Lake Erie Regional Grape Program- Vineyard Notes

June 2016

Lake Erie Regional Grape Program

Cornell University Cooperative Extension

PENNSTATE College of Agricultural Sciences

In this Issue:

Cover Crop Workshop and Field Day

September 1, 2016 @ CLEREL

9:00am-4:00pm

6592 West Main Rd.

Portland, NY 14769

Join the Lake Erie Regional Grape Program for a full day of education surrounding cover crops in Concord vineyards.

- Current research
- Leading scientists in cover crop research
- Tour demonstration plots
- Hear local growers sharing their experience

Fee: $ 10; includes morning refreshments and lunch

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Kevin Martin
Penn State University, LERGP,
Business Management Educator

Shoot Thinning and Variable Rate

Kevin Martin & Dr. Terence Bates

While shoot thinning is a standard viticulture practice, such a topic immediately evokes thoughts of high end wine grapes. These high end wines are typically produced from under-cropped and overly vigorous vines. The vineyard manager sends in a crew to remove shoots by hand. As growers no doubt know, we have been experimenting with a mechanical shoot thinner here at CLEREL, with a very different strategy in mind. While widespread commercial adoption in bulk production might be a few years off, the potential benefits of mechanized shoot thinning are becoming clear.

By itself, pruning is not an effective method of crop load management. It does not allow the grower the flexibility to predictably maintain balanced vines. The increased adoption of high speed hand pruning and mechanized pruning further undermine an already inadequate practice. Shoot thinning is a one of a few ways to manage crop load later in the season. It turns out, it might also be the easiest mechanical crop load tool to equip with variable rate technology.

Investment: Capacity and Cost

Despite the fact that mechanical shoot thinning is a very time sensitive practice, an individual machine has a capacity of at least 200 acres per year. With a ground speed of 2.5 to 3 miles per hour it removes excessive potential crop as fast as a harvester. Set up time is far less than a harvester and operational convenience is much higher for growers using harvesters as sprayers.

The investment required will vary considerably based on the operation. The mechanical shoot thinner that is currently commercially available is priced around $6,000. However, it is designed to be used with a proprietary tool carrier compatible with a mechanical pre-pruner. Growers that already own Oxbo or Midwest Grower Supply tool carriers will need to purchase a tool carrier or find another solution. The cost of a package that includes a pre-pruner, tool carrier and shoot thinner was recently quoted at $31,000.

Operating Costs

The shoot thinner may provide the least expensive way to remove potential crop after bud break from grapes for nearly all growers. The comparison in Table 1 assumes that that no equipment, other than the shoot thinner is purchased. In reality, depending on the operation, a farm might need to purchase a tractor, harvester or sprayer to complete this practice.

Cost Comparison	Shoot Thinner	Harvest Thinning
Depreciation	$6.22	$1.60
Capital Recovery	13.45	12.61
Taxes, Insurance, & Housing	0.04	0.00
Repairs	1.49	37.13
Fuel	1.48	7.43
Labor	6.70	14.32
Total	29.37	73.08

Table 1: A comparison of costs between shoot thinning and harvest thinning per acre

Inexpensive harvesters damage shoots and vines to an extent that there is not a brix or pruning weight response when the grape crop is thinned. Modern harvesters effectively and reliably thin the crop but do so at a significantly higher cost. Typically, set-up time is 8 – 10 hours of labor. Fuel costs range between $3.50 and $5 per acre. Depreciation and maintenance costs for the harvester vary between $30 and $55 per acre.

Increasing Vine Size in a Mechanized Operation
Initial research has begun to show the benefits of shoot thinning as a management strategy. We know over-cropped vines will decrease canopy growth and therefore decrease potential yields in following years. Fruit thinning has been effectively used to reduce crop size, maintain vine size, and proportionally increase potential crop in the following year. Fruit thinning, however, does not effectively increase vine size when vines are not appropriately sized for the trellis.

Shoot thinning appears to be the only known mechanical solution that provides the potential to remove enough crop to increase undersized vines to an optimal .35 pounds pruning weight per foot of row. Furthermore, the investment required to shoot thin, when mechanical pruning strategies are already implemented will be less than $4,000.

Drawbacks of Shoot Thinning
Shoot thinning is an effective tool to increase vine size and future potential crop. It is also an effective tool to reduce crop as a result of delayed bud break. When vines are over cropped due to bud fruitfulness, shoot thinning may be less effective. Shoot thinning must occur before fruit set when yields are still not well defined. Shoot thinning alone, is not a solution to control vine size and yield balance, and to ensure grapes ripen to minimum quality standards. As growers transition to mechanical pruning, shoot thinning offers a mechanical tool to substantially reduce hand follow-up practices to maintain vine size and reduce the probability that a grower needs to fruit thin with a harvester.

Variable Rate Shoot Thinning
Shoot thinning will be the first mechanical application of NDVI sensor technology in vineyards. This practice was chosen because of the simplicity of the machine, ability to increase vine size and reduce crop and the ability to cover significant acreage.

Investment Required to Variable Rate Shoot Thin
Variable rate shoot thinning requires a prescription map and the software and hardware to mechanically respond to the prescription map. At this time commercial adoption is impeded by the statistical analysis required to create a prescription map. The raw data is collected with NDVI and GPS sensors and it is recorded on data loggers. The two sensors and the data logger in a ruggedized format are commercially available for $7,200.

Adopting the shoot thinner to respond to a prescription map requires various hardware components that include a tractor computer, GPS and flow controllers. The total cost for such a system will range between $10,500 and $12,000, depending on the type of GPS and flow controllers needed. Further research will refine that upfront cost as we become more confident in our ability to recommend specific hardware. See Table 2 for a breakdown of costs for these upgrades. About 70% of the equipment is installed in the tractor and can be used on other machines as the grower adopts variable rate technology for other practices.

Why Shoot Thinning is Better
The theory behind the practice is the idea that increasing vine size through yield manipulation requires a vine to be under cropped for a year. The economic potential of the technology would allow growers to target zones of under sized vines. In doing so, yield would not be unnecessarily removed from adequately sized or large sized vines. Given the cost associated with unnecessary shoot removal, we believe there is potential to create a positive ROI on both the equipment and practice.
Shoot thinning promises a practical method of later season yield reduction for machine pruned vineyards on small

to medium sized farms. Less than 1/3 of regional growers own their own harvester. Control over the machinery to remove fruit is essential to controlling crop size. Custom hire is not reliable when growers that own harvesters may not need to thin their own crop. While an investment in equipment is required, the costs shown above illustrate an investment we view as practical for small to medium sized farms.

Furthermore, unnecessary fruit removal results in a reluctance by growers to complete necessary fruit removal. By improving the reliability of shoot and fruit removal, the adoption of these practices is more likely to occur. Removing crop via shoot thinning was more consistent, despite decades of experience, than fruit thinning. At a minimum our goal is to improve typical total farm yields by 150 tons over the period of 5 years. To ensure widespread adoption, we know we need to do better. Our goal is to not only achieve optimal results, results that are economically better than any alternative, but to achieve results that are obviously optimal.

Shoot thinning removes crop more reliably and predictably than fruit thinning with a harvester. Trials at the Fredonia Experiment Station showed a linear relationship between fruit reduction via shoot removal and RPM speed of the shoot thinner. A number of variables impact the ability of a harvester to remove fruit 30 days after bloom. Humidity, vine size and other uncontrollable factors result in imprecise fruit removal at similar RPM rod speed. This linear relationship will improve grower results and success in fruit thinning. It also makes the development of variable rate technology easier. Imprecise variable rate technology undermines the economic value of the investment; with shoot thinning it does not appear that such a challenge will be hard to overcome.

Influence on Vine Size

While single year results did not establish the influence of shoot thinning on vine size and pruning weights, the relationship between crop load, future vine size and potential yield is well researched by Dr. Bates and others. An earlier trial in Fredonia, NY shows the economic potential of any kind of improvements in pruning weight. As a result, commercial growers have worked hard to improve average pruning weights. For many blocks, further improvement will require variable rate management.

A pruning weight trial showed that uniform management of vines led to unacceptably high variation within the block, a common commercial grape production problem. Intensive and expensive management led to pruning weights over 6 lbs. per vine as well as a number of vines under 1 lb. As previously stated we are confident that optimal vine size is close to 3.5 lbs. Maximum yield was achieved in this study around 4.5 lbs. Beyond 5.5 lbs. the vine entered a vegetative state and yield actually declined. More intensive management of 20% of the vineyard to increase uniformity, would result in an increase in average pruning weight from 1.6 to 2.3. Potential yield would increase by 25% and standard deviation of pruning weights would decline. Chart 1 illustrates the average yield curve over the length of the study, as it relates to pruning weight.

It remains to be seen if variable rate shoot thinning has the ability to influence vine size this significantly. If so, a potential increase of this magnitude would increase gross revenue by as much as $480 per acre. Even discounting for market conditions and weather related variables, assuming the average grower found benefits across 50 acres of vineyards, the investment would improve net income within two years.

Building Prescription Maps for Commercial Vineyards

Image 1 shows a typical commercial vineyard growing Niagara grapes for bulk juice production. Average vine size is 62% of optimal. Given the vine spacing optimal pruning weight is 2.5 lbs. per vine. Actual mean pruning weight is 1.57. Variability is economically significant with a standard deviation of .98. Furthermore, much of that variability is related to spatial difference. Refer to image 1 to see the significant patterns.

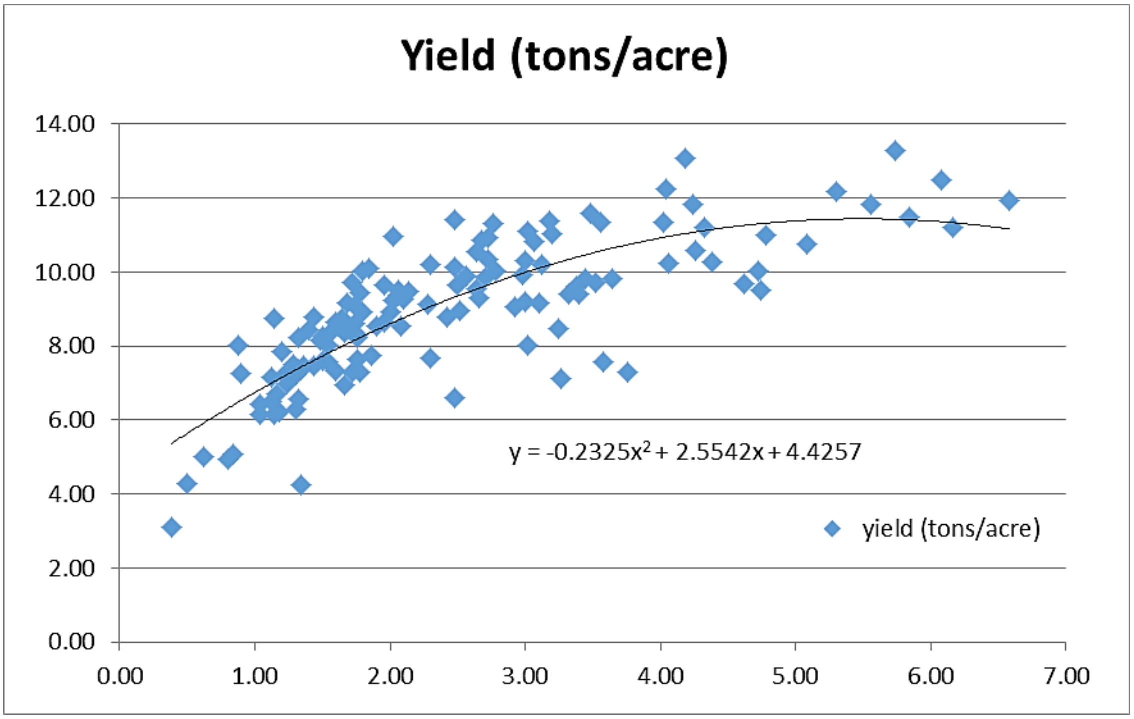

Image 1: Sensor data illustrates predicted pruning weights, which correlate with canopy fill, potential yield, and long-term average yields.

In this typical block a 20% increase in vine size should result in a 1-ton increase in yield at equal quality as defined by the market. With such high variability we would expect 30% of vines to be optimally sized. Given the map, some rows may be skipped entirely, while others would be thinned differentially. Potential crop in the following year would be much more uniform. In the event that there is a treatable viticulture explanation for the variability, shoot thinning would be utilized to increase vine size while another production practice would be necessary to maintain vine size and canopy fill and higher potential yields over the long term.

As preliminary as all of this information is, getting here was still a team effort. I want to thank all of the CLEREL staff over the years that have worked toward these goals and making this project possible. Dr Bates, Dr. James Taylor and Rhiann Jakubowski have been extremely helpful in providing the viticulture and GIS data necessary to draw these economic conclusions.

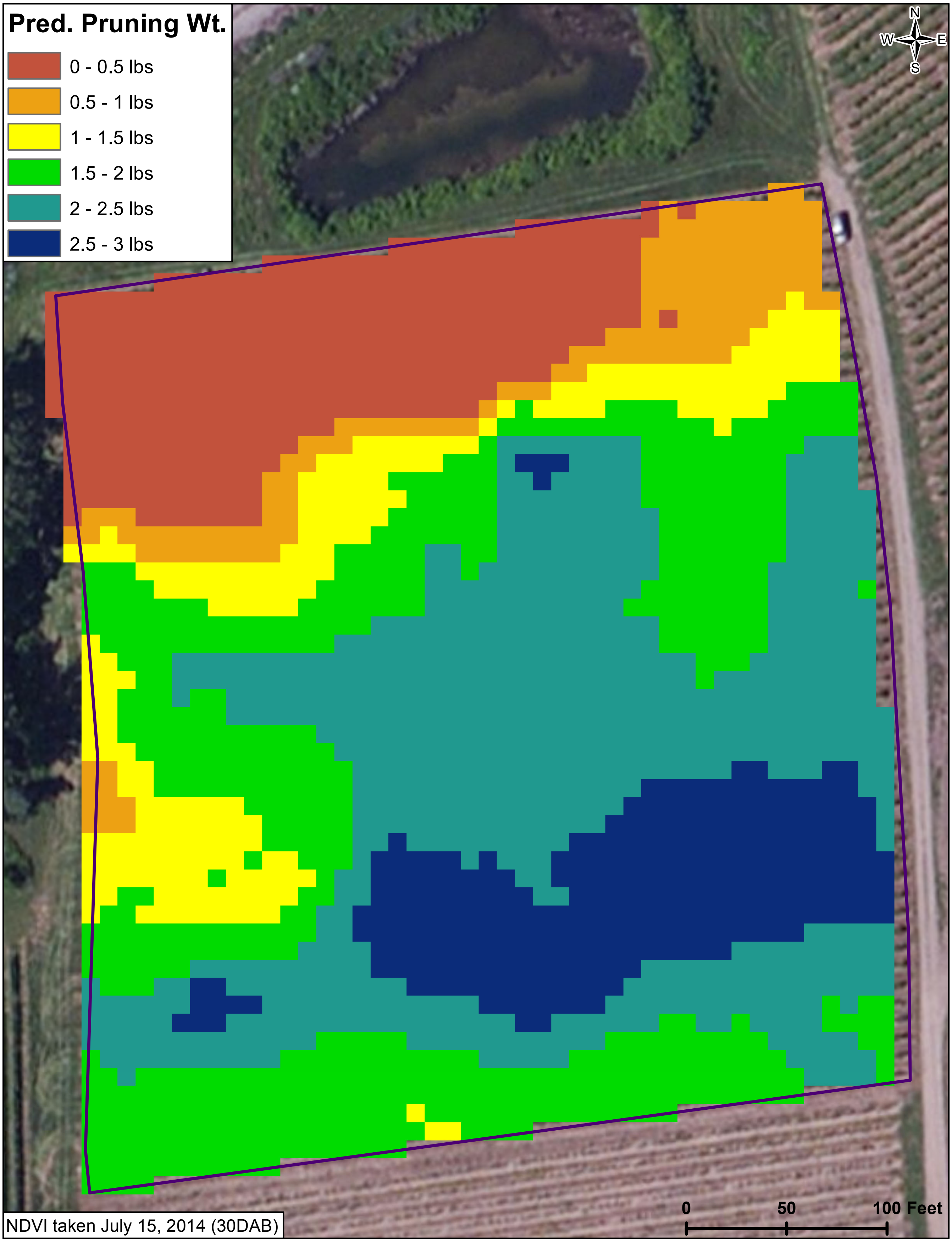

Image1: Sensor data illustrates predicted pruning weights, which correlate with canopy fill, potential yield and long term average yields.

Luke Haggerty
Viticulture Extension Associate
Lake Erie Regional Grape Program

Concord Nitrogen Needs

Luke Haggerty, Dr. Terry Bates, and Dr. Cain Hickey

Nitrogen is the mineral nutrient that is needed most by Concord grapevines. It is also the most widely applied fertilizer. Nitrogen is the backbone of amino acids and, as such, nitrogen is the building block for compounds such as proteins and chlorophyll, the latter, the pigment most responsible for photosynthesis. Nitrogen-deficient vines are often characterized by reduced vigor, crop yield, and photosynthesis. However, excessive nitrogen can cause overly vigorous shoot growth that results in shaded fruiting buds and reduced yields. Nitrogen is a very important nutrient for grapevines, and calculating nitrogen needs is a complicated decision. As such, nitrogen studies have been conducted in Concord for many years.

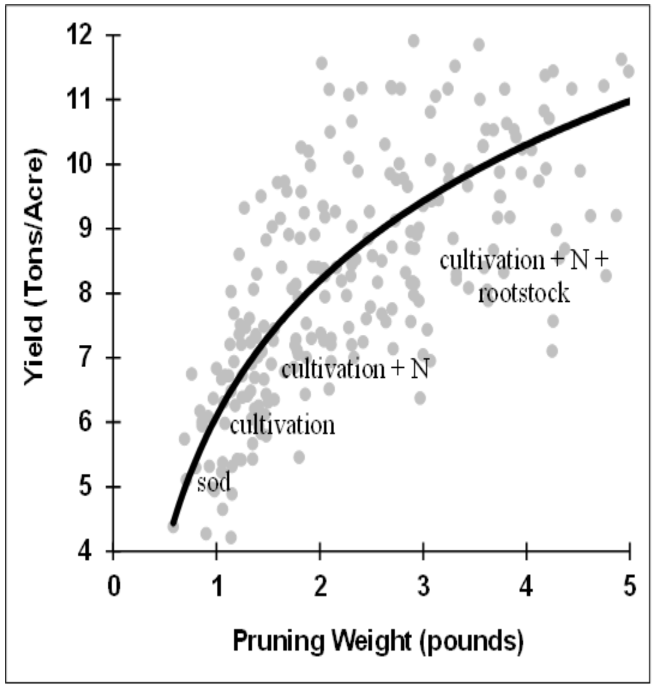

Figure1. The relationship between pruning weight and crop yield as affected by viticulture practices and nitrogen application.

Evaluation of Concord nitrogen needs started with Dr. Nelson Shaulis in the "West Tier" experiment. In this experiment, three nitrogen rates (0, 50, and 100 pounds of actual nitrogen per acre) and several viticultural practices were evaluated for their impact on vine size and crop yield potential. Vines with high nutrient and water uptake had increased vine size, pruning weight and yield potential (Figure 1). It was shown that 50 pounds of nitrogen per acre increased pruning weights (vines size) and crop yield, but adding an additional 50 pounds of nitrogen per acre offered no further benefit (Figure 2). Concord vines in the Lake Erie region typically have less than three pounds of pruning weight, and average less than eight tons per acre. Therefore, Dr. Shaulis concluded that healthy Concord vines required somewhere between 0 and 50 pounds of nitrogen per acre to increase and maintain vine growth and crop yield. (Bates et al. 2002)

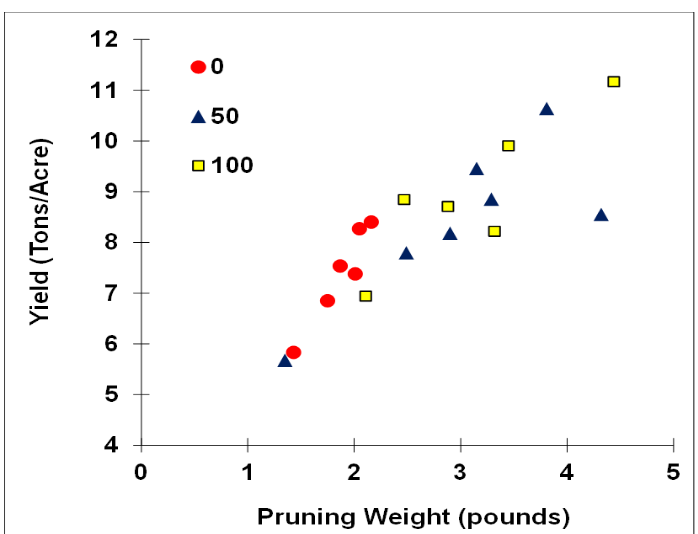

Figure 2. Concord yields compared to pruning weights using three N rates (0, 50, and 100 lbs/acre).

The West Tier experiment was conducted on well drained gravel loam soils with low organic matter. Years later, Dr. Bates conducted the same study, but on heavy clay soils with relatively high organic matter; this experiment was called the "Betts' Nitrogen Trial". Vines were again given 0, 50, and 100 pounds of nitrogen per acre over seven consecutive years. Similar to the West Tier experiment, it was observed that crop yield was greater when 50 compared to 0 pounds of nitrogen per acre was applied, but that applying 100 pounds per acre did not further increase crop yield. Figure 3). It was concluded that soils with high organic matter release more nitrogen and, thus, vines needed less supplemental nitrogen.

In other works, Dr. Lailiang Cheng and Dr. Bates investigated the ability of Concord vines to take up nitrogen, as well as their annual nitrogen demand. It was found that only 24% (24 pounds for every 100 applied) of 50 applied pounds of nitrogen was incorporated into the vine. In other words, vines were only able to uptake ¼ of the applied nitrogen. It was also found that about 50 pounds of nitrogen per acre were required in Concord vineyards. Other research found that only about 10 of 100 applied pounds of nitrogen per acre were incorporated into the vines. (Randall et al. 2004)

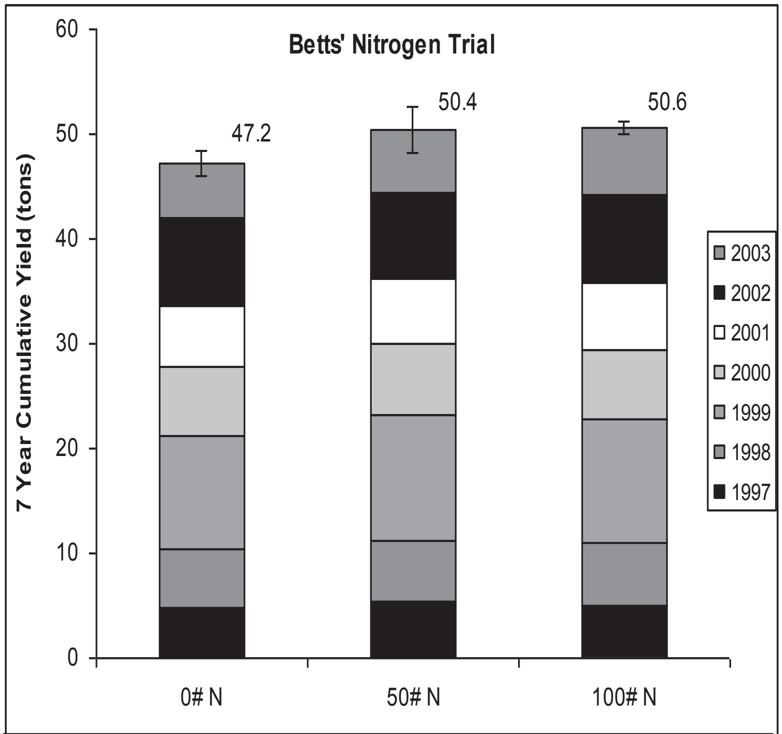

Figure 3. Seven year cumulative Concord yield using three different nitrogen rates (0, 50, and 100 pound of N per acre).

So where does the excess nitrogen go? Some nitrogen is used by macro and microorganisms in the soil, such as weeds, worms, and bacteria. This nitrogen enters the living portion of organic matter and can eventually be used by the vines in the future (remember from above that nitrogen can be supplied by soil organic matter) A very small amount of nitrogen is absorbed into soil particles by cation and anion exchange. The rest of the nitrogen can be lost through leaching, erosion, and denitrification. Nitrogen loss, especially leaching, is getting more attention these days because of its documented negative impact on the environment, such as algal blooms in bodies of water

Concord vines rely mostly on stored starches and nutrients during the transition from dormancy to bloom. Approximately 80% of the reserved starches and nutrients are used for pre-bloom shoot and root growth. Relatively little nitrogen (around 5%) is taken up prior to bloom when compared to what is taken up after bloom. However, this 5% has potential to be important if weak vines have inadequate nitrogen storage reserves. The 5% is less important in healthy vineyards where nitrogen reserves support strong early season growth; this includes new root growth that absorbs additional soil nitrogen.

Reserves are depleted after bloom. Thereafter, Concord vines rely on nutrient uptake from the roots, and assimilated carbon via photosynthesis. The amount of time it takes for supplemental nitrogen to reach the rooting zone is dependent on several factors, including rainfall and, consequently, soil moisture. Thus, it is typical for nitrogen applications to occur around or before bloom, when soil moisture is relatively high. Nitrogen should be applied in split applications in vineyards needing more than 40 pounds of nitrogen per acre; these sites may be characterized by large vines and/or low soil organic matter. The general rule for split application timing is at two weeks pre-bloom, and at two weeks post-bloom.

There are basically three nitrogen sources for grapevine growth: mineralization of nitrogen from soil organic matter, remobilization of stored nitrogen from perennial tissues, and inorganic nitrogen fertilizers. By far, the largest pool of N for grapevine growth comes from the mineralization of soil organic matter. While there are many biological, chemical, and environmental processes working in concert, the basic rule of thumb is that about 15-20 pounds of nitrogen is released for every 1% of soil organic matter in your vineyard (table 1). Storage nitrogen reserves are likely the most easily used by vines because it is already in the vine - it just needs to be converted and remobilized in the spring. Inorganic nitrogen fertilizers are primarily used to supplement nitrogen remobilization and mineralization sources during periods of peak nitrogen demand. Peak vine nitrogen demand occurs during rapid canopy and fruit development, which starts a few weeks before bloom, and lasts until about 40 days after bloom. During this timeframe, the release of nitrogen from organic sources may not be enough to keep up with vine demand. Therefore, supplemental nitrogen fertilizers should be applied just before rapid vine growth, even in vineyards with relatively high organic matter soils. In the Lake Erie region, this critical period of nitrogen fertilization is typically in late May or early June.

	Soil Organic Matter			
	1%	2%	3%	4%
N from Organic Matter	20	40	60	80
Vine N Need (Pounds)	50	50	50	50
Amount of N Needed or Surplus	**30**	**10**	**10**	**30**
Amount of N Fertilizer at 25% Efficiency	120	40	0	0

Table 1. Nitrogen needs based on % organic matter.

References:

Much of the information used for this article has not yet been published.

Bates, Terence R., Richard M. Dunst, and Paula Joy. "Seasonal dry matter, starch, and nutrient distribution in'Concord'grapevine roots." *HortScience* 37.2 (2002): 313-316.

Randall J., Thomas J. Zabadal, and Eric J. Hanson. "Effect of nitrogen application timing on N uptake by Vitis labrusca in a short-season region." *American journal of enology and viticulture* 55.3 (2004): 246-252.

Grape Rootworm and Grape Berry Moth, Why Worry About Them Now? *Tim Weigle, NYSIPM, LERGP*

Grape Rootworm

The traditional timing for scouting for grape rootworm has been the Fourth of July weekend. You go out and if you see the chain-like feeding damage from the adults, throw some DDT (back when it was labeled) in the tank and take care of the problem. This response demoted the grape rootworm from being the primary insect pest of grapes east of the Rockies to a “where did it go” status. Since that time grape berry moth has become the insect pest we time our insecticide programs for, a change which has helped grape rootworm start to make a comeback in New York and Pennsylvania vineyards.

In response to this comeback, the LERGREP, Inc. (aka National Grape Cooperative, Constellation Wine and Walker’s Fruit Basket) in conjunction with the NY Wine & Grape Foundation funded a project starting in 2014 led by Dr. Greg Loeb, Professor, Department of Entomology, NYSAES, and myself to look at the basic biology of grape rootworm, determine alternative materials for use against them, and determine the best timing for the various management tools.

Although there has only been one full year of scouting, meaning the results have not been replicated, last year showed that we may have been waiting far too long to start scouting for grape rootworm. A significant population of grape rootworm were found in 4 of the 10 vineyard blocks during the June 17, 2015 scouting. The more traditional timing of July 2 showed population peaks in only 2 of the 10 blocks involved with the project. Take home message: get a jump on grape rootworm scouting by starting no later than mid-June, especially in vineyard blocks with a history of grape rootworm feeding or an unexplained decrease in vine size. It is important to note that there are a number of reasons for a decrease in vine size so an insecticide application for grape rootworm should not be made until after scouting reveals the chain-like feeding patterns of the adult on sucker growth or in the canopy.

Once grape rootworm feeding has been identified, there are now a number of options available as far as modes of action. An efficacy field trial we conducted in conjunction with Greg Loeb found all four materials used in the trial (Admire Pro, Danitol 2.4 EC, Leverage 360 and Sniper) to be effective against grape rootworm. Armed with this information, Dr. Loeb applied for, and was granted, a FIFRA2 (ee) for each of the 4 insecticides tested. The FIFRA 2(ee) recommendation allows grape growers to use a material against an unlabeled pest (in this case, grape rootworm) in NY vineyards. The FIFRA 2 (ee) recommendations will provide access to materials needed to effectively manage this pest for years to come. By implementing a resistance management strategy of rotating effective materials with different modes of action, materials will remain effective against grape rootworm for a much longer time.

The FIFRA 2(ee) recommendation must be in the possession of the user at the time of application. A copy of the FIFRA 2(ee) recommendation for Admire Pro Systemic Protectant, Danitol 2.4 EC Spray, Leverage 360 Insecticide and Sniper can be obtained from the LERGP offices at CLEREL or on the LERGP website.

It is interesting to note that the foliar feeding by the adult stage of the grape rootworm rarely reaches a level where it causes economic damage. However, this pest spends most of its life as larvae, living life underground and feeing on the roots of the grapevine. This feeding, if left unchecked, can cause a rapid decline in vine vigor. Managing this pest is confounded by the fact that the only materials labeled for use against grape rootworm are for the adult stage.

Whenever I discuss grape rootworm, the question about the use of Montana insecticide for grape rootworm (both the 2F and 4F formulations are registered for use in grapes in NYS and PA) invariably comes up. And since Montana insecticide is an imidacloprid, just like the Admire Pro used in our 2014 study, it seems like it should work, right?

This is where reading the label comes in. First, grape rootworm is not on the label, so using it for that purpose is an illegal application. Second, tank mixing with an herbicide is not on the label, again making this method of application illegal. And while illegal is bad, the most important problem for a grower is, you are more than likely wasting your money by applying it in this manner. Evidenced by reading the label, and confirmed in conversations with Greg Loeb, the need for copious amounts of water to move the material into the soil is needed for the material to be effective. Below is the portion of the Montana 4F label speaking to soil application of the material. Under the Applications section you can see that it can be applied through chemigation (through irrigation), being side-dress shanked into the root-zone (followed by irrigation) or applied in a hill drench (followed by irrigation). The limited rain events that we have had so far this year are a far cry from the amount of water that would be applied using irrigation.

Grape Berry Moth

The last week of May, first week of June, brought reports of the various biofixes we use for calculating when grape bloom will occur. Locust bloom and wild grape bloom are the most often referenced biofixes by growers and can typically be used to estimate grape bloom occurring in the next 10- to 14-days. The occurrence of wild grape bloom as a biofix is also important for determining the start date for the Grape Berry Moth Phenology-based Degree Day model found on NEWA http://newa.cornell.edu. While the model has the ability to predict the biofix date for the start of the model, and has been pretty accurate most years, you have the ability to improve the accuracy of the model by plugging in the date wild grape bloom occurred in your various vineyard blocks. With many of the materials that are being used for grape berry moth these days, a few days here or there can have a big impact on the effectiveness of the materials.

While it seems that it is too early to start thinking of grape berry moth (it is a late season problem, right?) waiting until later in the season will put you in eradication mode that you will ultimately lose. And, even if you are proactive against grape berry moth, we still can see problems at harvest if you do not have a good management strategy. At a Coffee Pot meeting towards the end of May, the comment was made that someone they knew had sprayed six times for grape berry moth and still had problems. In the discussion that followed we (the growers in attendance and the extension team) came up with some of the following potential reasons why this could happen:

It all starts with the site. If the site has a history of severe grape berry moth damage year after year, there should be a plan in place that looks at implementing the best tools available at the correct times. What does that mean?

Choice of insecticides. In the case of a high-, or severe-risk vineyard block, you should choose the most effective insecticide and consider if its longevity fits your spray timing (once a generation or twice using bracket spraying). Spraying an inexpensive insecticide six times will not provide control if it loses its efficacy quickly and leaves fruit unprotected between applications.

Timing of insecticides. Applying even a top of the line insecticide at the incorrect time can lead to poor control. Use the weather and pest model information found on NEWA http://newa.cornell.edu to assist in the correct timing of insecticides for grape berry moth (and fungicides for PM, DM, BR and Phomopsis).

How are they applied? Knowing your sprayer and its ability to provide the type of coverage needed throughout the season is key. If you are not getting good coverage, the effectiveness of the insecticide application is diminished from the start.

Knowing and doing are two completely different things. Andy Muza and I had a conversation about how growers have commented that they are tired of hearing us talk about grape berry moth, early season disease management, etc., but many are still having difficulty with both insect and disease management. In talking to growers, a majority who are involved in the program know the recommended practices. However, it is still interesting to see the number who look at cost of materials above all else and/or treat all of their acres the same.

The bottom line is this, with all of the changes that have taken place in how grapes are grown since I started in 1989, it is impossible to make broad stroke recommendations for grape berry moth, diseases, or for that matter, fertilization. Each operation is different and all the components that make up that operation must be considered. Take a close look at your operation and develop a plan specific for each vineyard block. If you would like assistance, please contact me at thw4@cornell.edu (our phone system is still not working correctly) or Andy Muza ajm4@psu.edu and we would be happy to help.

See photos of Grape Rootworm and the chain like feeding pattern on the next page.

Grape rootworm adult on newly expanded leaf

Chain-like feeding pattern of the adult grape rootworm

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Components of an Insecticide Resistance Management Strategy for Grape Berry Moth

Andy Muza, LERGP & Penn State Extension – Erie County

In the recent article "Grape Insect and Mite Pests – 2016 Field Season" (LERGP - *Vineyard Notes*, May 18, 2016) Greg Loeb provided information on managing grape berry moth. This article discusses **insecticide resistance management** pertaining to grape berry moth control. This topic was covered at the 2016 LERGP Grape Growers' Conference but is worth repeating.

Before talking about resistance management some information concerning insecticide classification and modes of action is necessary. Insecticides are classified based on the similarity of the chemical structures of their active ingredients. Therefore, all insecticides in a certain group/class have similar characteristics. It is the chemical structure of the insecticide's active ingredient that defines how it works (i.e., **mode of action**) at the target site. The **target site** is the location within the insect where the insecticide acts.

Understanding modes of actions can be difficult due to the complex biochemical processes that occur within insects upon exposure. Fortunately, due to the efforts of the Insecticide Resistance Action Committee (IRAC) in classifying the Mode of Action (MoA) of insecticides, and assigning numbers to the mode of action groups, a detailed understanding of how insecticides work is not required. However, a basic knowledge regarding modes of action and the MoA classification scheme is useful for developing an insecticide resistance management strategy.

There are at least 8 different modes of action groups [IRAC Number - **1A, 1B, 3A, 5, 11, 18, 22A, 28**] listed in Table 4.2.2 on page 53 of the 2016 New York and Pennsylvania Pest Management Guidelines for Grapes that are rated good (+++) to moderate (++) for management of grape berry moth.

<u>IRAC Number (Modes of Action Classification)</u> : Insecticides for management of grape berry moth

IRAC NUMBER	GROUP/CLASS	INSECTICIDE OPTIONS
1A	**Carbamate**	*carbaryl* (Sevin)
MoA: Acetycholinesterase Inhibitors – bind to the enzyme cholinesterase preventing the breakdown of acetylcholine. Thus nerve cells continue sending electrical charges causing overstimulation of the nervous system, resulting in death.		
1B	**Organophosphates**	*phosmet* (Imidan)
MoA: Acetycholinesterase Inhibitors.		
3A	**Pyrethroids**	*beta-cyfluthrin* (Baythroid XL), *bifenthrin* (Brigade/Sniper), *fenpropathrin* (Danitol), *zeta-cypermethrin* (Mustang Max)
MoA: Sodium Channel Modulators. Prevent the closing of sodium channels causing continual transmission of nerve impulses leading to tremors and death.		
5	**Spinosyns**	*spinetoram* (Delegate), *spinosad* (Entrust/Spintor)
MoA: Nicotinic Acetycholine receptor allotseric modulators. Nerve action. Activity similar but slightly different from neonicotinoids (Group 4A).		
11	***Bacillus thuringiensis***	*Bt* (Biobit, Dipel, Deliver, Javelin)
MoA: Microbial disrupters of insect midgut membranes.		
18	**Diacylhydrazines**	*methoxyfenozide* (Intrepid)
MoA: Ecdysone Receptor Agonists.		
22A	**Oxadiazines**	*indoxacarb* (Avaunt)
MoA: Voltage – Dependent Sodium Channel Blockers.		
28	**Diamides**	*chlorantraniliprole* (Altacor), *flubendiamide* (Belt)
MoA: Ryanodine Receptor Modulators.		

Components of a Resistance Management Strategy

Cultural Practices

Maintain good weed control under the trellis. Poor weed management resulting in excessive vegetation under the vines can harbor grape berry moth (GBM) pupae (**Figure 1**). Viticultural practices that promote a more open, less dense canopy resulting in better exposure of clusters to sunlight (e.g., judicious use of nitrogen) will not only improve quality of fruit but will enable better spray coverage.

Vineyard area maintenance such as preventing overgrown, trashy areas around the vineyard will reduce overwintering sites for GBM pupae (**Figure 2**). If possible, removal of wild grapevines near the vineyard will decrease potential reservoir sites (**Figure 3**).

Figure 1. *Weeds under the trellis can harbor grape berry moth pupae.*

Figure 2. *Overgrown areas around the vineyard can be overwintering sites for grape berry moth pupae.*

Figure 2. *Wild grapevines near the vineyard are potential reservoir sites for grape berry moth.*

Scouting

Insecticides should be used only if needed. Regular scouting throughout the season is a critical component in determining if and where applications should be applied for GBM. A scouting protocol and assigning a GBM risk rating is outlined in "*Bulletin 138, Risk Assessment of Grape Berry Moth and Guidelines for Management of the Eastern Grape Leafhopper*" - http://nysipm.cornell.edu/publications/grapeman/files/risk.pdf

Timing of insecticide applications using the GBM Degree–Day Model

The GBM Degree–Day Model is incorporated into Cornell's Network for Environmental and Weather Applications (NEWA - http://www.newa.cornell.edu/) and many grape growers in the Lake Erie Region have adopted this model to more accurately time insecticide applications for GBM management.

Spray Application Practices

Obtaining good spray coverage on clusters is critical. Calibrate sprayers **at a minimum** in the beginning of each season. Preferably 2 - 3 times/season as canopy growth increases.

- Use appropriate gallonage, speed, pressure, and nozzles for good cluster coverage as the size of the canopy increases throughout the season.
- Spray Every Row.
- Minimize Spray Drift.

Rotate chemical groups/classes of insecticides

An important component in preventing or delaying insecticide resistance is to rotate insecticides with different modes of action into your GBM spray program**.** Use the MoA classification information above and consult the 2016 New York and Pennsylvania Pest Management Guidelines for Grapes to develop a rotational plan.

Be sure to incorporate GBM selective insecticides such as (Intrepid [**18**]**;** Altacor [**28**]; or Delegate [**5**]) into your spray program which will also aid in conserving natural enemies.

Understanding insecticide modes of action may not be easy but following the IRAC MoA Classification for resistance management is as simple as rotating the numbers.

References:

Brown, A.E. and E. Ingianni. Revised August 2013. "No. 43: Mode of Action of Insecticides and Related Pest Control Chemicals for Production Agriculture, Ornamentals, and Turf." University of Maryland. 13 pp.
http://pesticide.umd.edu/products/leaflet_series/leaflets/PIL43.pdf

Insecticide Resistance Action Committee (IRAC) http://www.irac-online.org/

Suiter, D.R. and M.E. Scharf. Reviewed January 2015. "Insecticide Basics *for the* Pest Management Professional (Bulletin 1352). University of Georgia. 28 pp.
http://extension.uga.edu/publications/detail.cfm?number=B1352

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LERGP Coffee Pot Schedule

May 4- 10:00am Betts 7365 East Route 20, Westfield NY 14787

May 11-10:00am Ann & Martin Schulze-2030 Old Commer Rd. Burt NY 14028

May 18-10:00am John Mason 8603 W Lake Rd. Lake City PA 16423

May 25-10:00am Dan Sprague- 12435 Versailles Plank Rd. Irving NY 14081

3:00pm Peter Loretto-10854 Versailles Plank Rd. North Collins NY 14111

June 1-10:00am Phillip Baideme- 7935 Route 5, Westfield NY 14787

3:00pm Tom Meehl Cloverhill Farm 10401 Sidehill Rd North East PA 16428

June 8-10:00am Earl & Eileen Blakely 183 Versailles Rd. Irving NY 14081

3:00pm- Paul Bencal 2645 Albright Rd Ransomville NY 14131

June 15- 10:00am Leo Hans-10929 West Perrysburg Rd. Perrysburg NY 14129

3:00pm -Evan Schiedel/Roy Orton- 10646 West Main Rd. Ripley NY 14775

June 22-10:00am Archer Pratz 9210 Lake Rd North East PA 16428

3:00pm-Alicia Munch-761 Bradley Rd. Hanover NY 14136

June 29-10:00am Kirk Hutchinson-4720 West Main Rd. Fredonia NY 14063

3:00pm Fred Luke 1755 Cemetery Rd. North East PA 16428

July 6- 10:00am David C. Nichols Farm 1906 Ridge Rd. Lewiston NY 14092

July 13-10:00am Beckman Bros. 2386 Avis Dr. Harborcreek PA 16421

July 20-10:00am Brant Town Hall- 1294 Brant North Collins Rd. Brant NY 14027

July 27-10:00am Tom Tower 759 Lockport Rd. Youngstown NY 14174

6592 West Main Rd., Portland, NY 14769 (716) 792-2800
662 North Cemetery Road, North East, PA 16428-2902 (814) 725-4601
850 East Gore Road, Erie, PA 16509-3798 (814) 825-0900

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Cooperatively yours,

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Andy Muza
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Kevin Martin
Business Management Educator

Luke Haggerty
Area Viticulture Extension Associate

Contact the Lake Erie Regional Grape Program if you have any special needs such as visual, hearing or mobility impairments.

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