Cornell University Cooperative Extension

Lake Erie Regional Grape Program

PennState Extension

Newsletter September 2019

Concords on their way to ripening-Jenn Russo, LERGP

Building Strong and Vibrant New York Communities

Diversity and Inclusion are a part of Cornell University's heritage. We are a recognized employer and educator valuing AA/EEO, Protected Veterans, and Individuals with Disabilities.

In this Issue:

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

Business Management

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

How Management Strategies Impact Sampling Cost

So you've got your refresher in proper soil and petiole sampling protocols. So what does it cost? I answer that question the same way I always answer that question. It depends. Ideally a grower is willing to make large investments in soil health to maximize long-term profitability. In reality, perhaps finances only permit so much investment in soil health. Perhaps rental ground or long-term ownership plans force plans to be less robust than ideal. Soil health is the expensive, boring unseen benefit. A great trellis, some vine size and yield history are enough to sell a vineyard. There should be a direct correlation between the number of samples the grower is willing to take and the complexity and cost of the nutrient management plan.

Sample Cost

A petiole test will run about $30 per sample, approximately $35 per sample when accounting for labor cost. A soil test depends on what nutrients you're looking to get. A pH and Phosphorus test is $5 - $7. A standard test is $10 - $15. Complete micronutrient tests usually increase the cost to $14 - $20. The tests submitted by LERGP to Dairy One are $16 for soils and $30 for petioles. As we extrapolate those costs on a per acre basis the cost is dependent on what the grower is willing to manage. For example, it doesn't make sense to test for boron if the grower isn't willing to manage boron. It also doesn't make sense to differentially sample if a grower isn't planning on fertilizing differentially.

Industry Practice: Cost Per Acre

Standard industry practice for the DIY grower focuses on soils but does sometimes include petioles. Growers practices do vary quite a bit but average costs for sampling is in the range of $1 per acre. Occasional petiole sampling does increase the cost but most grid sampling is between 15 – 20 acres. Samples are taken every 3 – 5 years. It is hard to justify this level of sampling, given the cost of fertilizer.

Standard industry practice for consulting services is to divide large blocks by soil types. If any areas are larger than 5 acres, they're subdivided into samples of 5 acres or less. This usually means about one soil test per 3 acres, or $7 per acre if you're doing it yourself. Most growers do this once every 3 years, meaning soil testing costs about $2.25 per acre per year. If a grower does not see visual symptoms of deficiency or imbalance and that grower is applying moderate rates of fertilizer, that is probably an economically sustainable protocol.

Increasing Information: Cost and Justification

The cost of sampling to industry standard is almost nothing. There is certainly room to increase costs if any potential savings in fertilizer or vine health could result. The first step to better samples applies to everybody. With each soil test, also test petioles. Over 50% of the time the results will probably be the same. When results differ from soil to petiole in the same area, recommendations can change significantly for the better. For growers that do not manage fertilizer differentially, sometimes consultants over-sample soil. There is no sense in paying for two soil tests, when soil type is the same, when we know the grower cannot manage the two areas differentially. A grower is better off taking petiole samples.

Another way to improve information, without substantially increasing cost, is to collect more data. Instead of drawing one core per ten acres, draw more. At a minimum, six cores from three locations. The additional cost will be well under $1 per acre. Additional cores per sample will provide more confidence in the results. The same can be said for petioles. Growers typically gather 50 petioles per sample. Researchers gather 100. Taking 100 petioles from a wider area can help increase confidence in sample reliability. The cost here might be $1 per acre as this does take longer. In total, a grower that manages large blocks uniformly is still spending well under $5 per acre per year.

Measuring Variability for Uniform Management

Typically paying for multiple soil and petiole samples within an area that will be managed uniformly does not make sense financially. One reason to do it is when fertilizer management strategies extend beyond NPK and standard applications of lime. When soil and petiole test results motivate a grower to apply certain micronutrients or excessive quantities of lime, there is a risk that managing to the average will have an adverse impact on soil and vine health that costs the grower money. When toxicity is a possibility due to variation, it pays to have an understanding of the level of variation within a block.

Sample Type	Total Cost
Industry Standard	$ 1.00
Consulting Standard	$ 2.25
Both Soil and Petioles	$ 3.00
More Cores and Petioles	$ 4.75
5 Acre Grid Soils	$ 6.00
5 A. Grid Soils & Petiole	$ 9.00

One soil sample per soil type, on a grid no larger than 5 acres per block is often adequate to understand variation. This would increase the cost to $6 per acre, per year. There is a fairly decent chance that this additional sampling will not chance practices. This investment could be wasted. However, when there is significant variability the cost savings are potentially quite large. There is also not typically a reason to replicate this dense sampling, for these purposes, very often.

Variable Rate Management

When symptoms of deficiency show up, costs are dramatic. The impact of corrective action continues to astound growers. It is common to hear stories of growth doubling or yield increasing by multiple tons. The temptation for many growers that see these impacts: more is better. What the viticulturalist would have you aim for is balance. Great news for business because the philosophy of more is better results in significant costs for fertilizer applications.

To keep soil healthy and nutrient ratios balanced, variable rate management is an option to maximize available nutrients without getting ratios out of balance. Efficient vineyard has covered sensor technology and variable rate technology and machinery that is ready for commercial vineyards. If you haven't invested in any of that technology, it's close to a $20,000 capital investment to do variable rate fertilizer applications. Growers in the Finger Lakes have access to a number of custom fertilizer applicators to avoid this capital investment. The application costs are high but it's a great deal for small growers. Hopefully we see custom applicators emerge in the Lake Erie region too.

Soil and petiole sampling protocols need to increase to maximize the use of the technology and reduce vine size variability to justify the capital investment. While results will vary based on available sensor data, it's realistic to plan for dividing blocks by EC (or soil) maps and 5 acre grids. This typically results in one sample per 3 – 4 acres. Total cost is $7 - $10 per acre per year.

The cost of maintaining healthy soils is fairly minimal. The cost of boosting soils to a level considered "very healthy" can be extremely high. Changing CEC can take decades. Even changing soil pH can

take a decade. It is both very costly and harmful to overdo it. When growers are at a stage in their operation when these high cost practices are at the core of their long-term business plan, variable rate fertilizer has the ability to pay for itself much more quickly.
In conclusion, growing grapes is very expensive. Fertilizer costs are no longer cheap, but also fairly reasonable given the efficiency of grape vines. Soil and petiole sampling costs very little and is easily justified whenever that data can be used to improve yields or even reduce fertilizer costs.

Vineyard Improvement Program

Kim Knappenberger

We are into our second year of the Vineyard Improvement Program. This is a 5 year program set up by the New York State Department of Agriculture and Markets through the Lake Erie Regional Grape Program that offers a reimbursement opportunity for Concord growers in the Southern Tier (+ Erie and Niagara counties) of New York state. The grants have been funded by the Southern Tier Agricultural Industry Enhancement Program.

This grant, as proposed by Governor Cuomo and Commissioner Ball, is intended to assist growers/property owners in removing abandoned or under-producing Concord vineyards and replacing those vineyards with an agricultural commodity that might be better suited to their needs. Removing sources of pest and infection will help neighboring commercial vineyards by reducing the amount of inoculum present and reducing the inputs required to keep those vineyards “clean”.

To date there have been eleven applicants, with one already completing the process and receiving reimbursement. Those eleven applications account for 113.94 acres of Concord vineyards being removed. 66.47 acres of those removed will be replanted with grapes, 11.3 of which are intended to be Concord. The acreage per county are as follows: 6 applications from Chautauqua County account for 64.32 acres; 3 from Niagara County account for 39.92 acres; 1 from Steuben County accounts for 4 acres; and 1 from Schuyler County accounts for 5.7 acres.

If you own an abandoned or under-producing Concord vineyard and are interested in seeing what we can do to help, you can either go to our website at lergp.com/about-vip or email or call Kim (ksk76@cornell.edu or 798-2800 ext 209).

Just a reminder: if you do intend to use the program please do not pull the vineyard out prior to submitting the application. We will need to verify that it was a Concord vineyard in order for the program to be applicable.

IPM

Tim Weigle, NYSIPM, Cornell University, LERGP Team Leader

Do You Have Fruit Flies That Won't Die?

Tim Weigle

As mentioned in the articles above, fruit flies have been linked to the occurrence and spread of sour rot in a vineyard. IF you have seen an increase in sour rot over the years, despite making insecticide applications to control fruit flies around harvest, I would like to hear from you. Greg Loeb, Cornell, is leading a project that is looking at potential resistance of fruit flies to different insecticides labeled against them.

If you have a vineyard with a history of sour rot despite multiple insecticide applications against fruit fly populations, we would like to hear from you. Participation in the project is extremely simple. All you need to do is contact us, show us where the vineyard is, and then we collect samples of the fruit flies present in that vineyard block.

If you are interested in the project please send me an email at thw4@cornell.edu or give me a call at 716.792.2800 x203

Managing Fruit Flies for Sour Rot in 2019

Greg Loeb and Hans Walter-Peterson

As many wine growers are aware, 2018 was a bad year for sour rot. A number of factors probably contributed to this but one factor that was clearly involved at one vineyard site in the Finger Lakes was failure of insecticides (particularly Mustang Maxx) to control Drosophila fruit flies. As we have reported previously, fruit flies (also called vinegar flies) significantly contribute to sour rot through mechanisms we do not fully understand. Nevertheless, insecticides targeting them prior to harvest (after about 15 Brix), coupled with biocides such as Oxidate targeting contributing microbes, have been shown to reduce the incidence and severity of sour rot. Several species of fruit flies probably contribute to the problem. Our research has actually indicated that *Drosophila melanogaster* (the common fruit fly of genetics fame often found in kitchens in the summer) is more commonly found in grapes than the invasive spotted wing drosophila, *Drosophila suzukii*, though both species likely contribute to our sour rot problems. Wine growers have increasingly been applying insecticides near harvest as part of their sour rot management program, primarily relying on the pyrethroid insecticide, Mustang Maxx. Recently, working with our Cornell colleague Dr. Jeffrey Scott, we have shown that a local population of *D. melanogaster* has developed resistance to Mustang Maxx, as well as Assail, a neonicotinoid, and malathion, an organophosphate. The population is still susceptible to spinosyn (Delegate or Entrust). We have not detected evidence of insecticide resistance for spotted wing drosophila in New York, however. We do not know how wide spread this *D. melanogaster* resistance issue is but we should have a better idea after this field season. In the meantime, we want to emphasize the need to rotate among several different classes of insecticides in order to slow the development of resistance. Mustang Maxx has several attributes that make it a logical choice for many growers including good efficacy against fruit flies and importantly, a

short days to harvest (DTH) restriction of 1 day. Despite these advantages, **it is essential, as part of a resistance management program, to rotate to other classes of insecticides.**

Here we want to review the chemical control options available for controlling Drosophila fruit flies to aid in developing your sour rot control program. Below is a table of the products currently labeled for use against either Drosophila fruit flies or specifically for spotted wing drosophila, including materials added through 2ee label exemptions. We provide the product name, chemical name, insecticide class (IRAC number), days to harvest restrictions and other notes. We do not recommend initiating your chemical control program until grapes reach about 15 Brix. Prior to this, it's not likely that many fruit flies will be present in your vineyard. We caution you to be conservative with sprays. For example, some cultivars with loose clusters such as Cab Franc and Lemberger, are not particularly susceptible to sour rot. Cultivars with tight clusters, such as Riesling and Vignoles, are more prone to sour rot issues. Also, be aware of other factors contributing to sour rot risk. For example, if the weather leading up to harvest is conducive to sour rot development (e.g. wet and warm conditions) be more diligent with your sprays, but if conditions are not conducive to sour rot, consider reducing sprays at least for cultivars that are not especially susceptible. Another important factor is minimizing berry damage from birds and direct insect pests such as grape berry moth as much as possible.

Some additional comments about insecticides. For insecticides listed in the table below that are allowed through 2ee exemption, make sure to have the exemption in your possession. You can download these from the NYS DEC PIMS web site (http://www.dec.ny.gov/nyspad/products). Note that some insecticide labels list Drosophila species or fruit flies generally. Others only list spotted wing drosophila. In the later situation, legally you must be targeting spotted wing drosophila. We have limited information on how frequently insecticides and biocides should be applied. Our initial studies started sprays at about 15 Brix and continued on a weekly basis until near harvest. We suspect we can reduce the number of sprays without loss of efficacy but we don't have enough data yet to make specific recommendations. Unless you believe you had a control failure the previous year associated with application of Mustang Maxx, it should be ok to use in your rotation. We suggest using at least three different classes of insecticides (different modes of action, e.g. different IRAC classes) in a season, taking into consideration efficacy, days to harvest restrictions and other restrictions such as total amount of active ingredient (A.I.) allowed and insecticides applied in your vineyard targeting other pests. For example, Delegate (a spinosyn) is considered a very good material against spotted wing drosophila but it has a 7 DTH restriction. There are also limitations to the total amount of A.I. allowed in a season and you also must rotate to a new class after two successive sprays.

Finally, please let us know if you have observed what appears to be a control failure for an insecticide application targeting fruit flies. An indication of a control failure would be observing numerous healthy-looking adult fruit flies in the vineyard block immediately or shortly after an insecticide application. Some adults might be expected with continual emergence, but populations should be noticeably lower.

Table 1. List of insecticides for use against Drosophila fruit flies (vinegar flies) labeled in New York including trade and common names, IRAC (Insecticide Resistance Action Committee) chemical class based on mode of action, days to harvest restriction and other information. Also see the NY and PA grape guidelines for additional information.

Product name	EPA Number	IRAC Code	2(ee) required?[a]	Rate	REI (hrs)	PHI (days)	Reapplication interval (days)[b]	Max applications per season	Maximum product applied per season	Comments
Assail 30SG	8033-36-70506	4A	Yes	4.5-5.3 oz/acre	12	3	14	2	10.6 oz	2ee required for SWD. Good but not great efficacy. Do not use an adjuvant.
Danitol 2.4 EC	59639-35	3A	No	11-21 fl oz/acre	24	21	7	2	42 fl oz	'Vinegar flies' and SWD listed on the label.
Delegate WG	62719-541	5	No	3-5 oz/acre	4	7	4	5	19.5 oz	SWD is listed on recent label. Older labels may not include SWD. No more than 2 consecutive applications of Group 5 materials.
Entrust SC	62719-621	5	Yes	4-8 fl oz/acre	4	7	5	5	23 fl oz	2ee required for SWD. OMRI listed. No more than 2 consecutive applications of Group 5 materials.
Grandevo WDG	84059-27	NA	No	2-3 lbs/acre	4	0	NA	NA	NA	Based on entopathogenic bacteria. Labeled for fruit flies. Organic. Modest efficacy but potential rotation option with Entrust SC for organic growers.
Malathion 5EC	19713-217	1B	No	3 pints/acre	24	3	14	2	6 pints	Drosophila included on the label. Use max rate.
Malathion 57%	67760-40-53883	1B	No	3 pints/acre	24	3	14	2	6 pints	Drosophila included on the label. Use max rate.
Malathion 8 Aquamul	34704-474	1B	No	1.88 pints/acre	24	3	14	2	3.76 pints	Drosophila included on the label. Use max rate.
Mustang Maxx	279-3426	3A	No	4.0 fl oz/acre	12	1	7	6	24 fl oz	'Vinegar flies' and SWD listed on the label.

[a] If yes, a copy of the 2(ee) approval must be in possession when the material is applied.

[b] Minimum number of days before reapplication of the material.

Suggested Fruit Fly Insecticide Program for 2019

Hans Walter-Peterson and Greg Loeb

As most growers are aware by now, a population of fruit flies from a Finger Lakes vineyard was found to be highly resistant to several different products registered for control of *Drosophila* in New York. Since that discovery, we have been strongly urging growers to use more than just one material for fruit fly control as a means of limiting sour rot development during the ripening and harvest season this year.

The following is a suggested schedule of chemical use for fruit fly control, developed in consultation with Greg Loeb, based on several factors:

1. This schedule uses at least one material from each IRAC category that is available for fruit fly control in New York. If any of these materials have been used previously during the growing season, growers will need to take that into consideration with regard to the maximum amount of material and applications for a season, and possibly substitute another material instead.
2. The schedule assumes that all materials are still effective against fruit flies. If a material is applied and high populations appear in the same area within 24-48 hours, it is possible that the population is developing resistance to that insecticide.
3. The schedule generally uses the concept of applying materials with longer PHI intervals first, then moving to materials with lower intervals from there.
4. We do not suggest applying the same material (or materials from the same IRAC category) in consecutive sprays, even if the label allows it.
5. The schedule assumes a spray interval of about 7 days between sprays. We created a program containing 6 sprays to cover most of the portion of the season where fruit fly control would be necessary. Hopefully growers will not need to use this many sprays before harvest, but it would not be impossible with some later ripening varieties.

	Material	IRAC Code	Max. Rate/ Application	PHI (days)	Comments
Spray #1*	Danitol 2.4C	3A	21 fl oz/acre	21	'Vinegar flies' and SWD listed on the label. Excellent on SWD.
Spray #2	Malathion 5EC; Malathion 57%; Malathion 8 Aquamul	1B	3 pints/acre; 3 pints/acre; 1.88 pints/acre	3	Use least expensive formulation (5EC, 57%, 8 Aquamul). Fruit flies included on the label. Good to very good efficacy; not very rain fast.
Spray #3	Assail 30SG	4A	5.3 oz/acre	3	2ee required for SWD. Do not use an adjuvant. Good but not great efficacy.
Spray #4	Delegate WG	5	5 oz/acre	7	SWD is listed on recent label. Older labels may not include SWD. Very good efficacy on SWD.
Spray #5	Malathion (see above)	1B	3 pints/acre or 1.88 pints/acre	3	See above
Spray #6	Mustang Maxx	3A	4 fl oz/acre	1	'Vinegar flies' and SWD listed on the label. Excellent efficacy on SWD

* Use only on varieties that will hang for more than 21 days after reaching 15° Brix. If resistance to Mustang Maxx is suspected, do not use Danitol.

NEWA – only as good as the data going into it!

Kim Knappenberger

NEWA is an amazing tool available to our growers, but it's only as good as the information that is fed into it. There are 23 weather stations throughout the Lake Erie Region that collect data. On occasion various things can go wrong with those stations that cause them to need some maintenance. We are notified daily whether or not the stations are transmitting data, but that does not indicate if the information is accurate.

The information that is collected is monitored so that issues can be corrected, but sometimes those problem go unnoticed. That's where you come in! If you are checking on a station and notice something that doesn't seem quite right, please email us! We have seen 2 stations recently that weren't collecting precipitation data, and it was just because the screen was dirty and needed to be cleaned. A 5 minute fix. Temperature, relative humidity, and leaf wetness sensors are also very important, and can be changed out as needed.

If you notice anything that doesn't seem right, please contact Kim at ksk76@cornell.edu.

Viticulture

Jennifer Russo, Viticulture Extension Specialist, LERGP

Tissue and Soil Sampling for Nutrient Evaluation and Troubleshooting

Monday, August 26th, was the official start of Concord veraison here at the Cornell Lake Erie Research and Extension Laboratory in Portland, NY. Veraison is the start of fruit ripening. In Concords, this is when the berries transition from hard, green, and bitter to softened, colorful, sweet and aromatic. Concord veraison occurs when five percent of the berries on 50% of the clusters are showing color. Some growers with hybrids and early ripening varieties are already preparing to harvest. This is one of my favorite times of the year, when the smell of grapes wafts through the air. Now is the time to consider sampling vine tissue for macronutrients, such as Nitrogen (N), Phosphorous (P), Potassium (K), and Magnesium (Mg). There are two reasons for a grower to conduct tissue sampling. One is a routine evaluation of vine nutrient status as part of your best management practices and the other is to troubleshoot any visual disorder when you suspect a nutrient deficiency.

Soil and petiole testing can provide a clear picture of what is going on in your vineyard in regards to nutrient availability and uptake. A loving parent would never medicate their child just because they felt that the child needed it, too much unnecessary medication or vitamins can be dangerous to their health. The same concept can be applied to your vineyards; you need to be able to diagnose nutrient deficiencies before adding nutrients.

Soil tests are a tool to 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. A soil test can indicate that the soil pH, K, Mg, P, and N levels are all adequate, but if the vines are still small, then something else might be at work. This is where a petiole test comes in handy.

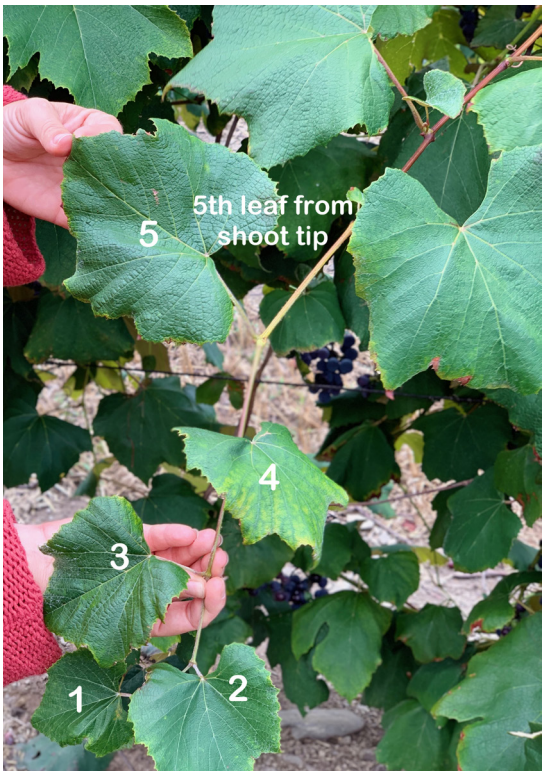
Tissue analysis is a tool that reveals the concentration of essential nutrients (elements absorbed, or taken up, by vine tissues). Samples collected are then compared to standard grapevine tissue references from healthy vines at the lab and classified as either adequate, high, or low/deficient. Once you receive your results, fertilizer recommendations to adjust nutrients that are low can be made with guidance from your viticulturist or the lab that processed your samples.

Ideally, a grower should sample at different times during the growing season (bloom and veraison) to evaluate different nutrients since they fluctuate over the course of the growing season. However, that is both inconvenient and expensive. It is recommended to sample as close to full bloom as possible because this is a well-defined stage of vine development that provides useful information for the majority of plant essential nutrients. If choosing to tissue sample now, it is recommended that sampling occur at 50% veraison. It is easy to collect petiole (leaf stem) samples for analysis and I have listed the instructions in the following paragraphs.

For veraison plant tissue analysis, you want to collect 100 petioles from the youngest fully-expanded leaves on well-exposed, fruiting shoots. These leaves are usually located from five to seven leaves back from the shoot tip. If the shoots have been hedged, then collect primary leaves near the point of hedging, but do not collect leaves from lateral re-growth. If you have taken advantage of our Free Loaner Sensor Program and have data-driven management zone maps, be sure to collect samples from each zone for total representation.

Growers and vineyard managers should also collect their samples from the same area as the soil

samples. Immediately separate petioles from leaf blades and place petioles in a small labeled paper bag or envelope. Plastic bags will promote decomposition or molding of your plant tissue samples and may alter test results.



Once petiole samples are collected, oven dry your samples at 200 degrees Fahrenheit for 30 minutes before shipping to the laboratory. If Cornell Lake Erie Research and Extension Laboratory is sending out your petiole samples for processing, then you do not need to oven dry them. If using the CLEREL, please include your soil type on the sample label if known.

For Troubleshooting suspected nutrient deficiencies, a grower may sample at any time during the season when symptoms become apparent. The collection sampling protocol differs for troubleshooting. Collect 100 petioles from the suspected nutrient deficiency area, regardless of shoot position. AND, you will need to collect another 100 petioles from a non-symptomatic, or healthy, portion of the canopy from relatively the same positions on the shoots as you collected the unhealthy sample from. In doing so, the results should allow you, the vineyard manager, or your viticulturist to compare the healthy and unhealthy elemental concentrations. We also recommend taking soil samples at the same time to assess whether the nutrients are available in the soil for uptake.
Leaf blades can also be collected for tissue samples, especially when trouble-shooting suspected nutrient deficiencies or toxicities. It has been suggested that leaf blades may be superior to petioles because they reflect a cumulative storage of nutrients. However, currently there is a much stronger database of bloom and fall petiole samples to use as standard references to compare to than leaf blades.

I have included video links below on petiole sampling procedures for visual learning. One is presented by Dr. Terry Bates and the second is by Hans Walter-Peterson.
https://www.youtube.com/watch?v=5gAp9gwl4rs
https://www.youtube.com/watch?v=IrvpQWUEQKw

The following table is the Sufficiency ranges for nutrient concentrations guidelines found in chapter eight of Tony K. Wolf's, *Wine Grape Production Guide for Eastern North America,* that was published in 2008 by Natural Resource, Agriculture, and Engineering Service (NRAES) Cooperative Extension.

Table 8.4 ▪ Sufficiency ranges for nutrient concentrations

Nutrient	Chemical symbol	Target values		
		Soil	Bloom petiole	Late-summer petiole (70–100 days after bloom)
Total Nitrogen	N	— [a]	1.2%–2.2%	0.8%–1.2%
Phosphorus	P	20–50 ppm	0.17%–0.30%	0.14%–0.30%
Potassium	K	75–100 ppm	1.5%–2.5%	1.2%–2.0%
Calcium	Ca	500–2,000 ppm [b]	1.0%–3.0%	1.0%–2.0%
Magnesium	Mg	100–250 ppm	0.3%–0.5%	0.35%–0.75%
Boron	B	0.3–2.0 ppm	25–50 ppm	25–50 ppm
Iron	Fe	20 ppm	30–100 ppm	30–100 ppm
Manganese	Mn	20 ppm	25–1,000 ppm	100–1,500 ppm
Copper	Cu	0.5 ppm	5-15 ppm	5–15 ppm
Zinc	Zn	2 ppm	30-60 ppm	30–60 ppm
Molybdenum	Mo	— [c]	0.5 ppm	0.5 ppm
Aluminum	Al	< 100 ppm [b]		
Organic matter		3–5%		
pH		5.5 (*V. labrusca*) 6.0 (hybrids) 6.5 (*V. vinifera*)		

Note: ppm is parts per million.
[a] Soil nitrogen is not normally evaluated for vineyards in eastern North America.
[b] Calcium level is normally adequate when pH is in the proper range for the grape variety. The same is true for aluminum.
[c] Adequacy of soil molybdenum for grapevines is uncertain.

PA Update

Andy Muza, LERGP Extension Educator, Penn State University

A Complex Late Season Bunch Rot

Harvest season will be here soon. So, late season bunch rots become a major concern for wine grape growers. A complex late season rot not controlled by fungicide applications is Sour Rot.

Question: What can you get when you combine: tight clustered varieties; yeast; acetic acid bacteria; berry injury; and fruit flies?
Answer – Sour Rot.

Over the last few years extensive research, by Wendy McFadden-Smith and her colleagues at OMAFRA in Ontario and Megan Hall, Wayne Wilcox and Greg Loeb at Cornell, has greatly increased our knowledge of the Sour Rot syndrome.
The following information is a brief summary of what the research revealed.

How do you know if the rot in your clusters is sour rot?

Sour rot has been defined by Megan Hall and Wayne Wilcox as, “a specific syndrome, characterized by the oxidation of the berry skin and the smell of acetic acid (vinegar) emanating from diseased berries.”

Therefore, field diagnosis is by both sight and smell. In white varieties, berry skins turn brown and in red varieties, berries have a reddish – purple discoloration (Figure 1). Infected berries degrade and have a vinegarlike odor. This syndrome is usually associated with large populations of fruit flies.

Figure 1. Brown discoloration of berries (symptomatic of sour rot) in cluster of Vignoles. Photo - Bryan Hed, Penn State.

Development of sour rot

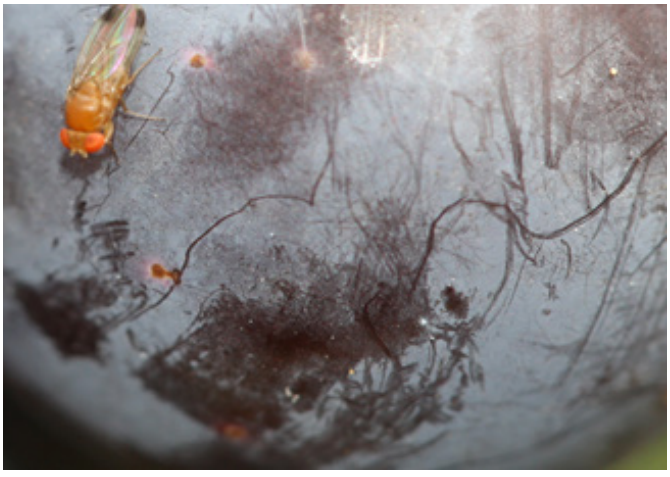


Figure 2. A male spotted wing drosophila (fruit fly) on Concord berry. Photo - Andy Muza, Penn State.

A wide variety of yeasts and bacteria naturally occur on and in grapes in the vineyard. **Yeasts**, whether in the vineyard or in the wine cellar, do what they do best. That is, they convert sugars in grape juice to alcohol (i.e., ethanol). Likewise, **acetic acid bacteria** (e.g., *Acetobacter spp*, *Gluconobacter spp*), whether in the vineyard or in the wine cellar, do what they do best. These bacteria convert ethanol into acetic acid (i.e., vinegar) in the presence of oxygen. **Injured berries** provide the gateway for bacteria, oxygen and insects (most commonly fruit flies) to enter berries.

The presence of **fruit flies** has been discovered to be a key component in the sour rot syndrome (Figure 2). Experiments showed that without fruit flies the symptoms of sour rot did not develop. Fruit flies spp. (e.g., common fruit fly, *Drosophila melanogaster* ; and spotted wing drosophila, *Drosophila suzukii*) are attracted to injured berries via the smell of acetic acid and ethanol. As fruit flies feed and deposit eggs they spread yeast and bacteria from their bodies or gut contents throughout the clusters. However, the complete role that fruit flies contribute in sour rot development is not yet fully understood. Megan Hall, now at the University of Missouri, is continuing research to determine the complete picture of the fruit fly connection in sour rot development.

Management

Cultural practices – Cultural practices play a critical role in the management of grape diseases and sour rot is no exception. Canopy management practices, such as shoot thinning/positioning and leaf removal around clusters, provide better air flow and sun exposure thus reducing a more favorable microclimate for disease development. In addition, this opens up the canopy to better spray penetration.

Hall and Wilcox also showed that a vertical shoot position training system significantly reduced sour rot compared to a high wire trellis system. This should be taken into consideration if you are planning on planting a new vineyard with tight clustered, thin skinned varieties.

Berry Injury – The management of berry injury can be broken into 2 categories:
1) What we cannot control, and 2) What we can control.

1) What we cannot control – the weather.
   The most widespread cause of late season injury to berries in our region is due to rainfall events which cause berries to split or pull away from their pedicels. Tight clustered, thin skinned varieties (such as Pinot Noir, Riesling, Vignoles, etc.) are the most susceptible to this injury and to sour rot and botrytis development.
   Unfortunately, tropical storms can and sometimes do occur around harvest, spreading excessive rainfall, resulting in berry splitting. The best we can hope for is that heavy rainfall events do not occur during harvest.

2) What we can control – injury caused by birds, diseases and insects.
   Any injury can predispose berries to invasion from a variety of fungi, yeasts and bacteria that can result in bunch rots. Management of: birds (through use of netting and/or scare devices); diseases (through effective use of fungicides); and insects, particularly grape berry moth (through well timed insecticide applications) are important components in the reduction of berry injury levels.

Fruit flies, acetic acid bacteria and yeasts – Fungicides used for grape disease management are effective against filamentous fungi (e.g., Botrytis, powdery mildew, etc.) but not effective against yeasts and bacteria. Therefore, fungicides are not directly effective in sour rot management. However, research conducted at Cornell in the Finger Lakes Region did show that applications of an antimicrobial material and insecticide applications against fruit flies are directly effective. Specifically, the most effective treatment regime consisted of weekly applications of Mustang Maxx insecticide (a.i. - zeta-cypermethrin) and OxiDate 2.0 (an antimicrobial, a.i. - includes hydrogen dioxide and peroxyacetic acid) starting when fruit reached 15 Brix and **before any sour rot symptoms were evident**. This regime (insecticide and antimicrobial) provided an average of 69% control of sour rot. However, the insecticide alone treatments in 2015 & 2016, still provided 57% and 40% control, respectively.

It is important to mention that in 2018 in a Finger Lakes, NY vineyard a local population of fruit flies have developed resistance to Mustang Maxx, malathion and Assail.

I cannot overemphasize the importance of rotating different classes of insecticides (i.e., different modes of actions/different IRAC numbers) for fruit fly management in order to avoid the development of insecticide resistance. There are a number of registered insecticides with different modes of action and short preharvest intervals (PHI) which are effective against fruit flies. These include: Assail 30SG (IRAC 4A, 3 days PHI); Delegate WG and Entrust SC (IRAC 5, 7 days PHI); Malathion 5EC or 57% or 8 Aquamul (IRAC 1B, 3 days PHI); and Mustang Maxx (IRAC 3A, 1 Day PHI). Greg Loeb and Hans Walter- Peterson (Cornell) suggest using **a variety of different classes of insecticides in a season** (refer to articles in this newsletter - Managing Fruit Flies for Sour Rot in 2019 and Suggested Fruit Fly Insecticide Program for 2019).

Management of Sour Rot in the Winemaking Process

Like it or not winemakers may be forced to deal with volatile acidity issues due to sour rot. Since I am not an enologist, I will suggest 2 articles below which provide information for dealing with this problem. In addition, winemakers can also contact their Enology Extension Educator for assistance. Penn State - Molly Kelly, e-mail: mxk1171@psu.edu, phone: 814-865-6840. Cornell – Chris Gerling, e-mail: cjg9@cornell.edu, phone: 315-787-2277.
Managing Sour Rotted Fruit in the Cellar. Denise Gardner. Updated: May 5, 2016.

Sour Rot Stinks: Some Strategies for managing Volatile Acidity. Chris Gerling. Veraison to Harvest. Statewide Vineyard Crop Development, Update #5. Sept. 2018.

Additional Link

For more comprehensive information concerning Sour Rot research at Cornell, I highly recommend checking out the link below.
Defining and Developing Management Strategies for Sour Rot. Megan Hall, Gregory Loeb, and Wayne Wilcox. Appellation Cornell – Research News from Cornell's Viticulture and Enology Program, Research Focus 2017-3.

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