 2018 produced one of their worst crops ever, often due to the development of various late season bunch rots. Late season fruit rots are often a result of a combination of Botrytis (which can be controlled to some extent with fungicides) and non-*Botrytis* microorganisms (that are not as easily, or not at all controlled by fungicides). In my experience, *Botrytis* specific fungicide trials over a number of years have often resulted in mediocre bunch rot control to Vignoles grape, suggesting that consistent improvements to late season fruit rot management *requires* the integration of cultural and other non-chemical methods. One of the most commonly recommended practices for integration into bunch rot management programs is fruit-zone leaf removal, developed over many years, by lots of research, by many people. Simply put, removal of leaves from nodes in the fruit-zone increases sunlight exposure, air circulation, and pesticide penetration to developing fruit, creating a hostile environment for Botrytis and other harvest-rot-inducing microorganisms that otherwise thrive in darkness, still air and high humidity.

The traditional timing for this practice has generally been between fruit set and veraison, with earlier being better than later. More recently, an *early fruit zone leaf removal* (ELR), which involves the removal of leaves just before or at the beginning of bloom, is gaining attention for effects on crop load management, fruit and wine quality, and control of bunch rots. The removal of the most mature, photosynthetically active leaves (those in the fruit zone) before or during bloom, starves the inflorescences for sugars, and reduces the number of flowers that set fruit. Fewer berries per cluster generally results in looser clusters that develop less bunch rot. Taken together, ELR combines the benefits of an improved fruit zone environment with less susceptible clusters

and often greater, more consistent reductions in bunch rot development than what would be achieved with post fruit set leaf removal. This practice can also reduce reliance on Botrytis specific fungicide applications. However, the reduction in berry number per cluster from ELR generally results in lower cluster weights and potentially lower yields. And though this can be managed to some extent, yield reductions may not jive with every grower's business plan.

Manual leaf removal is expensive and time consuming, and timing can be critical, making mechanization of ELR an important next step in the stream of leaf removal research. Over the past four years, we've been experimenting with air pulse leaf removal technology for ELR on two trellis systems (four-arm kniffen and single high wire cordon) for Vignoles grape, and on Pinot gris and Pinot noir trained to vertical shoot position trellis systems. In our experiments, the air pulse system tended to remove about 35-50% of the leaf area which would be achieved by hand removal in the fruit zone, working most efficiently on more upright, two dimensional training systems like the vertical shoot position and four-arm kniffen systems, when compared to more three dimensional training systems like the single, high-wire cordon, no-tie system.

On Vignoles, cluster weight was significantly reduced by mechanical ELR (compared to no leaf removal) on both trellis systems. Bunch rot was also reduced by mechanical ELR compared to no leaf removal, but the reductions were greater and more frequently significant among vines on the four arm kniffen system (significant in 3 of 4 years) compared to the high wire cordon (no tie) system (significant in only 1 of 4 years). With respect to juice composition, mechanical ELR generally resulted in higher brix and lower titratable acidity (TA) when compared to no leaf removal, but again, the differences were more frequently significant among four-arm kniffen trained vines (3 of 4 years for TA), than single high wire cordon trained vines (2 of 4 years for TA).

If you have bunch rot susceptible varieties like Chardonnay, Vignoles, or Pinot gris, and would like to test this practice in your vineyard, I would recommend you test it out on a few vines first and compare the results to the rest of your vineyard (all other things being equal) to see if this is something that will work for you, or not. Also, test it over more than one year; the results may vary somewhat from one variety to the next and from one season to the next. We often find that efforts to reduce bunch rot through treatments that loosen clusters, tend to be more effective in years when natural fruit set is higher rather than lower.

Lastly, some excellent research was conducted by Megan Hall and Wayne Wilcox a few years back that is important news for wine grape growers with sour rot susceptible varieties: please review Wayne's newsletter from June 2017 (Grape Disease Control 2017) regarding the Cornell research on sour rot control. However, I will attempt to summarize it here.
First, by sour rot, we're talking about the rot that smells of vinegar from acetic acid - with or without any observable mold - that attracts fruit flies and repels humans. Because the microorganisms that cause sour rot do not typically have the 'tools' to penetrate the skin of fruit, sour rots are initiated by wounding of the fruit, which can occur through feeding injury by birds or insects, powdery mildew and/or Botrytis infections, cluster compactness, rain cracking, etc. So, injuries enable various bacteria and yeasts to breach the skin and access the flesh of the fruit as a substrate for growth and reproduction. Warm, wet conditions favor these colonization processes and sour rot generally becomes manifest at the time fruit attain soluble solids levels of 15 brix, followed by a precipitation event. The yeast turn the sugar into ethanol and the bacteria turn the ethanol into acetic acid. But, for the last step to take place requires fruit flies.

Bottom line: There is no silver bullet for bunch/sour rot control. But by combining i) leaf removal in the fruit-zone with ii) the use of more upright, two dimensional training systems (like four-arm kniffen or VSP), followed by iii) control of sour rot inducing microorganisms (with sterilants or antimicrobials like Oxidate) and fruit flies (with insecticides) at around 15 brix, growers of susceptible varieties may more consistently improve control of sour/bunch rots, in spite of the weather.

Business Management

Kevin Martin, Penn State University, LERGP, Business Management Educator

USDA AG Census Quantifies Past Challenges: Remaining Growers Positioned for Success

USDA census of Agriculture is complete for 2017. The market has been challenging for nearly the entire census period, from 2012 until 2017. This is the best explanation for changes in acreage in most growing areas in the region. Overall the industry has declined by 3,700 acres, to 31,260. Average vineyard size has increased by 22% and now stands at 55 acres. Volatility in smaller counties like Cattaraugus is likely due to the small sample size. The trends in those areas show a decline in average farm size. On an individual level, this is a reminder that size does not fix everything. Increasing vineyard size requires careful mitigation of production and financial risk. Price challenges magnify the risks associated with debt and weather. USDA compiles the Census of Agriculture through the National Agricultural Statistical Service. Detailed reports and results of the census can be found here: 2017 Census of Agriculture. A 15% decline in NYS acreage highlights the challenges producers are facing. The wine industry in other parts of the state has not provided significant growth and opportunity for value-added and diverse varieties. Slow growth has not adequately limited exposure to commodity like pricing. Acreage has decreased by 6,000 state-wide. The total decline of acreage in Chautauqua, Erie, NY, and Cattaraugus was 5,000 acres.

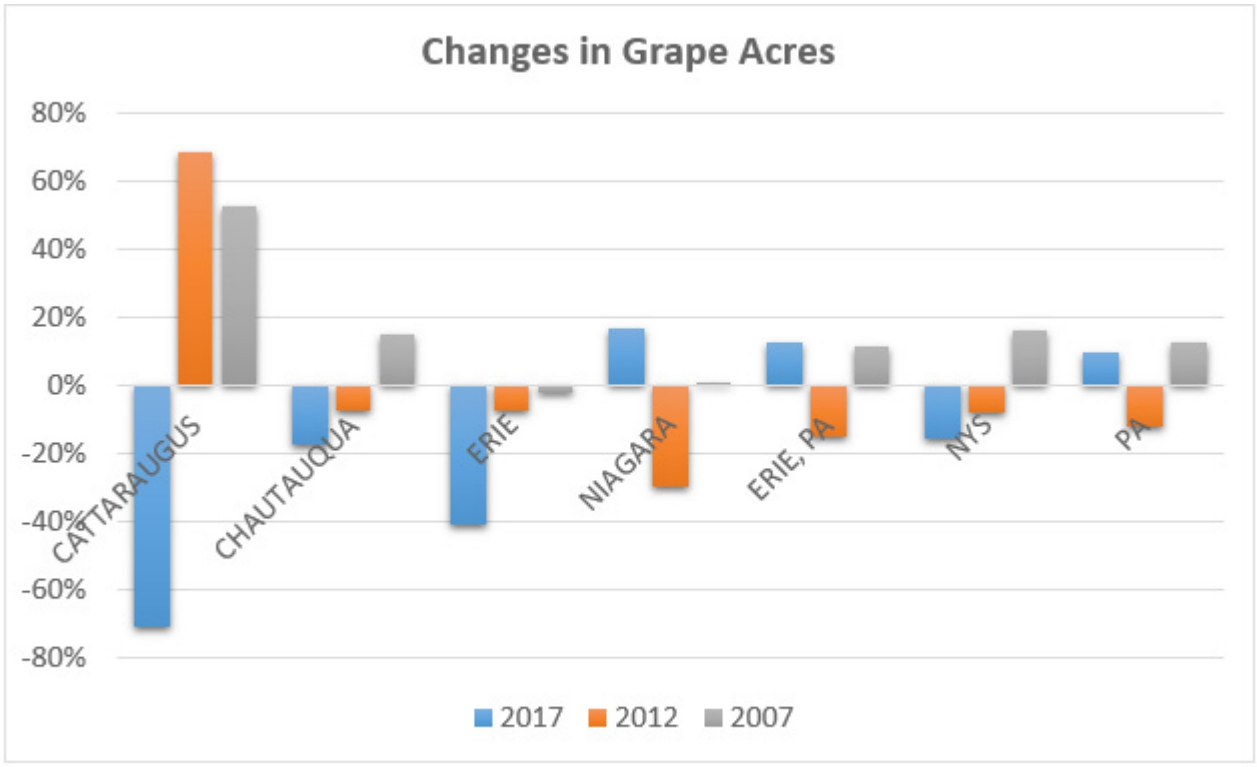


Chart 1: Percentage change in grape acreage from last NASS census.

A small uptick in Niagara County shows the ability of a slowly growing wine industry diversifying away from commodity juice. Acreage remains down from 2002 as there has been constant pressure on outlying areas trying to remain competitive in the Concord market. 2002 also surveyed wine acreage at a temporary peak in Niagara county.

The increase in Erie, County PA acreage is somewhat surprising. While it is basically offset from a 2007 – 2012 decline, it's interesting that acreage could increase by 18% in this last census period. The worst of the market cancellations impacted the cash market for NY based processors but PA was not immune from those market challenges. The Concord market has also dealt with the same low prices as everyone else. These trends have been consistent for decades. During periods of low prices, we continue to see consolidation amongst both farmers and acreage.

This impact on individual farmers has been much more dramatic. There has been a significant decrease in the number of vineyard operations as medium sized farms, in particular, consolidate. 794 vineyard operations in 2012 has decreased to 582 (-36%). While acreage has bounced up and down the number of operators has consistently trended lower since 2002, when there were 960 growers in the region. Vineyard operators have not been able to replicate the consolidation and economies of scale seen in field crops but over the last 20 years they've made some meaningful steps in that direction.

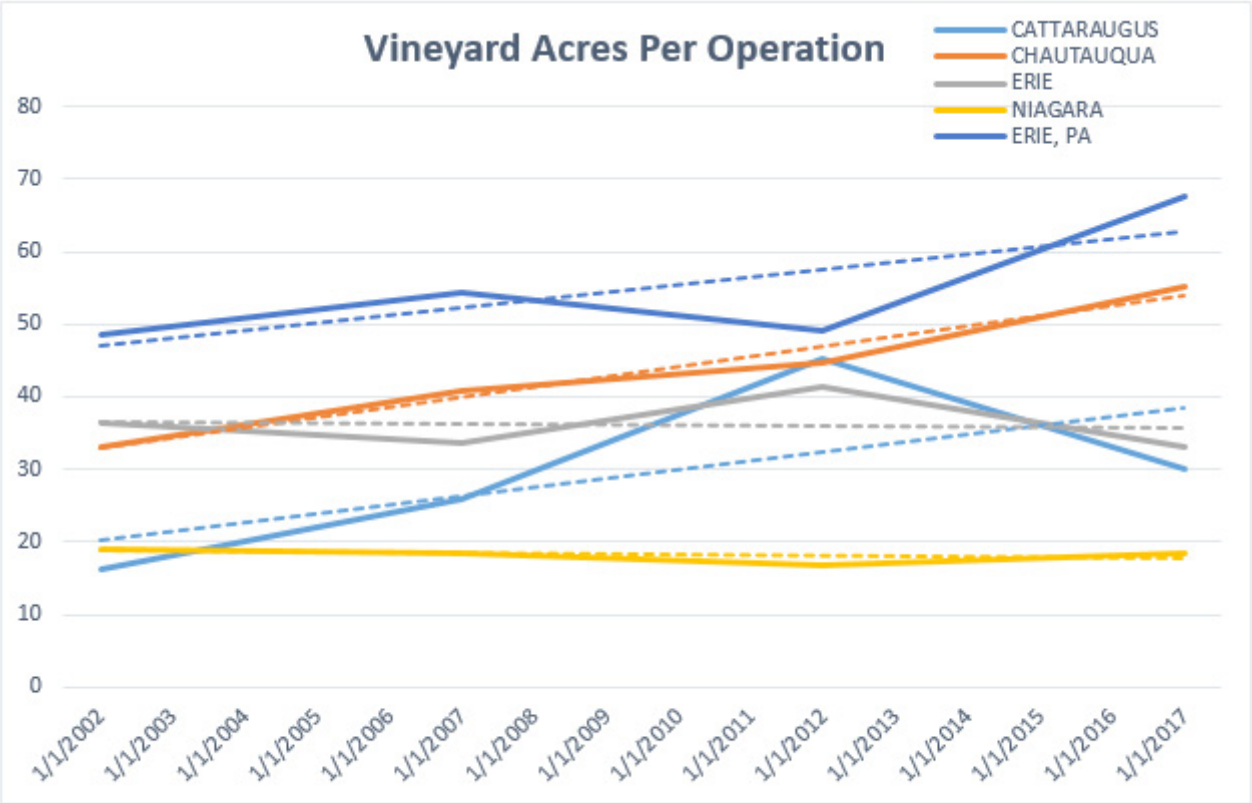


Chart 2: Every area except Niagara shows upward trends in acres per operation.

The economies of scale that remain essential for sustainability start with a concentration of acreage. Our outlying areas are losing their competitive edge as the cost for custom hire increases due to decreasing acreage and operations. The very recent improvement in the Concord market is essential to reversing this trend. If growers have available capital to expand we should be able to see average farm size increase to 70 acres per operation. This would put nearly all full time operators above 100 acres and many above 200 acres. This size operation realizes most of the benefits of size, at least based on the current market, technology and anecdotal evidence.

The reduction of operational size in outlying areas may be of concern. We know that trend toward smaller vineyards in Cattaraugus and Erie, NY are not a result of wineries. With a smaller sample size and financial challenges that frost prone areas create, it is more likely larger vineyards have been struggling to survive or implement generational transfer plans. All growers, particularly in higher risk areas, could benefit through more intensive risk management strategies. Growers should plan carefully before expanding operations to avoid cash

flow problems. Assumptions about yield and revenue can be derailed when a frost or price issues interrupt cash flow. We do not have very many risk management tools to avoid outright market cancellation. The impact of cancellations was devastating. If the census data is reflecting cancellations, there were not enough management tools to prevent financial hardship for those growers.

The possibility of market reversal is more than hope. One factor is a significant national decline in Concord acreage. Bearing acreage in Michigan has fallen by 12% by 2017. National Grape further reduced acreage in 2017 and 2018. Non-bearing acreage has leveled off as the number of operations continues to grow. Usually this indicates growth in the wine sector that masks commodity grape declines. While we continue to hear reports of Concord declines in Washington State, the grape market has grown rapidly. Their industry is a reminder of the possibility that diversification into wine can offer. This level of growth requires the marketability of premium wines grown at relatively high yields in quantities efficient enough to distribute internationally. While I'm not about to jump in that risk pool Washington State is a case study of being open to a changing market. With a wine market of this strength, commodity grape efficiency can increase. If a market does evolve, a grower does not want to be left behind.

The best short term strategy for most growers is to use available resources to first improve acreage efficiency. There are many opportunities to improve vine productivity, particularly for growers that have taken over nearly abandoned vineyards. Investments in soil health, pesticide programs, trellis maintenance, and drainage will increase ROI as prices rise. Increasing acreage is a secondary beneficial strategy that would put some growers in a good position to capitalize on a strengthening Concord market. This investment is not without risk. Mitigating that risk requires good site selection, available cash and crop insurance. A grower should have access to cash, also known as liquidity, of about $1,500 - $2,000 per grape acre when expanding. Anything less than $1,200 per acre presents serious risk of cash flow challenges that will reduce operational efficiency and possibly yield.

The most immediate need for high yields this time of year is an adjustment in disease management. A robust management program that increases scouting protocols and decreases thresholds for reaction. Many vineyards reported unexpected disease pressure last year. The best early reaction is an ounce of prevention to ensure maximum yields and quality this year. The next 75 days are the critical period prevention of major diseases. A grower could spend $70 per acre on materials and hope for good weather. Or a grower could spend $90 - $100 and likely have good to excellent control, regardless of weather.

A grape grower once said, "If I did everything LERGP told me to do, I'd be broke in a week." He wasn't wrong. We are full of innovative strategies for improving disease control, pest control and soil health. When you add them all up, the cost can exceed gross revenue. Profitability through investment in production practices is not a shotgun. It is a focused approach on the limiting factors in your blocks or sub-blocks.

IPM

Tim Weigle, NYSIPM, Cornell University, LERGP Team Leader

NEWA – A Tool for Lake Erie Grape Growers Economic and Environmental Sustainability

As we enter the 2019 growing season growers in the Lake Erie region have the ability to access weather and pest model information from a total of 26 sites involved with the Lake Erie Mesonet of stations reporting to the Network for Environment and Weather Applications http://newa.cornell.edu. This significant growth came about through the incorporation of three more stations added to the six Rainwise stations erected in 2018 in Hanover, East Fredonia, Forestville, Brocton, Ripley Escarpment and Ripley Stateline and the two NY Mesonet stations in Fredonia and Burt. The three latest Rainwise stations are installed in Erie county Pennsylvania in the vicinity of North East (State Line), North East (Side Hill) and Harborcreek (Escarpment).

For precise locations of any of the stations please visit the homepage of the station on the NEWA website. The station page is easily found by accessing Station Pages using the drop down menu in the blue bar on the home page. Choose the state you are interested in from the drop down menu and you will be provided a list of all the stations currently in that state. Or, if you know where the station is located, you can use the map on the home page. Hovering your mouse over one of the blue and green dots will provide you with the name of the station. Once you have found the station you want, a single click of the mouse will take you to the home page.

A quick glance at the station page will give you information on;

- The last time information from the station was downloaded
- What station sensors are available
- The location of the station (latitude, longitude and elevation)
- The pest forecasts available for grapes (see Andy Muza's article for those you should be concerned about) and a number of other crops.

You can use the station page to access **daily summaries** for the following weather parameters;
Average air temperature, maximum air temperature, minimum air temperature (in degrees Fahrenheit), total precipitation in inches, leaf wetness in hours, relative humidity in hours, average wind speed in mph, and solar radiation in langleys.

Hourly information can be found on these weather parameters;
Air temperature(degrees Fahrenheit), precipitation in inches, leaf wetness in inches, relative humidty in percent, wind speed in mph, wind direction in degrees, solar radiation in langleys, dewpoint in degrees fahrenheit.

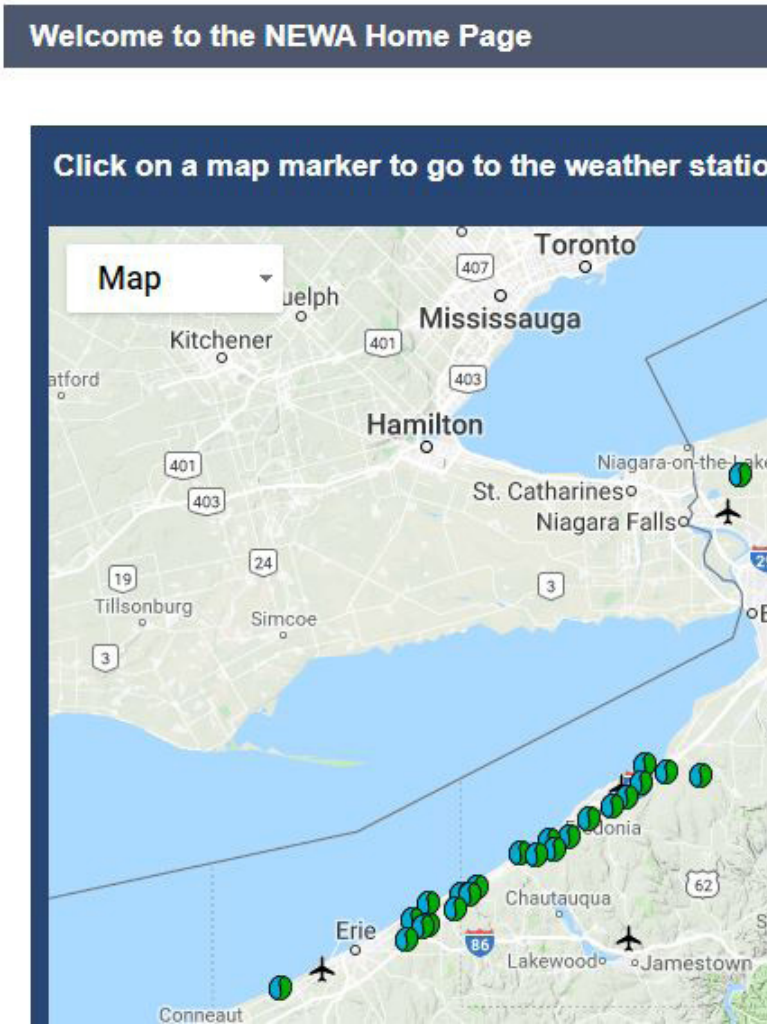
Keep NEWA in mind as we move closer to bud break and things like spring frosts and Phomopsis start entering into the thought process. Not only will NEWA tell you what happened, but the forecasts on NEWA will also help you plan the need, and timing of your next spray with pest forecasts stretching out up to 5 days in the future. NEWA also provides the ability to go back and view both weather and pest model information by date. There is also the opportunity to view the infection periods and leaf wetness periods that have occurred since the start of the growing season providing the information that you need to decide whether or not a spray interval

should be shortened. The Lake Erie Mesonet system of NEWA is supported by the Lake Erie Regional Grape Research and Extension Program, Inc., NYS Wine & Grape Foundation and the NYS IPM Program.

If you don't want to check the NEWA website each day you can have the weather and pest information delivered to your email inbox by signing up for eNEWA. What is eNEWA you ask? eNEWA is a daily reminder of the current weather and grape disease and insect model information found on NEWA (Network for Environment and Weather Applications) http://newa.cornell.edu. This daily email contains current weather and grape pest model information from a station, or stations, near you. The email will contain; 1) high, low and average temperature, rainfall, wind speed and relative humidity 2) the 5-day forecast for these weather parameters, 3) GDD totals (Base 50F), 4) 5-day GDD (Base 50F) forecast and 5) model results for powdery mildew, black rot, Phomopsis and grape berry moth.

eNEWA is a great way to get an idea of pest potentials for your vineyard operation without having to click around the NEWA website every day. eNEWA is not meant to be a replacement for the website, rather it is a quick and easy way to determine if a visit to the website is warranted. For example, if one of the pest models is reporting the potential for an infection event, you can visit the NEWA website to provide information specific to your site. This will increase the accuracy of the output of the disease and grape berry moth models. You will also need to access the NEWA website to use the DMCast model for downy mildew as user input is required.

We worked with Dan Olmstead, NEWA Coordinator, to streamline the sign up process for eNEWA in 2019. By visiting Your NEWA Blog you will have the ability to choose from any station that is currently part of the NEWA network in New York and Pennsylvania. You can choose to receive information from one to five station locations and have the information delivered up to three times per day. Please keep in mind that you will receive a separate email (approximately 3 pages in length) for each station you choose. Once during the growing season and again after harvest, you will be asked to complete a short survey to assist us in improving the eNEWA for grapes email system. If you would like to be a part of this project visit Your NEWA Blog. eNEWA alerts should start shortly after the growing season begins.



Viticulture

Jennifer Russo, Viticulture Extension Specialist, LERGP

Let's Talk About Soil

Without it our industry, nor us, would not exist. When we look at our vineyards, we can visibly see how the vines are doing; are they healthy? Visual inspections of the foliage and vine vigor can provide clues as to whether vines are suffering nutrient stress, but it is really difficult to see through the dirt to assess root or soil health.

To look deeper into soil, we must first understand what it is. Soil is a construct of three main components:

1. Weathered rock which contributes minerals.
2. Organic matter, which is the remains of anything that was once living and is now decaying contributing its nutrients to the soil (fertility, the darker the soil, the greater the concentration of organic matter).
3. Living organisms, like decomposers that eat the decaying matter and release the nutrients back into the soil.

Depending on what type of rock was weathered, how long the weathering has occurred, the local climate, ecosystem and land use all determine what type of soil is present. Our Lake Erie Regional Grape American Viticulture Appellation (AVA), was created by the glacial forces, which not only brought particles of rock that it picked up as it bulldozed its way across our landscape depositing along its route, but it gorged out the geology as it advanced and retreated creating our Great Lakes and great soils. The soils are layers or mixtures of clays, carbonates, silts, sands, gravels, and boulders, and historical lake levels have deposited nutrients over time creating the fertile agricultural soils that we grow in today.

Just for fun, try picking up a handful of a sandy soil. You will notice that it feels 'gritty', because it is made up of large mineral particles. A handful of clay soil feels sticky to touch when wet because it has finer particles which can hold more water. Silty soils are made up of a combination of sandy and clay ones and have a smooth feel to them. Our soils run the gamut, but most are loamy, meaning it contains relatively equal amounts of silt, sand and clay.

The demand for higher yield has increased over the years, which in turn increased the vine's demand for nutrients in the form of fertilizers. Grapevines are perennial crops in which an important relationship is built up with the soil to establish a nutrient balance. However, pest and disease pressures calling for spray programs that, over time, degrade the living biology necessary in our soils and the soils become off-balance. In a natural ecosystem, such as a forest, nutrients are recycled through the decomposition of dead and decaying living species. In commercial agricultural systems, nutrients are lost when fruit is harvested as well as through leaching and runoff. Overuse tends to degrade our soil health, this is why we have nutrient management strategies for our vineyards to rebuild our soils and keep our vines productive and profitable.

Grapevines need nitrogen to grow. Organic matter, which is dead or decaying material, is the main source of this nitrogen, however, it is not in a form which the vine can take up and use. Bacteria found in soils convert organic nitrogen to inorganic forms that the plant can use.

Organisms in the soil

The biological component of the soil is populated by a variety of living creatures, ranging from tiny microbes such as bacteria and fungi, to smaller insects like centipedes and other animals such as worms, and larger animals that, in turn, eat them. All of these organisms are part of what we call The Nitrogen Cycle. At any given time, there can be over 4 billion micro-organisms in a single teaspoon of soil! These organisms play a very important role in our soil health with many different jobs. Certain microbes break down the tough organic matter such as lignin,

or chemicals such like pesticides, while others breakdown rock minerals and release nutrients for the grapevines.

In order for nitrogen to be used by different living organisms, it must change into different states. There is nitrogen gas in air, nitrates, nitrites, and ammonium. Plants normally use nitrogen in only the ammonium and nitrate forms. Nitrite is actually toxic to plants. Bacteria are responsible for making these state changes and much of the decomposition of organic material in soils. Nitrogen Fixation is the first step in the process of making nitrogen usable by plants. Some bacteria can turn, or "fix", nitrogen gas from air into ammonia, and then the fixed nitrogen is made available to plants when nitrogen-fixing bacteria die and release it into the soil or from the symbiotic relationship of some nitrogen-fixing bacteria have with roots. Other bacteria perform nitrification, which is the process that converts ammonia to nitrite and then other bacteria convert nitrite to nitrate in the nitrogen cycle. The next part of The Nitrogen Cycle is denitrification, the process that converts the nitrate to nitrogen gas, returning it to the atmosphere and completing the cycle. There is also ammonification**,** when an organism excretes waste or dies it releases the nitrogen in its tissues in the form of organic nitrogen into the soil for grapevines to use. Nitrogen is essential for many biological processes. In plants, much of the nitrogen is used in chlorophyll, which provides the energy necessary for photosynthesis, the process that turns carbon dioxide and water into carbohydrates to sustain plant growth and oxygen.

Earthworms are another vital species, because they provide so many benefits for healthy soils. They help restore soil nutrients as they decompose decaying material and improve soil structure by generating tons of casts (worm poop) per acre, which are full of microbes to facilitate more nutrient cycling in the soil. Earthworms move through the soil creating space that allows for increased infiltration, improves water-holding capacity, provide channels for root growth, and pull surface residue into their burrows incorporating biomass and nutrients deeper in the soil profile.

Maintaining Healthy Soils

Grape growers understand the importance of a healthy soil and the role it plays in producing abundant harvests. In order to be sustainable in our industry, we must take soil health very seriously. Agricultural strides in soil health have been gaining since the 1980-90's when no-till and conservation tillage management practices began where viable. Some growers have incorporated floor management strategies, like cover crops, mulching, and haying middle rows, which leaves biomass on the soil. Leaving the decaying plant biomass for the microbes and invertebrates to incorporate necessary nutrients and water to build into the soils has increased productivity and decreased soil erosion according to the USDA.

Cover crops is another nutrient and water management practice that many our growers have implemented to some extent. This practice also contributes to climate resilient solutions of variable nutrient/water management strategies during drought and water removal when conditions are wet need to be developed and implemented. Floor management practices using cover crops will aid in pest/weed management, water retention/removal, arrest soil/nutrient erosion, improve compaction, filtration, ground stabilization, and add nutrients when they decay. Many different combinations of cover crop mixes can provide benefits for farmers depending on what your end goal is.

Modern agriculture and innovative growers have developed and implemented tools that support sustainable farming, increase efficiencies and profitability. We have many programs here at Lake Erie Regional Grape Program to aid in your decision making and management practices.

We have the New York Guide to Sustainable Viticulture Practiced Grower Self-Assessment Workbook developed by Cornell University Cooperative Extension and endorsed by the Agricultural Environmental Management Program of the New York State Soil & Water Conservation Committee and New York State Department of Agriculture & Markets available for our growers. This workbook addresses soil, nutrition, vineyard, irrigation, weed, pest, and pesticide managements, as well as, an education and action plan component.

Just as you would never medicate your children without knowing whether or not they actually have an infection, you need to be able to diagnose nutrient deficiencies in your vineyards. How to do it? Soil and petiole testing can provide a clear picture of what is going on in your vineyard. The soil tests will determine what nutrients are available to be taken up by the vines' roots, and the petiole tests will show whether or not the roots are actually absorbing those nutrients. Once you have the soil tests, you have one side of the story, and petiole tests will give you the other side of the vine nutrient story. A basic soil test is adequate, but if the vines are still puny, something else might be at work. This is where a petiole test comes in handy. We offer a 2019 Soil and Petiole Testing Service for our growers on a per sample cost basis. Cost for soil tests can be as low as $15 and $28 for soil samples. We send your samples out to Dairy One for analysis and then our team provides soil health and nutrient recommendations based on the results. We are not partial on where you have your soil and petioles tested, just make sure that you get a complete analysis and have our LERGP Extension Team review your results.

Loaner Sensor Program

For the 2019 growing season, we also encourage you to take advantage of our Free Loaner Sensor Programs for our members. The loaner sensor program is an outreach program designed to introduce interested growers to the technology developed by the Efficient Vineyard researchers. It involves a technician from the Lake Erie Regional Grape Program coming out to the farm to install or attach scanners and computers to existing equipment. The subsequent data collection is then completed during normal activity such as pesticide spraying. Once the data is collected it can be sent back to researchers to generate a prescription map.

DualEM Service

The DualEM soil sensor requires a technician to operate so if you would like to have a soil scan done of your vineyard, please contact the Portland, NY Cornell Extension office and make an appointment.

Cover Crop Seeder

We also offer our Tye Seeder Loaner Program where you can sign-out our Tye seeder to aid in your cover crop seeding; please contact Cornell Lake Erie Research and Extension Laboratory to make an appointment.

There is a wealth of knowledge and resources available to you on our website, www.lergp.com, including a Nitrogen Requirements & Costs Worksheet for Concord Vineyards, and more information located at our www.efficientvineyard.com website. Please feel free to call or visit our team for more information and guidance.

Grape Grower - WPS/PPE TRAINING COURSE EVENT

Cornell Cooperative Extension Chautauqua County's Lake Erie Regional Grape Program is pleased to announce the National Grape Cooperative Association and The Lake Erie Regional Grape Program are collaborating to bring NYS Department of Conservation approved course instructor, Michael Nierenberg, to present WPS/PPE TRAINING COURSE to the Lake Erie Region. The course event will be held at the Cornell Lake Erie Research and Extension Laboratory located at 6592 West Main Road, Portland, NY 14769, on April 30,2019 from 3:00-5:00 PM and the New York Department of Conservation has awarded 2 pesticide credits for completion of the course.

Our intentions are to keep our grape growers, pesticide applicators, handlers and workers compliant and up to date with the required WPS/PPE standards. Agricultural Worker Protection Standard (WPS) is aimed at reducing the risk of pesticide poisoning and injury among agricultural workers and pesticide handlers. Per the Environmental Protection Agency, the WPS requires owners and employers on agricultural establishments and commercial pesticide handling establishments to protect employees on farms, forests, nurseries, and greenhouses from occupational exposure to agricultural pesticides. The WPS protections cover two types of employees:

- Pesticide handlers: those who mix, load, or apply agricultural pesticides; clean or repair pesticide application equipment; or assist with the application of pesticides.
- Agricultural workers: those who perform tasks related to growing and harvesting plants on farms.

This program will address respirator requirements, including medical evaluations, fit testing and record keeping for the same. Safety training for Handlers and Workers will also be addressed, plus Decontamination provisions and more. The DEC instructor will also cover the AEZ = Application Exclusion Zone, which prevents pesticide applicators from applying pesticides if someone is within the AEZ boundaries. Being out of compliance is serious and violations could be costly, therefore it's best to be in compliance. This training course review will direct pesticide applicators and handlers in the right direction to Worker Protection Standards and Personal Protection Equipment usage. Pesticides are valuable tools in the production of agricultural commodities. However, improperly used, pesticides can injure health, property and the environment. This information is for individuals and businesses involved in selling, using or storing pesticides for agricultural use in New York State; the event is open to the public and we encourage all Growers and their Employees to attend. The New York State Department of Conservation will award 2 pesticide credits to licensed individuals after completion of this course.

PA Update

Andy Muza, LERGP Extension Educator, Penn State University

Two Potential Disease Problems in the 2019 Season

As we approach the start of the 2019 growing season, a heads up about 2 potential disease problems - **Phomopsis** and **Black Rot**.

Phomopsis

Spores of the Phomopsis fungus are produced in fruiting structures called pycnidia which develop in diseased woody tissue in the trellis. In the spring, spores will ooze from pycnidia during wet weather and are then rain splashed onto green tissue. Frequent and extended periods of rainy weather during the early season provide ideal conditions for infections to occur. Vines are susceptible to these infections as soon as buds break in the spring and green tissue is exposed. The majority of spores are released from bud break through bloom.

Figure 1. Phomopsis lesions on Concord shoot, leaf petioles and rachises. Photo - Andy Muza, Penn State

Infected shoots develop black lesions which are usually located on the first few basal internodes (Figure 1). These lesions can elongate and split resulting in a blackened, scabby appearance. Numerous lesions on internodes can weaken shoot tissue leading to breakage. In addition, pedicel (berry stem) infections can result in fruit infections later in the season when berries ripen. Crop loss can occur if rachis lesions girdle cluster stems or pedicel infections cause shelling of berries.

In 2017, during the first week of May when shoots were between 1 – 3 inches, extended wetting periods occurred which resulted in extensive shoot lesions occurring throughout the region. A similar situation occurred in 2018 during early shoot growth. At least 47 hours of wetness occurred starting at budbreak with infection events for Phomopsis spanning May 11th to May 15th. However, in 2018, the incidence and severity of shoot lesions were less than expected considering both: wetting periods just after budbreak, and the level of inoculum from the 2017 season.

But, as a result of numerous shoot infections over the last two seasons, there will be plenty of Phomopsis inoculum at the start of the 2019 season. An important cultural practice to reduce inoculum levels is to remove as much dead and diseased wood, as practical, during pruning.

The Phomopsis model in NEWA advises that an "early spray at around 3 inch shoot growth, when clusters first become visible, is most important for controlling rachis infections, shoot infections that serve as future sources of inoculum, and infections that move from berry stems into the fruit. A minimal spray program should include at least one application during this period to protect against infection events, especially in blocks with a history of Phomopsis." However, be prepared to apply a broad-spectrum protectant fungicide application (e.g., mancozeb, captan, ziram) as early as 1 inch shoot growth if an extended period of wet weather is predicted during this stage. Fungicide protection against Phomopsis infections on rachises, pedicels and berries is important until berries have reached about pea size.

Black Rot

The fungus that causes black rot overwinters in: 1) mummified berries in the trellis or on the ground; and 2) cane lesions. Rainfall in the spring initiates the release of spores from mummies and cane lesions. Black rot infections can occur at various temperatures depending on the number of hours that leaves remain wet after a rainfall (see: 2019 New York and Pennsylvania Pest Management Guidelines for Grapes, Table 3.1.2, page 16). During the 2016 and 2017 seasons only a minimal amount of black rot leaf lesions and berry infections were found in vineyard blocks in the Lake Erie Region. In 2018 the black rot picture changed. During May 2018, Grape Infection Events Logs in NEWA, indicated that rainfall events after budbreak resulted in a number of black rot infection periods across the belt. In fact, I began finding leaf lesions in Concord vineyards on May 31st. Grape Infection Events Logs also showed that rainfall events from June 10 – 27th resulted in 5 - 6 black rot infection periods during the most susceptible period for berry infection. By July 12th, at least some berry infections were not hard to find in border areas near wood lines. Overall, in 2018, black rot was found in at least small amounts in many vineyards (i.e., both leaf lesions and infected berries) but pockets of medium to high levels were evident in certain blocks. Throughout the season I also received various reports from growers concerning black rot infections in their vineyards.

Although I consider black rot inoculum levels to be low in most vineyards across our region this disease still poses a potential threat particularly: in areas near wood lines, blocks that have a history of black rot problems, and blocks that don't receive adequate fungicide protection. A critical cultural practice for black rot management is to remove mummies from the canopy (Figure 2).

I encourage growers to make full use of the NEWA sites (Network for Environment and Weather Applications, (NEWA) available throughout the region (see Tim Weigle's article about NEWA). NEWA stations contain both black rot and Phomopsis models that determine when infection periods occur for these diseases. We now have a total of 26 sites throughout the region (7 in PA and 19 in NY) so there is a station nearby that growers can check to monitor infection periods. A broad-spectrum protectant fungicide application (e.g., mancozeb, ziram) should be applied before an infection period occurs. (**Note**: Captan is not as effective as either mancozeb or ziram for black rot management). If a protectant spray is not applied before an infection period occurs then effective post-infection fungicide options include: tebuconazole products; Rally (myclobutanil); Mettle (tetraconazole); or Rhyme (flutriafol). Research indicates that these fungicides have significant **post-infection** activity (at least 3 days and potentially longer).

Figure 2. Black rot mummies. Photo - Andy Muza, Penn State

Shoot Thinning in Scheid Vineyards

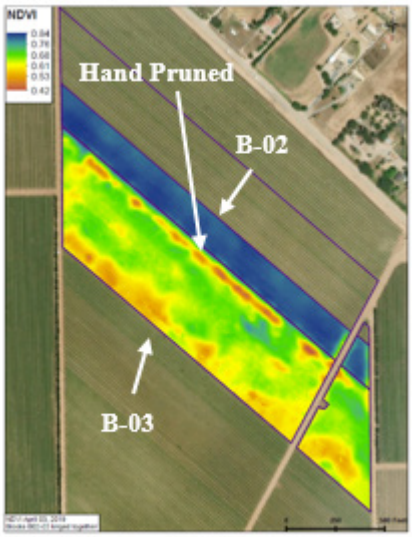
By Heather Barrett

The Efficient Vineyard project is funded through the USDA and NIFA. Its overarching theme of mechanizing vineyard operations aims at reducing variability within a vineyard which would hopefully lead to an increase in vine health and balance. Variability is a common characteristic of vineyards regardless of location, climate or soil type and therefore could be approached across the board using variable rate technology. On this trip we were able to show how such technology can be implemented even in vineyards with limited variation.

The main goal of flying out to California was to demonstrate a shoot thinner that automatically adjusts for variability in the vineyard. As we pulled into the vineyards I became confused as to where, in the row upon row of identical vines, were we going to find enough variation to justify variable rate management. Of course, what the human eye can detect is very different from what infra-red sensors could detect. The Efficient Vineyard project uses infra-red sensors to detect changes in shoot health or vigor based on the light they reflect. These are more sensitive than the human eye and can pick up underlying differences that would otherwise go unnoticed.

The VMech-2220 is a two row tool carrier that requires three operators: two on the trailer to control the arms and one to drive the tractor. Scheid Vineyards had already been using this rig for set rate shoot thinning. VMech has made and sold these trailers for some time now without the variable rate option. To adapt to variable rate, the machine has to be altered so that a field computer can control the flow of hydraulic fluid to the drive motors (which control the paddles), creating the necessary speed control. That speed is determined through calibrating the machine by testing speeds and calculating shoot removal percentage for each vineyard. Other adjustments include a monitor for uploading and viewing prescription maps, GPS and wiring so that the grower or vineyard manager can create a connection between the field computer with the prescription maps and the trailer. All of the data points used to build a prescription map are embedded with a location. By attaching a GPS to the shoot thinner, the paddles change their speed to correlate with the information associated with that part of the vineyard.

Scheid Family Wines owns and operates around 4,000 acres of grape vineyards in the central valley of California. From that, two blocks of Pinot Noir growing two different clones were selected for Efficient Vineyard research trials, B-02 and B-03. B-02 reflected the uniform growth that I expected, B-03 showed why we use sensors. In B-02, most of the shoots were between six and eight inches long while B-03 had ariable growth with some areas only grown out by one to two inches and some parts as long as four inches. Both however had roughly the same average number of shoots. Our research plot surrounded ten rows in the middle



where Scheid crews had hand pruned back 5 to 10 rows at the beginning of B-03 with a lower shoot density than the rest of the vineyard. These rows can be seen as a red stretch near the border of B-02 and B-03.

On the third day of our trip, the demo was scheduled for 1 PM at which point the skies promptly opened up and rained on us for about an hour. This however, did not dampen the excitement of the viewers who came out with rain jackets and umbrellas to watch as the shoot thinner switched from a gentler shoot thinning speed to rapidly removing half of the shoots. Like the Concord vineyards along Lake Erie, there is a sweet spot where the vine ripens fruit in a timely manner and meets quality standards without being overtaxed or undertaxed (vine balance). The counts we were collecting suggested that the shoot thinner needed to bring the number down four to nine shoots/foot of row depending on the zone. That would create the desired shoot density between our averages (24 to 27 shoots/foot of row) and the hand pruned vines (10 shoots/foot of row). After we knew how many of the shoots needed to be removed we were able to calibrate the machine so that the shoot thinner knew what speed to move the paddles based on what zone it was in.

Scheid vineyards was the perfect vineyard to display not only the potential of variable rate shoot thinning, but also that it may take sensors to detect variations within a vineyard. The Efficient Vineyard researchers will be back out to California by the time you are reading this, hopefully to meet with the same success that this excursion produced!

Registration Form

44th Annual

American Society for Enology and Viticulture-
Eastern Section Conference with Nelson J. Shaulis Symposium

"Digital Viticulture: New Tools for Precision Management of Vineyards"

July 16-18, 2019, Geneva, New York

PLEASE PRINT:

Name (as desired on name badge)_____

Name of Spouse (if attending functions)_____

Company/Affiliation: _____

Address: _____

City_____ State/Province_____ Zip/Postal Code_____

Phone _____ Email _____

Events	Number Attending	Rate	Total
Tuesday, July 16: Conference Registration *(includes Business Lunch/Awards and Oenolympics with Wines of the East Reception)*			
Eastern Section Member/ New York Vineyard or Winery Owners		**$150**	
Non-Member		**$275**	
Student Member/Spouse of Full Registrant		**$100**	
Tuesday, July 16: Extra Ticket Oenolympics Reception		**$45**	
Wednesday, July 17: New York Digital Viticulture Tour & Demonstrations *(includes Lunch and Reception, maximum capacity 100 people)*		**$100**	
Thursday, July 18: Nelson J. Shaulis Symposium Registration *(includes Lunch and Reception)*		**$150**	
LATE FEE: ***(after July 2)***		**$100**	
TOTAL AMOUNT ENCLOSED			
___ *I request a v*egetarian/vegan entrée for meals. Please contact ASEV-ES with other diet restrictions. ___ I would like to participate in the Oenolympics. Students and nonstudents can participate.			

PAYMENT BY CREDIT CARD, CHECK OR MONEY ORDER; US OR CANADIAN CURRENCY
PAYABLE TO: ***ASEV-Eastern Section, Inc.***

Pay for ASEV-ES conference activities with credit cards or PayPal
on our website at http://www.asev-es.org/ or Click here to pay.

CREDIT CARD INFORMATION: MasterCard ____ Visa _____ *(AmEx not accepted)*

Card Number: _____ Expiration Date: _____ CSC (security code): _____

Card Holder Name: _____Total Amount: _____

Signature: _____ Zip Code (*associated with credit card*): _____

Email, Mail or FAX completed registration form to:

Nancy Long, ASEV-ES Registration, Cornell University Jordan Hall, 630 W. North St., Geneva, NY 14456
Questions?? Phone: (315)787-2288 FAX: (315)787-2488 Email: NPL1@cornell.edu

Registration and Cancellation Policy: Registration is required for all events. Registration can be cancelled by written request to ASEV-ES. No refunds after July 1. Substitutions are allowed. "No shows" will not receive a refund.

CONFERENCE OVERVIEW

44th Annual American Society for Enology and Viticulture-Eastern Section Conference with

Nelson J. Shaulis Symposium

"Digital Viticulture: New Tools for Precision Management of Vineyards"

July 16-18, 2019

Hobart and William Smith Colleges

Scandling Campus Center, 300 Pulteney, Geneva, NY 14456

Monday, July 15, 2019

6:00 - 9:00 pm: ASEV-ES Board of Directors Meeting (location to be decided)

Tuesday, July 16, 2019 **ASEV-ES Conference**

8:00 am- 12:00 pm: ASEV-ES Technical Sessions, Student Competitions and Poster Flash Talks
12:00 - 1:30 pm: Lunch and ASEV-ES Business Meeting and Awards
1:30 - 5:30 pm: ASEV-ES Technical Sessions and Poster Flash Talks
5:30 - 7:30 pm: Oenolympics with Wines of the East Reception

Wednesday, July 17, 2019 **New York Digital Viticulture Tour**

7:30 am - 6:00 pm: New York Digital Viticulture Tour and Equipment Demonstrations in vineyards on Keuka and Seneca Lakes (lunch and reception included)

Thursday, July 18, 2019 **Nelson J. Shaulis Symposium**

8:00 am - 12:00 pm: Shaulis Symposium Sessions
12:00 - 1:30 pm: Lunch
1:30 - 5:30 pm: Shaulis Symposium Sessions
5:30 - 7:00 pm: Shaulis Symposium Reception

This schedule is subject to change. Updated conference information will be available at our website (www.asev-es.org).

ASEV-ES Conference Information

Conference

The 44th Annual ASEV-ES Conference with Nelson J. Shaulis Symposium will be July 16-18, 2019 in Geneva, NY at Hobart and William Smith Colleges. The **ASEV-ES conference** will begin with technical/research presentations on Tuesday, July 16 and include the awards/lunch and Oenolympics with Wines of the East Reception. On Wednesday, July 17 there will be a **New York Digital Viticulture Tour and Equipment Demonstrations** in vineyards on Keuka and Seneca Lakes. The **Nelson J. Shaulis Symposium** on Thursday, July 18 will feature invited speakers to discuss "Digital Viticulture: New Tools for Precision Management of Vineyards".

For more information on the schedule contact **Dr. Paul Read,** Professor, University of Nebraska (402-472-5136, pread@unl.edu).

Oenolympics Reception, Tuesday, July 16, 2019

Conference attendees to the Reception are invited to cheer your favorite team at the Eighth Annual Oenolympics, a student competition designed to promote fun, fellowship, and creative thinking with enology and viticulture-themed games. The Oenolympics, comprised of student teams, is a true spectator's event, not to be missed! All ASEV-ES students registered for the conference are invited to compete in the Oenolympics. **Back again this year!** A faculty/industry team will participate in the event, challenging the students!

For more information on the Oenolympics contact **Dr. Anna Katharine Mansfield**, Associate Professor of Enology, NYSAES, Cornell University (315-787-2268, akm87@cornell.edu).

New York Digital Viticulture Tour and Demonstrations, Wednesday, July 17, 2019

The New York Digital Viticulture Tour and Demonstrations will include visits to two sites on Keuka and Seneca Lake for extensive demonstrations of equipment and tools for precision vineyard management. The morning will focus on currently available technology in hybrid and Concord vineyards on Keuka Lake, and the afternoon will focus on emerging technologies in a *Vinifera* block on West Seneca Lake. Lunch and a wine tasting by the Keuka Wine Trail will be served, and the day will close with a reception and Seneca Lake wine tasting at Anthony Road Vineyards. Technology demonstrated will include:

- Tractor-mounted and drone sensors for measuring canopy fill and vine size
- Variable-rate equipment for shoot thinning and crop thinning
- Yield monitors and spatial refractometers for producing spatial yield and brix maps
- Sensors for continual monitoring of vine water status
- Networked temperature sensors
- New equipment for precision viticulture from manufacturers and suppliers

For more information on the tour contact **Dr. Tim Martinson,** Senior Extension Associate, Cornell University (315-787-2448, tem2@cornell.edu).

Nelson J. Shaulis Symposium, Thursday, July 18

DIGITAL VITICULTURE Nelson J. Shaulis Symposium

The Nelson J. Shaulis Symposium, **Digital Viticulture: New Tools for Precision Management of Vineyards,** will be held Thursday, July 18. Dr. Nelson Shaulis and others developed principles of vine physiology that form the basis of modern viticulture. His focus on the importance of light interception, canopy density, and balanced cropping have been applied worldwide. However, growers have lacked the tools to apply these principles on a vine-by-vine basis to manage variable vineyards. New technologies such as inexpensive sensors, digital imaging, geographical information systems, and precision machinery are converging to make precision viticulture possible. These technologies offer producers the prospect of applying management to individual vines to maximize quality and yield.

New York vineyard and winery owners can attend the July 16 conference at ASEV-ES member rate.

For more information on the schedule contact **Chris Gerling,** Enology Extension Associate, Cornell University (315-787-2277, cjg9@cornell.edu) or **Dr. Tim Martinson,** Senior Extension Associate, Cornell University (315-787-2448, tem2@cornell.edu).

Seeder Loaner Program: For Vineyard Use

Purpose: Cover crops can be a useful tool in improving soil physical, chemical, and biological properties. The purpose of this no-till seeder loaner program is for grape growers to gain experience with cover crop seeding in their own vineyard operations.

The Cornell Lake Erie Research and Extension Laboratory acquired this five-foot seeder from Chautauqua County Soil and Water and our intent is to loan out the implement at no charge to Lake Erie Regional Grape Program members for vineyard use. Since this is a no-fee program, we need to minimize the burden on CLEREL staff. We ask that you pick up and drop off the seeder by your own means, operate the equipment as if it were your own, and return it in good working order.

Thank you for your cooperation in this program for your fellow growers. If the seeder becomes abused, broken, or unsafe to operate, the CLEREL Director will discontinue the program.

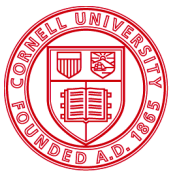
Criteria:

- Must be a member of the LERGP
- To be used in Vineyards for moderate amounts of acreage
- Maximum 3 days/ use
- Must pick up and return by own means- we do not deliver or pick up
- Must return in same working condition as picked up

Procedure-
Grower will call LERGP at (716) 792-2800 ext 201 (Katie) and schedule a time to come get the seeder. Once here, grower will inspect the equipment and, if needed, attain basic instructions of use for the seeder. A profile sheet will be filled out to gather grower information and signed agreeing on terms. Upon return of the equipment, an inspection of condition will occur.

Lake Erie Regional Grape Program Team Members:
Andy Muza, (ajm4@psu.edu)Extension Educator, Erie County, PA Extension, 814.825.0900
Tim Weigle,(thw4@cornell.edu) Grape IPM Extension Associate, NYSIPM, 716.792.2800 ext. 203
Kevin Martin, (kmm52@psu.edu) Business Management Educator, 716. 792.2800 ext. 202

THE LAKE ERIE REGIONAL GRAPE PROGRAM at CLEREL
6592 West Main Road
Portland, NY 14769
716-792-2800



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