The Lake Erie Regional Grape Program

Vineyard Notes

November Harvest Issue 2017

Cornell University
Cooperative Extension

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.

Dates to Remember:

Thanksgiving Break- CLEREL Closed-
November 23 & 24, 2017

December Holiday Break- CLEREL Closed-
December 25, 2017- January 1, 2018

Reporting Session: Thursday, February 15, 2018

2018 Winter Grower Conference: Wednesday, March 14, 2018

A sincere and heartfelt wish of a Happy Thanksgiving and Holiday season to you and yours from all of us here at CLEREL!

Business Management

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

Variable Rate Thinning

Mechanical Variable rate thinning

2017 was a year of highly variable crop sizes and crop loads throughout our region. This trend was consistent within vineyard blocks. This enabled the SCRI project to advance as we continue to learn more about the challenges and successes associated with variable rate management. Variable rate thinning is just one aspect of this project that may be the financial reason sensor technology is adopted in LE vineyards.

The team continues to work hard to make quality sensor data available to Lake Erie grape growers and compatible with existing and future mechanization technology. While the commercialization of sensor technology continues in the private sector, there is still a disconnect between high quality meaningful data and the sale of sensor technology. In order to have a meaningful impact on vine size and vineyard efficiency high quality data is the first step to ensuring that variable rate management is based on meaningful data.

Part of this project also involves learning and developing tools that allow growers to mechanize their application of this data. From an engineering standpoint, variable rate nitrogen is old technology and easy to sell. The commercialization of that technology has already happened. However, a typical vineyard grower, would not likely find any economic impact to that technology.

Our vine size variability rarely relates to nitrogen deficiency. To monetize this technology and make the investment worthwhile we need to focus on crop load. To the extent that this technology allows us to understand the vine size variability and manage yield in a variable way that puts crop load in balance will allow vineyards to produce large (ripe) crops more consistently.

Collection of thinned grapes to weigh for data

Practically, one way of accomplishing a balanced crop load more efficiency, may be with variable rate thinning. As growers are well aware, thinning is a difficult task to manage. It is often fraught with mixed results. By using data to drive the decision-making process and focusing thinning on areas within blocks, we may be able to improve the results of thinning while thinning less fruit.

When comparing thinning with spatial data and variable rate technology, we see a lot of potential. One of the problems we would like to solve is the ability of a grower to accurately measure crop size and quantity of fruit removed. While the tools to do so are mostly there, if we can decrease the amount of sampling required, we may allow growers to improve estimates with less work. This has the potential to reduce thinning mistakes. Growers can unintentionally remove more fruit than desired or less fruit than desired. Since fruit thinning is such a cost intensive operation, increasing the accuracy offers the opportunity to substantially reduce costs.

Cover Crops

Cover Crops in new planting

In 2017 we began wrapping up our work in cover crops, at least for now. We learned a lot about different multi-species combinations, weed suppression and vine size benefits. Having the benefit of a serious drought and at least some mild drought conditions in other years, we also learned the perils of cover crops.

Large vines need lots of water. The combination of well-drained soil and cover crops at inopportune times result in unwanted competition for large vines. The financial costs of decreasing vine size are large and this risk should be avoided at all costs. Think carefully about planting cover crops on any well drained soil. If vine size on a well-drained soil is already large, cover crops are probably not recommended. If you are planting cover crops in those conditions (for weed suppression or nitrogen fixation) be especially careful about termination. Terminate those cover crops at bud break.

It can also be a struggle to achieve fast growth and germination in the fall. Timing for planting, so far, involves a little luck. To improve the ability of cover crops to compete with existing weed populations requires timely termination and a high pH. Cover crops are not recommended when soil pH is below 5.3.

Successful cover crop plantings will likely benefit smaller vines on heavier ground the most. A shortage of water tends to be less of a problem and improving holding capacity may have more immediate benefits on these heavier soils with low organic matter.

Crop Insurance For Bulk Grape Production

Crop insurance education for Lake Erie growers continued into 2017. We focused on disseminating information through coffee pot meetings, newsletter articles and crop updates. With low grape prices we continue to see crop insurance acreage in the region decline. Hopefully through education we can minimize the impact low prices have on a willingness to manage risk.

It can become increasingly important to adjust insurance levels as prices decline much faster than prices that are used for purposes of crop insurance. Crop insurance offers a number of tools to manage risk when grape prices are lower than historical average.

Growers can insure at less than 100% of price. Growers can also insure different blocks at different levels. Growers can purchase the supplemental coverage option and yield exclusion.

These tools allow growers to decrease their level of protection, which will decrease the size of a payout, but not decrease the likelihood of a payout. It may not always be the most advantageous method, but it will prevent insurance premiums from being a burden on cash flow. In preventing a cash flow problem related to insurance, it allows growers to continue to manage risk despite low prices for grapes.

Crop insurance is getting more complex. To help make these decisions growers can check out ag-analytics.com for more information about premium and coverage levels customized to their farm.

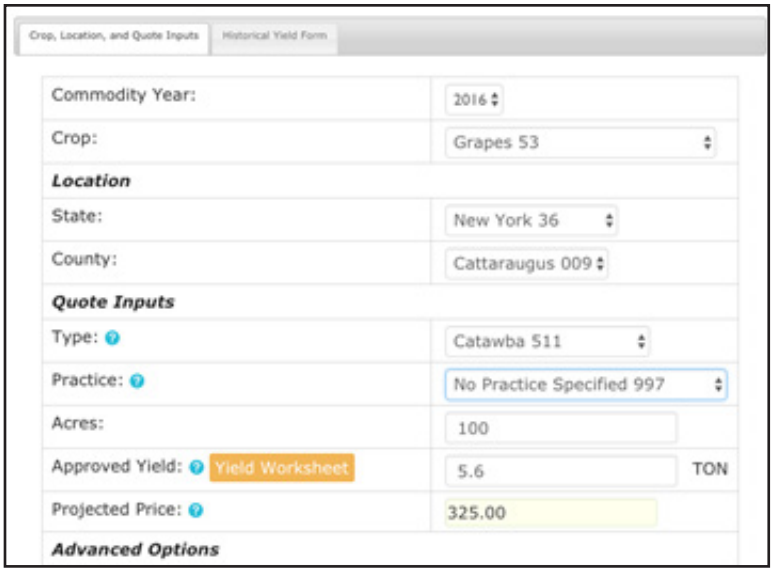


Figure 1. Input variable data to in crop insurance table to find specific premium information for your farm.

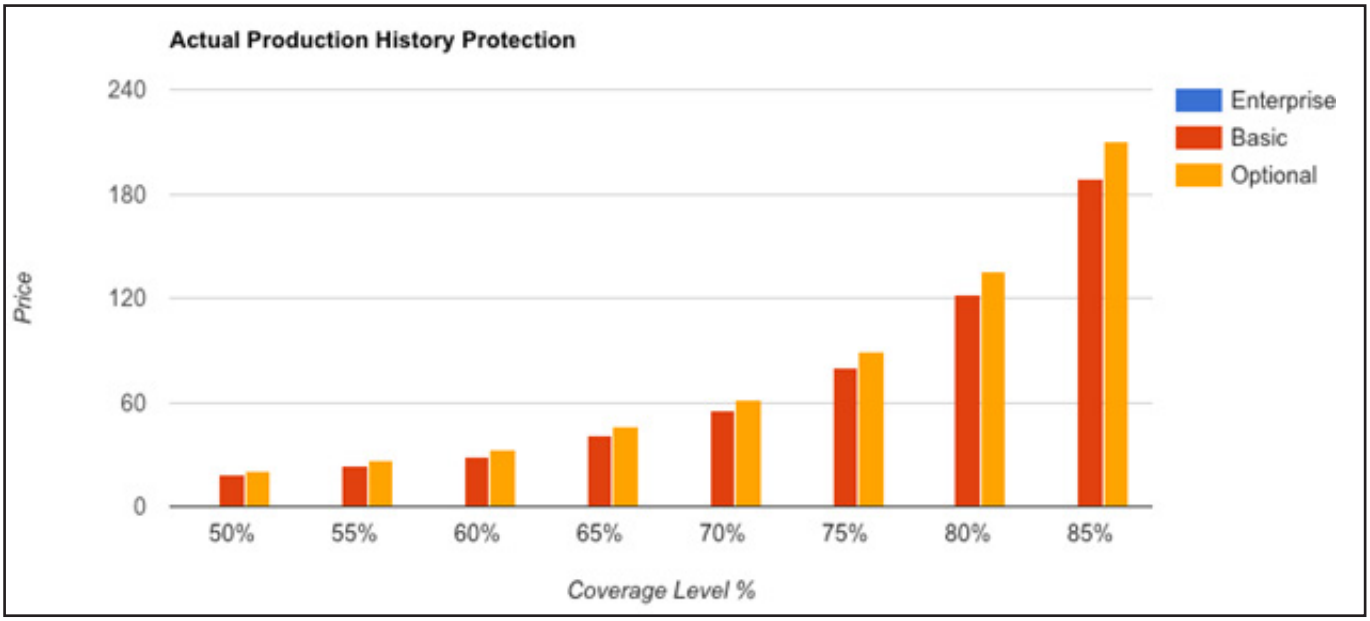


Figure 2. Producer premium is displayed visually showing varying coverage levels. Premiums will vary significantly based on data input into the crop insurance table.

IPM

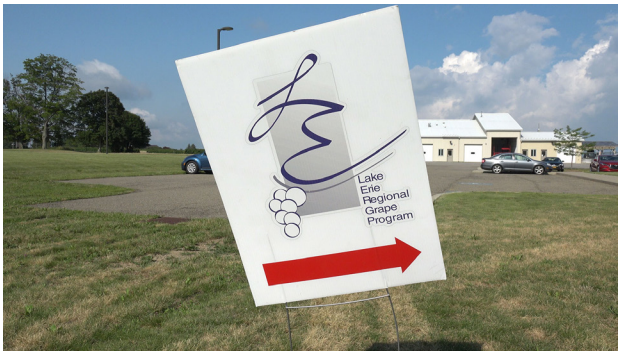
Tim Weigle, NYSIPM, Cornell University, LERGP Team Leader

Lake Erie Regional Grape Program (LERGP) Open House – To celebrate the 25th anniversary of the LERGP an open house for growers, members of the grape industry and the general public was held on Saturday, August 12, 2017. Attendees were able to get a first-hand look at the research and extension activities conducted at the Cornell Lake Erie Research and Extension Laboratory vineyards and hopyards. Approximately 85 people visited with LERGP staff at static displays, in and outside of the building, and took advantage of a narrated hayride of all the activities happening at CLEREL.

Senator Cathy Young presenting 25 year anniversary proclamation to Terry Bates and Tim Weigle

Tim Weigle holding a hop bine and speaking to Open House particpants

Andy Muza at his Open House station



LERGP meeting signage

Coffee Pot Meetings – Weekly Coffee Pot meetings wrapped up for the season in the third week of July. A total of sixteen meetings were held in the 5 counties involved in the LERGP; Chautauqua, Cattaraugus, Erie and Niagara Counties in New York and Erie County in PA and were attended by a total of 265 growers and members of the Lake Erie grape industry. Coffee Pot meetings started the first Wednesday in May with AM meetings only. Coffee Pot meetings provide growers and the LERGP team a chance to learn from each other, as there is no set agenda. Questions from participants guide the conversation and reflect what growers see as the most pressing needs. No two Coffee Pot meetings are the same as meetings are held at grower venues across the large geographical area of the Lake Erie grape belt. Growing conditions, and pest pressures, can be drastically different between Harborcreek in Erie County Pennsylvania and Ransomville in Niagara County New York. Our partners in the Lake Erie Regional Grape Program fund this project.

Spraying Grapes Without a Respirator – A Response to the New WPS Requirements

The new Worker Protection Standard regulations had many growers scrambling to get respirator fit training before the 2017 growing season so they could legally apply pesticides. While many saw this regulation as new, the requirement for respirator use has actually been around as long as the pesticide label has been in place. A common grower question this past year was if it is possible to grow grapes using materials that do not require the use of a respirator? My first thought when asked that question was "Why wouldn't you want to protect your lungs, and potential future health, by wearing one" but that did not answer the question being asked.

The only way to accurately determine if a respirator is required when mixing, loading or applying a pesticide – whether it be an herbicide, fungicide or insecticide, is to read the label for each product being used. There are two main places on the label that will give you requirements for the use of personal protective equipment (PPE). As shown in Figure 1, Precautionary Statements (typically found on the second page of a label) gives PPE requirements for mixing, loading and applying the pesticide while the Agricultural Use Requirements, Figure 2, will provide information on the required PPE for early entry by workers into treated areas as permitted by the WPS. Notice that in both of these examples, no respirator is required for any activity involving the use of the pesticide.

With all the generic materials out there now it would be impossible to determine the requirement for all the materials listed for use in grapes in New York and Pennsylvania. However, in an attempt to start answering the question of whether or not grapes could be grown using pesticides without requiring a respirator, the LERGP team accessed the labels for all of the pesticides listed in the tables of Chapter 8, Pesticides for New York and Pennsylvania Vineyards in the *2017 New York and Pennsylvania Pest Management Guidelines for Grapes*. The results can be found on the LERGP website at http://lergp.com/resources/#1490206840224-615847d3-9832

PRECAUTIONARY STATEMENTS
Hazards to Humans and Domestic Animals
CAUTION

Harmful if swallowed or absorbed through skin. Causes moderate eye irritation. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

Personal Protective Equipment:

Applicators and other handlers (other than mixers and loaders) must wear:

- Long-sleeved shirt and long pants
- Waterproof gloves
- Shoes plus socks

Mixers and Loaders must wear:

- Long-sleeved shirt and long pants
- Waterproof gloves
- Shoes plus socks
- Protective eyewear

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

But please remember… This is not an exhaustive list. THE ONLY WAY TO DETERMINE THE NEED FOR A RESPIRATOR WHEN APPLYING A PESTICIDE IS TO THOROUGHLY READ THE LABEL. Our partners in the Lake Erie Regional Grape Program fund this project.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted-entry intervals. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 12 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is: coveralls; waterproof gloves; and shoes plus socks.

Efficient Vineyard Project. Providing leadership for the extension component of the $6 million NIFA/SCRI project led by Dr. Terry Bates, Department of Horticulture, Cornell Lake Erie Research and Extension Laboratory. The Effective Vineyard website https://www.efficientvineyard.com is on-line and provides updates in the areas of Current Research, Outreach, Project Participants and News (contains a blog, publications and photo gallery). We continue to develop the project web site and are developing a schedule for the main project participants to contribute information to the website via blog and short informational videos. You can also follow the project on Facebook https://www.facebook.com/EfficientVineyard-1105411842849154 This project is funded by USDA/NIFA Specialty Crop Research Initiative.

Efficient Vineyard Is Going On the Road

Outreach for the Efficient Vineyard project outside of the original participating areas was undertaken by Dr. Terry Bates' group when they traveled to Michigan in August 2017. Working with the local Michigan State University Horticulture educator, Brad Baughman and Dave Miller, assistant professor, Michigan State University, Dr. Bates and his group worked with two growers in four separate variety blocks to scan approximately 40 acres. After returning from Michigan, the team worked with Hans Walter Peterson, Cornell Finger Lakes Grape Program, to conduct scanning at a local vineyard and provide a grower presentation to spread the word on the potential to implement the technology developed in the Efficient Vineyard project in growers' vineyards.

As the Efficient Vineyard project goes into its third year, there is an opportunity for extension programs and growers in grape growing areas not originally included in the project to get in on NDVI scanning. A key component of this outreach is working with local extension educators or consultants. Getting an NDVI map will provide little information without follow up on identification of why different management units are occurring.

If you are in the Lake Erie region and would like to participate, contact any member of the LERGP extension team and we will be happy to assist you in getting into our loaner sensor program. A survey of the four growers participating in the Lake Erie region this year showed they were very happy with the program, find it very easy to complete the scanning themselves, and would recommend participation in the loaner sensor program to any grower. This project is funded by USDA/NIFA Specialty Crop Research Initiative.

Podcasts – Provided leadership in the development of weekly podcasts in association with the Lake Erie Regional Grape Program research and extension team. There are currently 41 podcasts that can be accessed through the new LERGP website at http://lergp.com/podcasts/ . A number of the podcasts focus on general vineyard production practices while others are more specific and address nutrition deficiencies, managing vineyard pests, NEWA http://newa.cornell.edu, developing a vineyard IPM strategy and even a travel documentary about CLEREL hops making a trip to Ellicottville Brewing Company (Podcast 35). Our partners in the Lake Erie Regional Grape Program fund this project.

Rootworm scouting

Grape Rootworm –For the third year in a row, weekly scouting has shown first emergence of this pest occurring two to three weeks prior to the Fourth of

July weekend, which is the traditional timing for scouting to determine the need to manage this pest. For the first time in the history of the project, weekly scouting continued into the first week of September for two of the control blocks (received no insecticide applications) as we continued to find grape rootworm adults in the canopy. Growing degree day (GDD) information from NEWA stations in the Lake Erie region is being collected for use in determining the first and peak emergence of this pest to allow for better timing of scouting and management. As shown in Table 1, the use of GDD accumulation to track grape rootworm adults in the 2017 growing season did not compare favorably to the first two years of the project. The only exception is for first emergence with GDD accumulation starting in January.


Adult Rootworm

Table 1. Comparison of growing degree-day accumulation and presence of grape rootworm adults over a three year period 2015 – 2017.

Emergence	Date 2015	Date 2016	Date 2017	January DD			April DD		
				2015	2016	2017	2015	2016	2017
First	June 10	June 21	June 20	642	761	766	642	714.5	741
Peak	June 17	June 21	July 3	784.5	761	991	784.5	714.5	967
Last	Aug 8	July 6	Sept 9*	1778.5	1073.5	2228	1778.5	1027	2203

* Scouting was discontinued after September 9.

This project is funded by the Lake Erie Regional Grape Research and Extension Program, Inc. and NY Wine & Grape Foundation.

Commodity Ag Pest Survey (CAPS)/Farm Bill project. Working with regional grape programs and cooperators in the major NY grape growing regions (Lake Erie, Finger Lakes, Long Island and the Hudson Valley) this project involves 366 traps located in 5 nursery blocks and 36 grower vineyards across the state looking for invasive species with the potential to negatively affect grape production in NYS vineyards. The project wrapped up for the season with no positive captures of target moths reported in any of the regions. A visual inspection for Spotted Lanternfly was also conducted in all 41 vineyard blocks and surrounding vegetation with no sightings reported. This project is funded by the US Farm Bill and NYS Ag and Markets.

Spotted Lanternfly

While not yet a problem in our region, Spotted Lanternfly (*Lycorma delicatula*), an invasive species that is currently established in a few counties in central Pennsylvania, has been shown to have the potential to be a significant pest in grapes. Despite quarantines and extensive eradication efforts by the state of Pennsylvania and the federal government, this pest is rapidly expanding its range. While it has not yet been found in New York or the Lake Erie Region of Pennsylvania, it is expected to make its way north. Penn State has put out a pest alert on Spotted Lanternfly that can be found at http://ento.psu.edu/extension/fruit/pest-alert-spotted-lanternfly.

To get an idea of the size of this pest, check out this YouTube video showing Spotted Lanternfly adults feeding on grapes. https://www.youtube.com/watch?v=vE1QJ4ADV7c


Spotted Lanternfly

Now is an excellent time to look for egg masses of Spotted Lanternfly (see photo). I would not expect to see live adults but you may be able to find dead adults at the base of the plant containing the egg mass.

If you detect Spotted Lanternfly in or around your vineyards, please contact Tim Weigle thw4@cornell.edu, Andy Muza ajm4@cornell.edu, or your local grape extension specialist.

United States Department of Agriculture
National Institute of Food and Agriculture

Hops IPM from Greenhouse to Hopyard – In conjunction with Betsy Lamb, NYS IPM Program, and Steve Miller, Madison County CCE, we started work on the NYFVI grant project. Betsy Lamb is providing the lead for the scouting app portion of the grant with assistance from Lily Calderwood and myself. Research on the use of biological control for twospotted spider mites and alternative weed management strategies are underway in the research and demonstration hopyards at CLEREL. Virtual Hop IPM Meetings were held (using Zoom) every other Monday, during the lunch hour, to allow growers to multitask by attending the meeting while having lunch. There is no set agenda for these meetings. The participants help set the agenda by the questions that they ask. This project is funded by the New York Farm Viability Institute.

A COLLABORATIVE EFFORT – EBC AND CORNELL UNIVERSITY TEAM UP TO PRODUCE HARVEST ALE

-by Tim Weigle

Ellicottville Brewing Company, Ellicottville, NY, and Cornell University have once again teamed up to use hops grown at the Cornell Lake Erie Research and Extension Laboratory (CLEREL) in Portland, NY. Every year since 2013 members of the Lake Erie Regional Grape Program extension and research staff have taken sacks of wet hops to EBC in Ellicottville, NY to assist brewers Dan Minner and James "Miyagi" Antonio in brewing a harvest ale. What makes this beer special is that it can be brewed only once per year as the addition of wet hops can happen only during the hops harvest season. This is due to the use of wet hops, which are harvested and delivered as quickly as possible for use in the brewing process, without any of the additional processing like drying or pelletizing. For the first time since this project began, EBC employees were able to come to CLEREL and assist in the hops harvest.

In years past, the hops varieties Cascade and Chinook were used in all stages of the brewing process – bittering, aroma, and dry hopping at the end. This year, the variety Cashmere replaced Chinook, and a good deal of the Cascade, typically used. Cashmere is known as a dual-purpose hop that can be used for additions of both bitterness and aroma. The aroma characteristics of the hop are intensively fruity and provide flavors of lemon, lime, peach and melon. If you have a good palette you might also be able to pick up coconut, lemongrass and herbs.

Another first this year was a bit of experimentation of how the cones were prepared for immersion into the brew kettle. After all, who at Cornell University isn't up for a little experimentation? Previously, the hop cones were left intact, packed into muslin bags containing approximately 2 pounds each and suspended in the brew kettle. For the 2017 ale, cones were fed through a mulching device in order to expose more of the lupulin glands that contain the oils responsible for the bittering and aroma properties the hops provide. The mulched hops were then placed in the muslin bags and suspended in the brew kettle. For the past four years this harvest ale has gone under the name Hopicity. There was talk on the brew room floor of renaming the brew to better represent the number of 'firsts' that took place this year.

The hops used in this brew are somewhat unique, not only for being local, being harvested and brewed within an 18 hour window, but also because they were grown as part of a project looking at how alternative management practices can be used to control pests. As part of a project funded by the New York Farm Viability Institute, management of Twospotted spider mites using biocontrol was examined in the Cascade planting. The Cashmere were part of the same project but had different weed management strategies ranging from propane weed burners and rotary hoes to hay mulch applied. Tim Weigle, NYS Integrated Pest Management Program, has been looking at ways to manage hop pests using sustainable practices. One of the reasons behind this is that hops are considered a specialty crop so there are limited conventional materials labeled for use against hop pests in New York. Creating Integrated Pest Management strategies for hop growers will allow them to economically manage pests while producing a quality crop. This will be instrumental in ensuring the hops supply needed not only for local harvest ales but also to keep the farm breweries supplied with the hops they need to produce beers from ingredients produced in New York.

The Hopyards at CLEREL are a combined effort of members of the NYS IPM Program and the Lake Erie Regional Grape Program. A short video of our hops taking their annual trip to EBC is on the LERGP website as Podcast 35 at http://lergp.com/podcasts/

LERGP Team members work with James Antonio from EBC to brew fall beer using hops grown on LERGP at CLEREL farm.

PA Update

Andy Muza, LERGP Extension Team, Penn State Extension- Erie County

Vineyard Scouting Network – A Recap of the 2017 Season

Vineyard Scouting was conducted weekly at various sites extending from Girard/Lake City area to North East, Pennsylvania. The objective was to provide timely information, throughout the season, on potential/ developing pest problems in vineyards. Monitoring of vineyard blocks began in May and continued until the end of September. Scouting information along with accompanying photos of pest problems, obtained during the weekly monitoring, were reported in the Crop Update. The inclusion of pictures was to assist growers in accurate identification of insects, diseases and pest injury on shoots, leaves, rachises, and berries.

The following is a recap of scouting information from the 2017 Season which was reported in the Crop Updates from May – September.

DISEASES:

Figure 1. Black, scabby lesions on Concord shoot due to phomopsis infection. Photo: Andy Muza

Phomopsis

The season started out wet (May and June). Due to the cool, wet weather in May, shoot growth was minimal for a period of about a week. We started reporting about extensive phomopsis shoot infections in the region which occurred between the 1" - 3" stage of shoot growth (Crop Update: 5-18-17). No matter which vineyards were checked these shoot symptoms were widespread in Concord and Niagara vineyards. Few fungicide applications were applied in the region during this period (1"- 3" stage) which left vines vulnerable to phomopsis infections. Our initial concern was not only the extent of shoot infections but more importantly infections of rachises and berry stems (Figure 1). Phomopsis rachis lesions can cause girdling resulting in loss of clusters while pedicel (berry stem) infections can result in fruit infections later in the season after veraison. Fortunately, the majority of growers did apply fungicide applications for phomopsis after the 3" stage and through the first Postbloom spray to protect against additional shoot, rachis and berry stem infections.

By the end of September (Crop Update: 9-28-17) I was seeing more browning and shriveling of rachises, browning and drying of berry stems (pedicels) and some shelling which was due to phomopsis infections (Figure 2). Although I did not seen any extensive shelling I would not be surprised if this occurred in some blocks. I would like to hear from growers concerning shelling that occurred in their blocks.

Figure 2. Browning/shriveling of Concord rachis due to phomopsis infection. Photo: Andy Muza, Penn State.

Eutypa Dieback

Symptoms of Eutypa (stunted shoots with cupped, yellowish leaves) were easy to see and scouting for this disease suggested at this time (Crop

Update: 6-1-17).

Black Rot

Black rot lesions were observed on Concord leaves for the first time this season (Crop Update: 6-15-17). Three weeks later black rot was found on Concord clusters at only 1 site (Crop Update: 7-7-17). During the entire season only a small number of black rot leaf lesions and berry infections were found in the vast majority of vineyards.

Downy Mildew

Downy mildew was found for the first time this season (Crop Update: 6-22-17). A leaf lesion was found in a Delaware block and an infected cluster in a Fredonia block. This Delaware block had enough leaf lesions by the end of July, despite the dry weather, to warrant a fungicide application. This was the only site where I have found any appreciable amounts of DM all season. The dry weather throughout the region in July and August kept the incidence of DM from very low to nonexistent in Concord and Niagara vineyards. However, growers were warned to be on the lookout for late season downy mildew because I was starting to find a small number of downy mildew lesions popping up in a few Niagara blocks (Crop Update: 9-7-17).

Powdery Mildew

Powdery Mildew levels were higher this season compared to the 2016 season. Small colonies of powdery mildew were observed on Concord leaves for the first time (Crop Update: 6-15-17) and 2 weeks later were evident on berries. Distorted, cupped leaves near shoot tips (caused by powdery mildew infections) were evident in vineyards throughout the region by the last week in July (Figure 3). By the first week in September, overwintering structures (tiny, black fruiting bodies) were becoming more evident on leaves and rachises infected with powdery mildew.

Figure 3. Distorted, cupped Concord leaves caused by powdery mildew infections. Photo: Andy Muza, Penn State.

INSECTS:

Rose Chafer

On June 6th I was contacted by a grower in North East, PA that a few rose chafers were found in their vineyard. Every year around this time (about a week before bloom) large numbers of beetles emerge from the soil and begin mating and feeding extensively on tender flower clusters and minimally on leaves.

Grape Berry Moth

Although we were a few weeks away from when an insecticide application for the second generation may have been needed (Crop Update: 6-22-17), growers were encouraged to start checking the GBM Degree Day Model in NEWA to track GBM degree days at their sites. Two weeks later on July 5th GBM eggs were found on berries at High and Severe risk sites.

In Crop Update: 8-4-17, growers were advised, according to the GBM Degree Day Model, to "Prepare to scout all vineyard blocks for grape berry moth damage when DD accumulation reaches 1470 – 1620 DD". By the third week in August, although past the recommended timing for an insecticide treatment for the third generation, GBM eggs were not hard to find at a Severe Risk site in Erie County, PA (Figure 4). This highlighted the fact that some egg laying was still occurring at sites with high populations of GBM (Crop Update: 8-17-17).

Japanese beetle

Growers reported seeing more Japanese beetles this season than in the last few years. JB started to show up in vineyards the first week in July (Crop Update: 7-7-17). By the third week of July there was a noticeable increase in population levels in vineyards. Various levels of leaf feeding were evident in vineyards across the region. By the first week of August the Japanese beetle threat was winding down in the majority of vineyards throughout the region.

Figure 4. Grape berry moth eggs on Concord berry. Photo: Andy Muza, Penn State.

Grape Leafhopper

By the third week in July grape leafhopper populations were building on suckers and on the interior leaves of the canopy in some blocks. Both adults and nymphs were present in vineyards at that time. However, by the end of the season, GLH was not a problem in the majority of vineyards. But, leaf injury ranged from very spotty and hard to find to easily visible depending on the block.

Other Problems:

Honeyvine Milkweed

An increasing number of vineyards in Erie County, PA are having problems with this perennial weed. Honeyvine milkweed (HvM), also known as climbing milkweed, that I saw (Crop Update: 7-13-17) ranged from 11 – 17 inches with some just starting to climb vine trunks (Figure 5). In two more Crop Updates (8-17-17 & 9-14-17) growers were reminded to scout vineyards and spot treat for this weed.

Blackleaf/Potassium Deficiencies

Figure 5. Honeyvine milkweed climbing a Concord trunk. Photo: Andy Muza, Penn State.

Blackleaf/Potassium deficiencies were evident in Concord canopies throughout the region (Crop Update: 9-14-17). This was widespread but not unexpected due to the sunny, dry conditions in July and August and high crop loads in some blocks.

PA Update

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

2017 Fungicide efficacy testing at the Lake Erie Regional Grape Research and Extension Center, Penn State University

This year we evaluated a number of unregistered and relatively new products for disease control on juice and wine grapes. For starters, one of our goals was to evaluate products with low mammalian toxicity that pose little or no threat to the environment. These tests were motivated by the ongoing search for disease control products that enhance the healthy profile of the juice grape industry. On Concord and Niagara we took a second look at OSO 5% (polyoxin D zinc salt), Double Nickel (a formulation of a Bacillus bacterium (*B. amyloliquefaciens*)), and Fracture (a polypeptide derived from Lupines), either in solo programs or in rotations with conventional materials. Our focus with these products was black rot and powdery mildew control and they were compared to or rotated with conventional materials, copper, and of course, an unsprayed check. Dry weather in July made for less than ideal conditions for a black rot trial, but we managed (with a little help from hanging black rot mummies in the trellis and some wet weather in June) to squeeze out some decent results (fruit loss of 21% in the checks). Unfortunately, for the second year, our results did not enable us to recommend any of these products for black rot control. The copper fungicide we included (Badge X2) provided modest control (5.5% loss of fruit) as expected, and the ziram of course provided complete control. We did record what I would call 'suppression' of black rot (41% control) with the OSO5% program, but it wasn't significant. And so the search goes on for that elusive 'soft' material that provides commercial levels of black rot control without breaking the bank. On a side note, a tank mix of low rate of copper (less than a pound per acre per spray) and either OSO, Fracture, or Double Nickel, provided 79-88% control of black rot on Niagara grape. However, this occurred under what I would consider relatively modest black rot pressure. All of these alternative materials provided modest control of powdery mildew on fruit and leaves of juice (Concord) and wine grapes (Chambourcin), with OSO5% leading the pack, Fracture coming in second, and Double Nickel, last. This is typical of my experience testing 'soft' or 'alternative' materials over the years; microbial pesticides generally have been less effective than bio-derived materials. Conventional materials like Vivando and Quintec were the overall winners for powdery mildew control.

We also looked at LifeGard (another microbial) and Zonix (a rhamnolipid biosurfactant that works by killing zoospores of the pathogen) for downy mildew control. Again, dry summer weather made for very poor conditions for examining downy mildew efficacy. In fact, our only results came from inoculating clusters and leaves with the pathogen. Previous trials by Wayne Wilcox at Cornell have shown some promise from LifeGard. Unfortunately, we could not reproduce his positive results with our inoculations. LifeGard performed poorly when we inoculated leaves and clusters of Chardonnay and Niagara that had been previously sprayed with LifeGard. One possible explanation for this is that the effect of the material may need to be built up over multiple applications; the product is claimed to control disease by inducing/enhancing a plant's natural defense mechanisms and a single spray may not deliver the same effect as multiple, weekly sprays over a period of time. Unfortunately our field trial with Niagara grape (weekly sprays of LifeGard) was a bust; little or no downy mildew, even in the checks! So, our results represent a very limited look at LifeGard and we will have to take another look at it next year before making any further judgements on its performance. On the other hand, Zonix did quite well. The same tests under which LifeGard performed poorly, showed Zonix to be quite effective against downy mildew. Applying the material to either Chardonnay or Niagara leaves provided nearly complete protection against downy mildew, equivalent to that of mancozeb or ziram. But again, these tests represent a rather limited look at this product and field trials will be the ultimate test next year.

Lastly, we tested some unregistered conventional materials that performed extremely well. Miravis prime, one of the new adepidyn based fungicides from Syngenta provided excellent control of black rot

and powdery mildew. It combines a succinate dehydrogenase inhibitor (SDHI) chemistry (FRAC 7, like boscalid in Endura and Pristine and fluopyram in Luna Experience)) with fludioxinil (an older active ingredient, FRAC 12), that has generally been used to control Botrytis (which we are also evaluating). It should be available within the next year or two, at least for Pennsylvania growers. Last year we examined another new SDHI from Syngenta called Aprovia (solatenol) that is now available to grape growers in PA. As with other SDHIs, Aprovia is quite effective against powdery mildew. It also has some activity against black rot, but with some shortcomings against that disease, and shouldn't be relied on for black rot control on highly susceptible varieties, especially in wet seasons. However, it is also formulated with difenoconazole as Aprovia Top, which we tested this year and found to be excellent against black rot, thanks of course, to the sterol inhibitor, difenoconazole. Unfortunately, it cannot be used on Concord grape and other varieties that are damaged by the difenoconazole (any Syngenta fungicide with the name 'Top' in it contains difenoconazole).

PA Update

Jody Timer, Entomology, Lake Erie Grape Research and Extension Center

Trapping data from 22 traps throughout the North East area indicated that the Grape Berry moth (GBM) population was average to below average this season. First generation numbers were high, however, lack of rainfall may have contributed to the decline in numbers later in the season. We are in the third, and final, season of spray timing trials based on percentage of GBM emergence and its correlation to spring temperatures. Our hypothesis states that the more intimately the GBM spring emergence coincides with grape bloom the greater the survivorship of the first generation of GBM. Consequently, a large first generation emergence would result in subsequent generations, all of which would emerge in the presences of suitable hosts, exponentially proliferating. The data is not fully analyzed but so far the results have shown that two sprays in either July or August work better than one spray. There was also not a significant difference between targeting 50% emergence (what the NEWA model is based on) and 25% emergence. Although this seems like a significant difference, the curve of emergence in GBM is rather steep, consequently 25% and 50% emergence correlates to approximately two days difference in spray timing. Unfortunately, spring emergence all three years coincided with wild grape bloom.

Spotted wing drosophila (SWD) trapping data over the past seven years continue to show SWD emerging earlier each year, increasing in numbers, and overwintering in this region. Research on a variety of grape cultivars showed that SWD was present at the end of the season in all varieties tested, with the exception of the wild native grape. This research also concluded that SWD prefer ripe fruit and rarely attack grapes before verasion. Further experiments have shown that SWD are capable of transferring late season rots to healthy grape bunches.

The Brown Marmorated stink bug (BMSB) trapping over the last five years suggests that their presence in the area is increasing annually. Grapes are one of their preferred hosts and prior research has shown that they are capable of surviving on a diet of grapes. This year is the first season where we found BMSB damage in small patches in vineyards. However, their numbers are not yet plentiful in this area, and they are not yet presenting a risk to the juice grape industry. Wine growers should scout for their presences because they are capable of damaging fruit which opens up pathways for late season rots. Research on their defensive odor when raised on various diets continues. This research hopefully can be utilized to detect stink bugs in import and export materials.

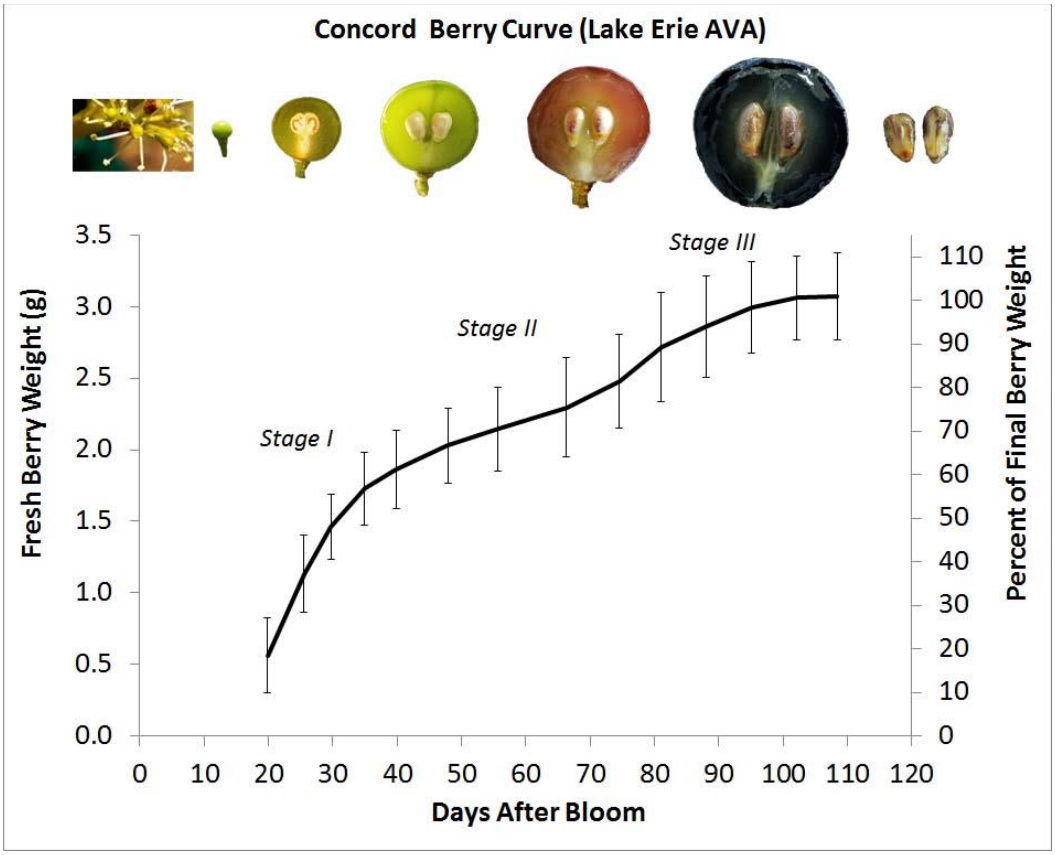
We are completing the second year of research to determine if an optimal insecticide and fungicide spray program applied to extremely high-pressure vineyards is able to of reduce insect and disease injury to acceptable threshold levels. We are also examining the economic feasibility of such a spray program. The first year of this program showed a 60% reduction in insect and disease damage at the vineyard edges and an 85% reduction in GBM damage in the vineyards' interior.

Research

Dr. Terry Bates, CLEREL Director

Seasonal Concord Fruit Development in the Lake Erie Region

Understanding fruit development is important in Concord grape production because fruit is the final agricultural product delivered to be processed into juice and other grape products. Payment to producers is based on fruit yield and juice soluble solids. Controlling crop size in relation to vine size is critical in delivering the highest possible yield of quality fruit. Fruit set and development are influenced by biological and environmental factors and it is important to understand and track how the crop is developing to make appropriate crop control management decisions. This article discusses Concord fruit development from bloom through the three stages of berry growth to harvest during the 2017 season.



Concord Fresh Berry Weight

Each growing season, Concord fresh berry weight is collected from a standard set of "phenology" vines maintained at the Cornell Lake Erie Research and Extension Laboratory in Portland, NY. The curve represents the 18-year mean in berry weight (error bars = standard deviation). Tracking the current season berry weight in relation to the long-term mean assists with a more accurate crop estimate.

Concord Bloom: 6/14/2017

This season, the staff at CLEREL recorded trace bloom in the standard phenology vines on 6/11/2017 and official bloom (50% cap fall) on 6/12/2017. The Concord flower cluster in this image is at over 90% full bloom on June 14th.

Most of the wild grapes you see on the roadside or in the woods have either all male or all female flowers. However, most of the cultivated grape varieties we grow have "perfect" or "hermaphrodite" flowers. Interestingly, cultivated grapes are also highly self-pollinated because the pollen will go from the anther to the stigma before the cap pops off. To catch and rehydrate the pollen, the stigma produces a sap (seen at the tip of the stigma arrow in the picture). Rehydration of pollen takes about 30 minutes and then the pollen uses stored starch in the pollen grain to grow down the style. The speed of pollen tube growth and the time it takes to reach the ovule is related to temperature (roughly 48 hours at 60 degrees F, 24 hours at 70 degrees, and 12 hours at 80 degrees). The colder it is, the slower the pollen tubes grow. Since the ovules are only receptive for a short time, cool weather during bloom can cause the pollen to miss the window and lead to poor fruit set.

Concord Pre-Fruit Set: 6/16/2017 (left) and Concord Mid-Shatter: 6/19/2017 (right)

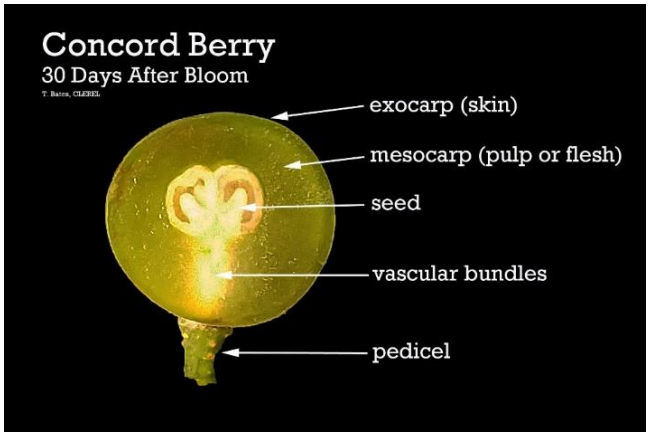
Just after flowering, the pollinated pistils on the grape clusters will start to develop but not all of the ovaries will successfully develop into fruit. This Concord cluster has about 100 developing

ovaries but will only retain and develop 25-30 fruit, on average. Expanding pollen must first fertilize at least one of four ovules while they are receptive. Successful fertilization induces the production of certain plant growth hormones for cell division (auxin) and cell expansion (gibberellin) in different tissue layers. The balance of these hormones is important for the successful retention of the developing ovary. Percent total fruit set is influenced by cultivar and certain management practices, such as pruning level. A variety of environmental stresses (light, temperature, carbohydrate, nutrient, and water stress) can also reduce fruit set. Many of our management recommendations, such as for weed control and mineral nutrition, aim to eliminate any vine stress during the fruit set and berry cell division phase in the 3-4 weeks after bloom. Unfertilized or stressed ovaries will eventually abscise or "shatter."

Just one week after the start of bloom, Concord clusters are setting fertilized berries and dropping others. This cluster has dropped about 40% of the pistils which were originally pollinated but not successfully fertilized. A corky abscission scar can be seen where the pedicel of aborted flowers have separated from the rachis (cluster stem).

Why is it important to track fruit set?

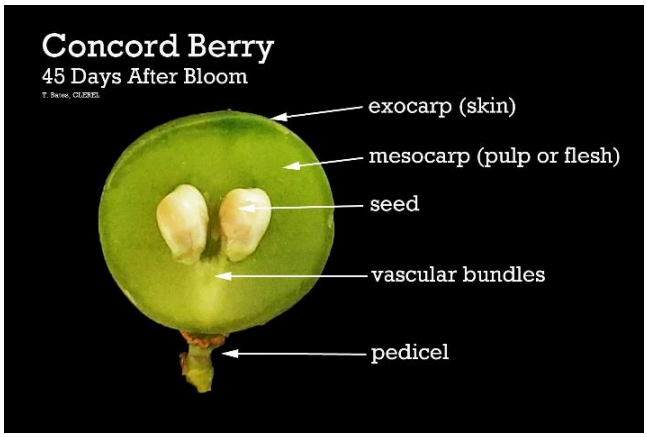
Current research objectives aim to improve mid-season crop estimation. Grape yield is a function of shoots/vine, clusters/shoot, berries/cluster, and final berry weight. These "yield components" can be influenced by biological factors such as vine size and vine water status, management factors such as pruning level, or environmental factors such as temperature during fruit set. Spatial data from the Efficient Vineyard project illustrate how yield components can vary from vineyard to vineyard as well as within a vineyard. We are testing the use of the Carnegie Mellon Image sensor to directly detect and count certain yield components – such as shoot number and berry number across a vineyard. We are also combining this information with other spatial data to direct vineyard sampling during the middle of the growing season to predict final crop size across whole vineyard blocks.



Concord 30 Days After Bloom: 7/12/2017

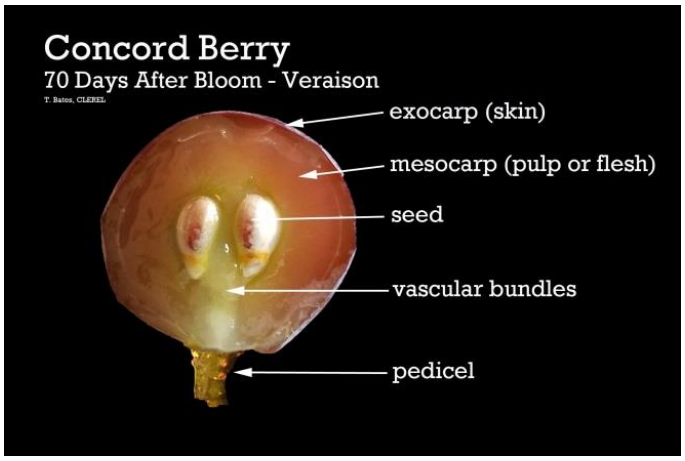
After bloom and fruit set, Concord berries enter a growth phase of both cell division and cell expansion. At 4-weeks post-bloom, Concord berries will reach approximately 50% of their final fresh weight but will still be in the middle of the rapid fruit growth (stage I). Berry size and weight in a cluster, vine, or vineyard varies at both 30 days after bloom and at harvest (as seen in the photo). Variation in berry growth is a function of both cell number (through cell division) and cell size (through cell expansion) – and these are controlled by both biological and environmental factors.

The developing seeds produce auxin, cytokinin, and gibberellin and it is the balance of these hormones which influences the amount of cell division and expansion in the fruit. A berry with more seeds will tend to be larger than one with fewer seeds because of the seeds' influence on cell division and expansion. While all parts of the fruit are developing during stage I, it is the division and expansion of the mesocarp (flesh or pulp) that makes up most of the berry volume. Environmental factors, such as water availability, will also influence berry weight at 30 days after bloom by influencing cell expansion – again primarily in the mesocarp tissue. Cell number will double two times during stage I through cell division. In addition, cell volume will increase through cell wall loosening and the expansion of cell vacuole volume. Presumably, the cell division hormone, cytokinin, diminishes through stage I, which slows cell division as the berries enter the lag phase of berry growth (stage II).



Concord 45 Days After Bloom

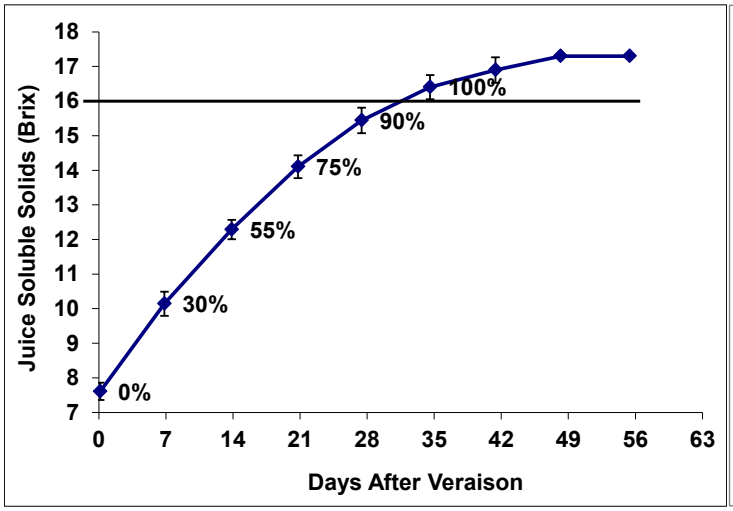
At 45 days after bloom, Concord berries are between 60-65% final fresh weight and are entering stage II of berry development. This stage is also referred to as the lag phase and will last until veraison (approximately 69 days after bloom in Lake Erie Concord). Lag phase is dominated by seed development and maturation. By veraison, the seeds will reach their final size and lignify in preparation for dispersal. The growth of the mesocarp and exocarp slows during the lag phase. Again, it is the balance of plant hormones, such as auxin, cytokinin, and abscisic acid, which controls the cell division and expansion in berry tissues and prevents the seeds from germinating too early.

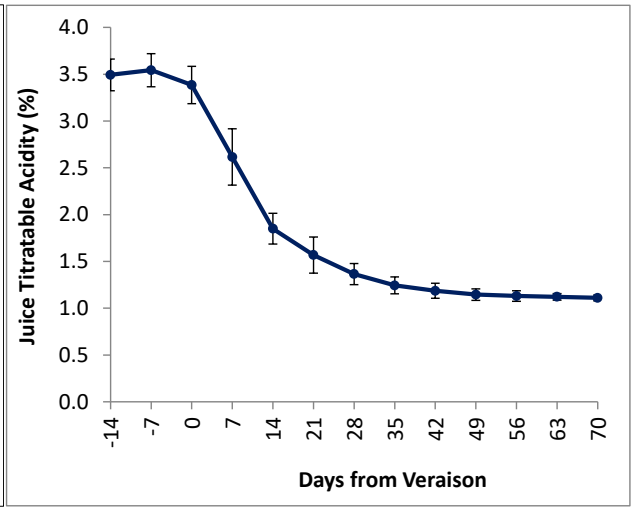


Concord Fresh Berry Weight Development: Beginning of Stage III.

During stage III, the cell walls of the mesocarp change physically and chemically to soften and accumulate water and sugar. The seeds turn brown from tannin accumulation and harden through desiccation and become ready for dispersal. Veraison also triggers the accumulation of anthocyanins (purple pigments) in the grape skins (exocarp).

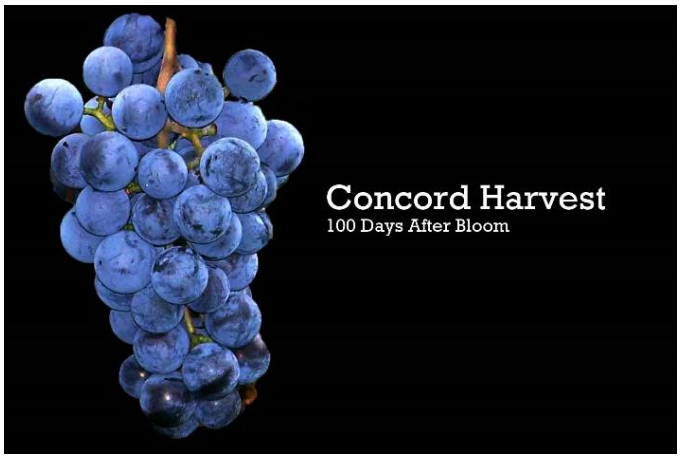
In Stage III of berry development from veraision to harvest, the seeds finish maturing and the fruit ripens to attract animal feeding for seed dispersal. Just before veraison, the berries are hard and green with relatively high organic acid (30 g/L) and low sugar concentrations (7.5 ^{o}Brix). Over a four to five week period from veraison to harvest, Concord fruit will become soft and dark purple with relatively low organic acid (10 g/L) and high sugar concentrations (16 ^{o}Brix). In Lake Erie Concord, veraison occurs 69 days after bloom, on average. Veraison may start a few days earlier in warm, dry years with moderate vine water stress and lower berry weight and it may be delayed in cool, wet seasons with high vine water status and larger berries. Veraison marks a physiological change in the fruit characterized by a rapid increase in water and sugar accumulation in the mesocarp (flesh) and anthocyanin accumulation in the exocarp (skin). There is also a degradation of organic acids and chlorophyll and the fruit will become soft as the cells walls of the mesocarp change and weaken.

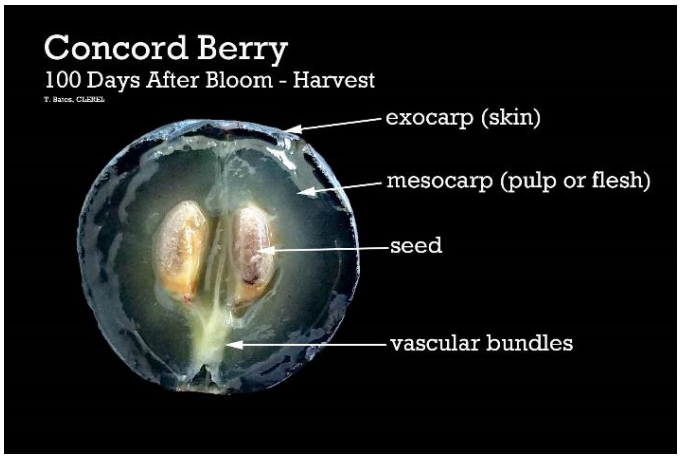




Typical ripening concentration curves of juice soluble solids (left) and juice titratable acidity (right) in Lake Erie Concord.

Desired fruit chemistry for producing single strength juice is 16 °Brix (+/- 0.5) and 1.0-1.1% (10-11 g/L) titratable acidity at approximately 30-40 days post-veraison. Environmental conditions (precipitation, sunlight, temperature) as well as viticulture management (crop load) can influence berry weight and the rate of sugar accumulation.





Concord Ready for Harvest

At approximately 100 days after bloom, Concord seeds are fully mature and the fruit has reached the right sugar, acidity, color, and texture to be eaten by animals and promote seed dispersal. In the processing industry, we use these attributes to harvest and process the fruit into grape juice. Most of the water, natural sugar, and fruit acidity can be pressed out of the mesocarp. The deep purple pigments are primarily in the grape skins and need to be extracted during processing to give Concord products the characteristic purple color. After juice processing, Concord seeds can also be collected, dried, and pressed to extract grapeseed oil.

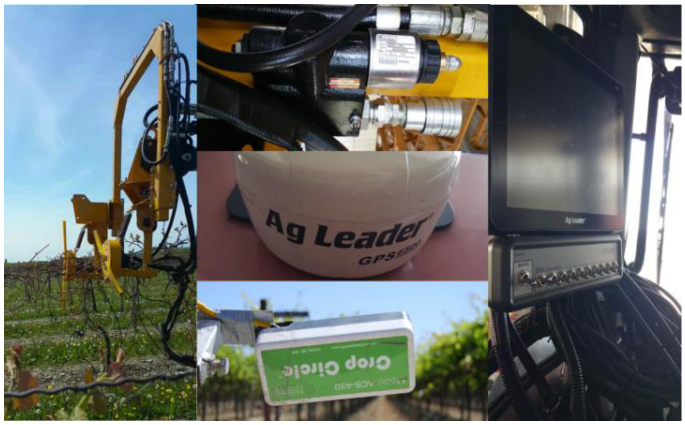
Variable Rate Shoot Thinning Tested in Commercial Vineyards

Jackie Dresser, Rhiann Jakubowski & Dr. Terry Bates

As mechanical pruning gains popularity in the Lake Erie region, crop control becomes increasingly important. Hand pruned vineyards may also need adjustment in crop level, especially if higher bud numbers are left as insurance against the threat of early season frost. The earliest opportunity to adjust crop level after bud break is through mechanized shoot thinning. Using spatial data, collected just after shoots emerge, in tandem with variable rate technology, shoot thinning can be tailored to the variability in shoot number across a vineyard. The CLEREL team tested this method in three commercial vineyards in Harborcreek, Fredonia and Silver Creek.

Components of a Variable Rate System

Mechanized variable rate shoot thinning relies on four major components, the thinner itself, hydraulic flow control, a field computer, and location. The location element is a simple solution and a plethora of options for GPS receivers exist on the market at affordable prices. We used an AgLeader GPS6000 in our system. Our field computer was built by AgLeader (InCommand 1200) and loaded with their proprietary software, but there are many other options commercially available. The field computer is there to provide the digital instructions to the key component of the system, the pulse-width modulation (PWM) valve. The PWM valve is capable of precisely regulating hydraulic flow, which makes the thinning component able to function at variable rates.



Variable Rate Shoot Thinning Components:
1. Tool carrier and shoot thinning heads (OXBO International Corporation), 2. PWM (pulse-width modulation) valve (Raven Industries), 3. GPS receiver (GPS 6000, AgLeader Technology), 4. NDVI Sensor and data logger (Holland Scientific), 5. Field computer and software (InCommand1200, AgLeader Technology)

An NDVI sensor is critical to the process of variable rate shoot thinning, as it is used in conjunction with some manual shoot counting to create spatial maps of shoot density early in the season. These maps are the first step to creating digital instructions that the shoot thinner will follow. Currently, the LERGP offers loaner sensors that can be used as part of membership. Although, it may be a considerable advantage to own sensors to ensure they are available at critical times, as shoot thinning must take place in a very short window to be effective. The entire system pictured above cost about $25,000, but this figure can vary widely depending on what commercial options are chosen.

Variable Rate Shoot Thinning Step-By-Step

Any management decision made in the vineyard should begin with measurement of a dependent variable. In this case, the CLEREL team was interested in shoot number and its spatial variation in the vineyard.

Step 1: Collect spatial data

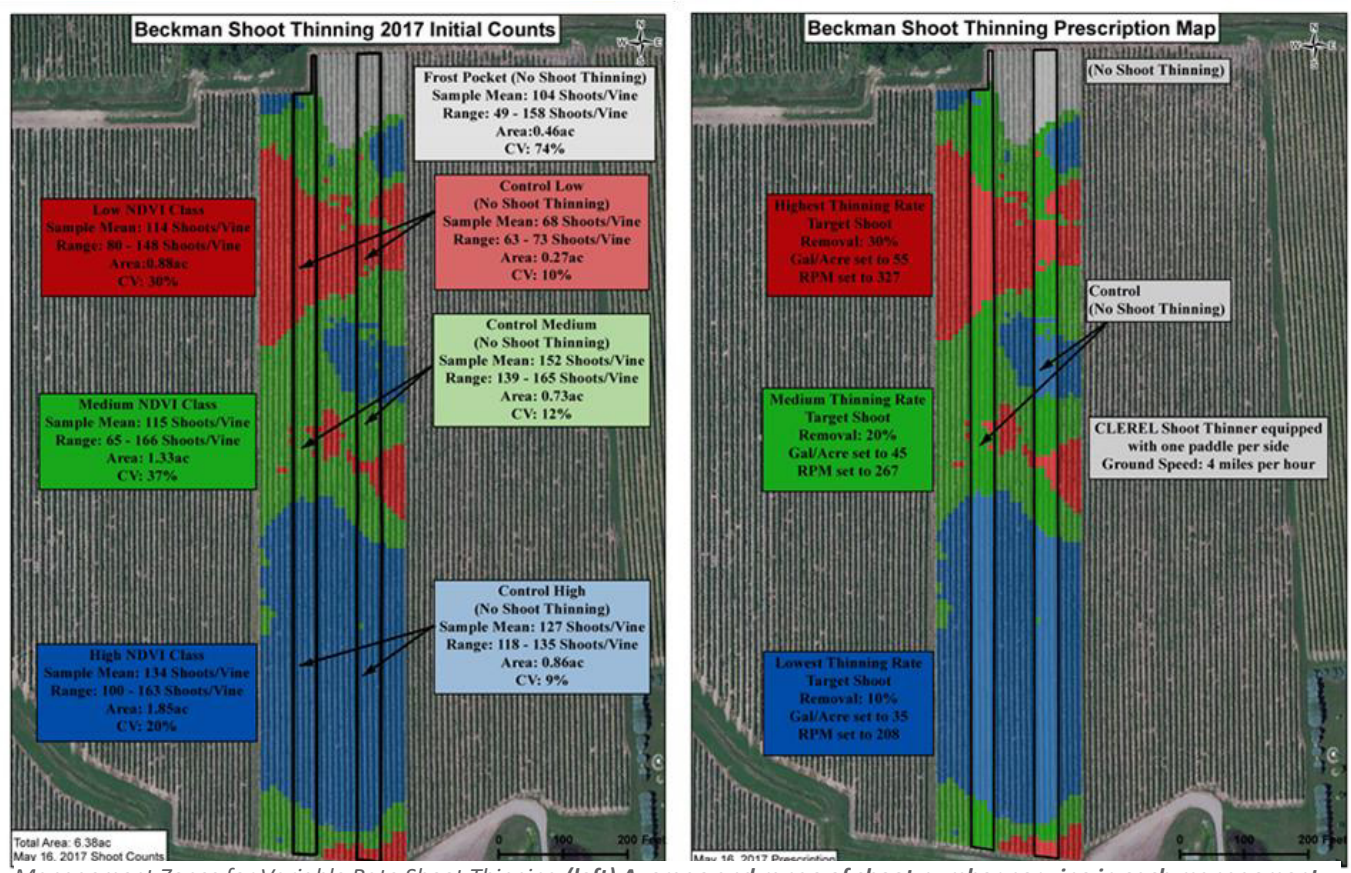
NDVI sensors are sensitive to the unique spectral signature of vegetation, even shoots that are 1”-3” long. Though these sensors are not able to count shoots, these scans provide a relative idea of where shoot density is higher and where it is lower. With a two sensor system with sensors facing opposite rows, driving every third row at about 5 miles per hour should allow 10-15 acres to be scanned per hour.

Step 2: Count shoots

NDVI maps only provide relative information related to shoot density. To get an absolute map, some manual shoot counting is necessary. A sampling density of about three post lengths per acre of vineyard should allow the NDVI map to be converted to a shoot count map. When choosing where to count shoots, it is important to capture the variation present in the relative map, so samples should be spread out to cover areas of low, medium, and high NDVI.

Step 3: Make a prescription map

Equipped with a map of shoot count per vine across the vineyard, a management decision must be made for what levels of shoot thinning will be imposed in different areas of the vineyard. This is most easily accomplished by establishing management zones. Researchers at CLEREL have specific protocols for accomplishing this and are happy to assist with this process. The key objective is to break up a vineyard into



Management Zones for Variable Rate Shoot Thinning ***(left) Average and range of shoot number per vine in each management zone shown to inform management decision. Control area received no thinning. (right) Prescription map provides digital instructions that controls rate of shoot thinning in each management zone***

distinct zones that are different enough from one another to warrant managing them separately. Once this is done, a management decision must be made as to what level of shoot thinning will be imposed in each zone.

Step 4: Implement shoot thinning

This step is the most attractive part of this practice. At this stage, all the operator must focus on is driving and making sure the thinning head is positioned correctly over the trellis. The thinning heads change their speed of rotation autonomously at this point based on the instructions coded in the prescription map. In the field trials, growers had different objectives based on their production goals. Some growers intended to create uniform shoot count across the three management zones, while others used shoot thinning more severely on smaller vines and less severely on larger vines with the intention of balancing crop load. Either way, they were able to do so efficiently and precisely at a whole- field scale using variable rate shoot thinning technology.

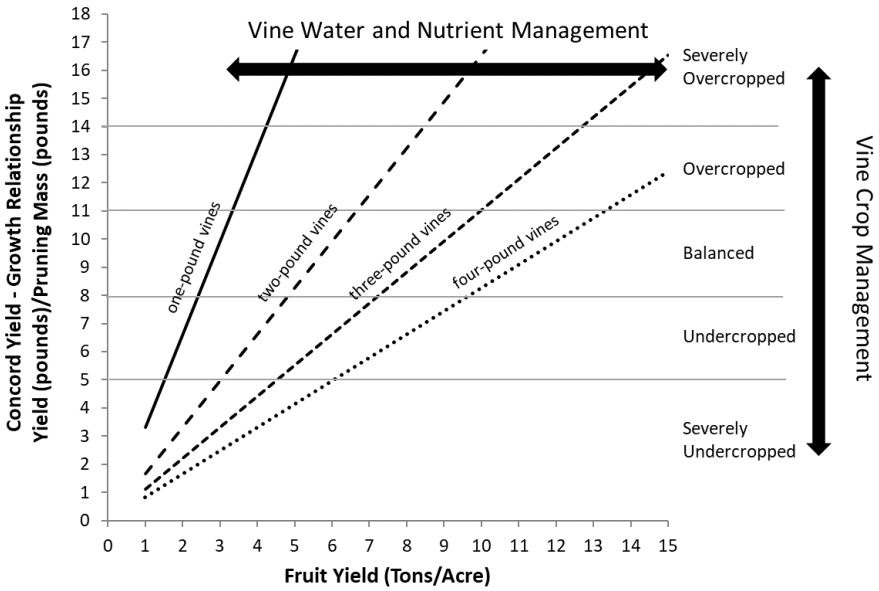
Preliminary Results

For the first full scale field trials using variable rate shoot thinning in Concord, the performance of the shoot thinning units was promising. The shoot thinning units performed within 5% of target shoot removal in most cases. The worst performance (17% from target rate) took place in the first test vineyard and provided a good lesson that in-field calibration was necessary. There was also a large amount of measurement error in manual shoot counts in this vineyard. A change was made moving forward to have the same person count the same vines before and after thinning to reduce the effect of subjectivity in shoot counting. This decreased measurement error from up to 10% down to below 5%.

After shoot thinning was implemented in three commercial vineyards, the CLEREL team tracked ripening and overall yield at harvest. The increased rate of ripening was most pronounced in the machine pruned site which received the most severe shoot thinning (Figure A). The widest difference was in the low initial shoot density zone where 45% shoot removal was coded into the prescription map, with harvest Brix testing almost 3° higher in thinned vs. un-thinned areas. This area, characterized by smaller vines, was ready for harvest before the plant opened, while the un-thinned counterpart did not meet minimum standards at time of harvest. Both the “low” and “medium” management zones saw dramatic increases in ripening rate in this vineyard. Especially given that many growers were not able to meet minimum Brix standards early in the harvest season, variable rate shoot thinning is a valuable tool to increase Brix earlier in the harvest season.

Where shoot thinning may not offer an increase in ripening potential is in areas where crop load is balanced. In some cases, it appeared that vines were large enough to ripen the shoot density set by pruning and did not benefit from thinning. Pruning weight measurements taken this dormant season will confirm vine size and allow crop load to be calculated. Based on previous research at CLEREL, a one-pound vine is balanced at 2-3 tons/acre, while a two-pound vine is balanced at 4.5-6 tons per acre. Vine size was not measured prior to shoot thinning in every research site. However, knowing crop load from last season would offer insight into the shoot thinning management plan.

An increase in Brix comes at the expense of yield in a given season, but may be the best insurance for long term production sustainability. For example, if one-pound vines are loaded with 5 tons per acre of crop, it is likely that the yield will be drastically lower the following year as the vine partitions energy toward ripening an excessive crop rather than building mature wood and storing energy for next years' emerging shoots. This problem is reflected in the annual fluctuations in average yield across the entire Lake Erie region.



Crop Load in Concord ***Balanced Concord vines have a crop load of between 8 and 11. Courtesy of Dr. Terry Bates, CLEREL***

In the field trials conducted this year, the relationship between shoot thinning rate and yield reduction was inconsistent. In some cases, yield was higher in the thinned areas compared to their un-thinned control areas (Figure B). This needs further research, but it is possible that there is some yield compensation from remaining shoots or from secondary or tertiary shoots emerging after thinning. Crop load is another likely factor in this inconsistency. This field trial left the thinning decisions up to the grower, who would benefit from having better information (i.e. Crop Load) to base their decisions on. As archiving spatial data becomes more routine, management decisions should become more reliable, and their results more consistent.

The Big Picture

Shoot thinning provides crucial manipulation of crop level just after bud break. This provides ample time for vines to reap the benefits of a more balanced crop load and may be supplemented by fruit thinning later in the season after crop estimation. While shoot thinning should reduce yield in the current growing season, this will likely be accompanied by an increase in ripening and higher Brix at harvest. Making shoot thinning variable rate allows for variable management of a variable vineyard. A grower should be able to thin smaller vines adequately, allowing them to build in size perennially, and thin larger vines more delicately (in balance with crop load) to ensure profitability in the short and long term.

Smaller vines that are overcropped stand to benefit the most from shoot thinning, both with respect to ripening and increase in vine size and yield potential in the following years. Therefore, it is important to consider crop load when developing a management plan for shoot thinning. Further research will quantify 2017 crop load in the sites where variable rate shoot thinning was field tested and look at return crop in the 2018 season. Areas where vines were overcropped should see diminishing yields and vine size in the coming growing seasons. Areas with balanced crop load should see sustained or increased yield in subsequent years.

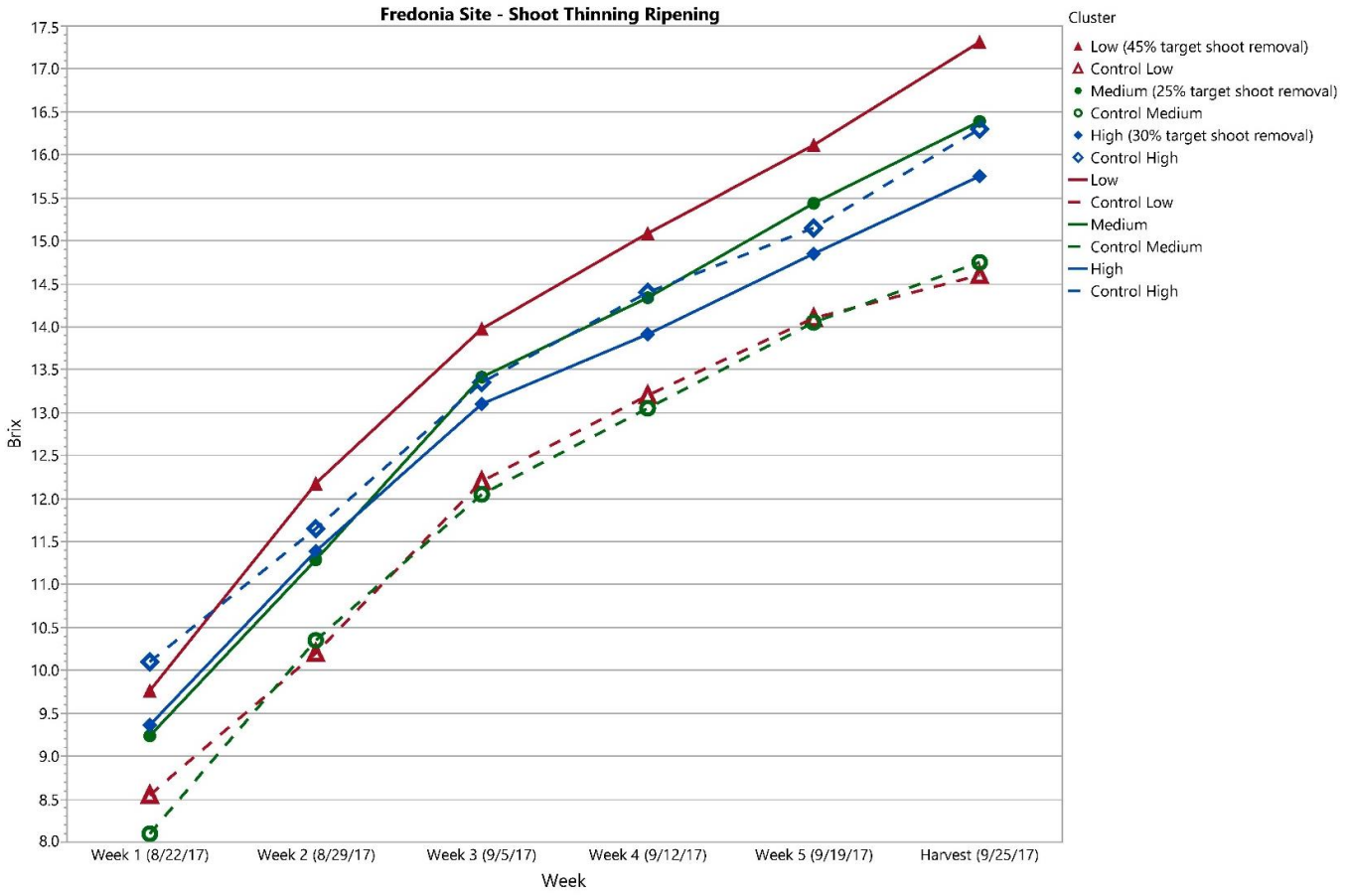


Figure A ***Fredonia Site Ripening by Management Zone. Dashed lines depict ripening of un-thinned vines in each management class. Solid lines represent three thinning levels: 45% target shoot removal, 31% actual (red), 25% target shoot removal, 23% actual (green) and 30% target shoot removal, 29% actual (blue).***

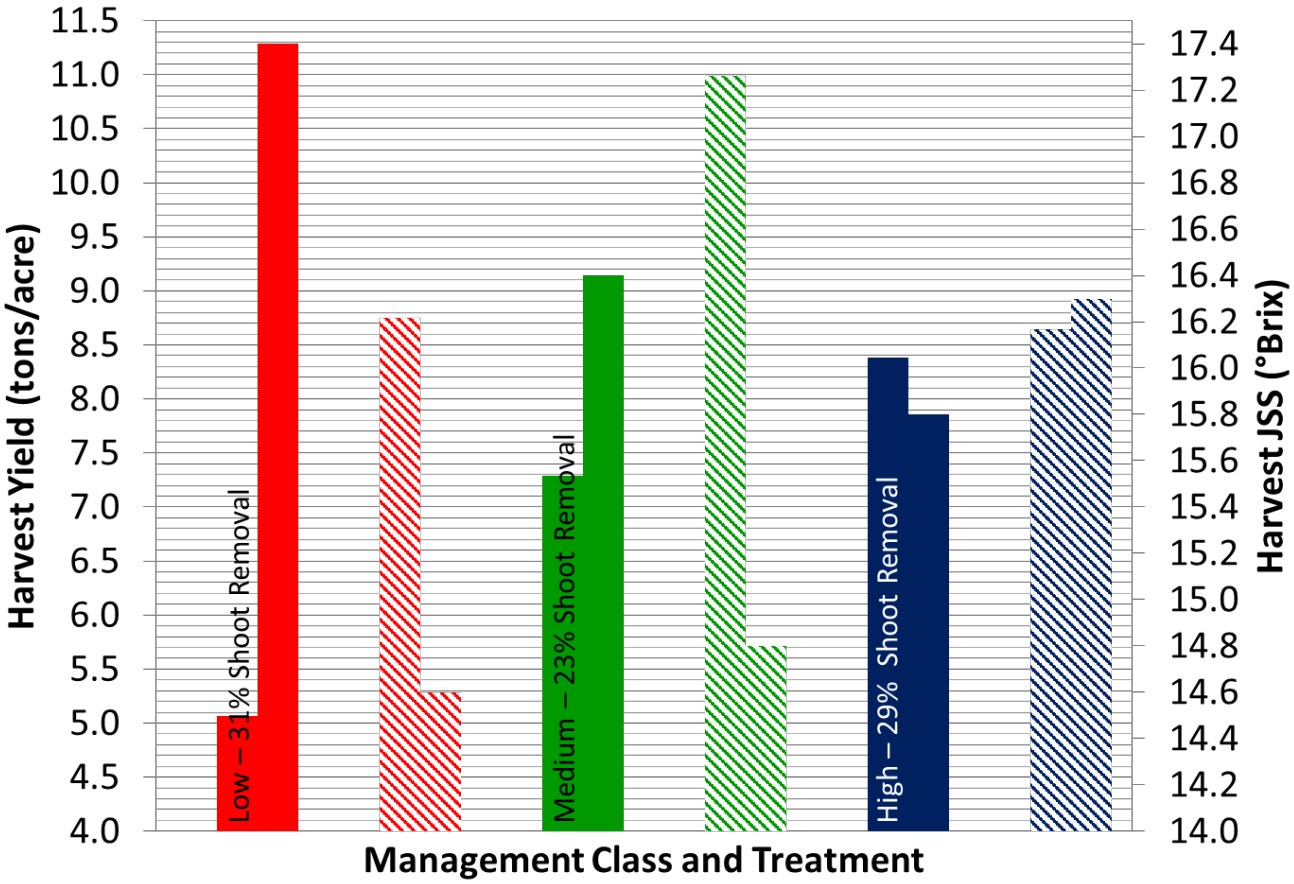


Figure B ***Fredonia Site Yield and Brix by Management Zone. Striped bars show un-thinned vines in each management class. Solid bars represent three thinning levels.***

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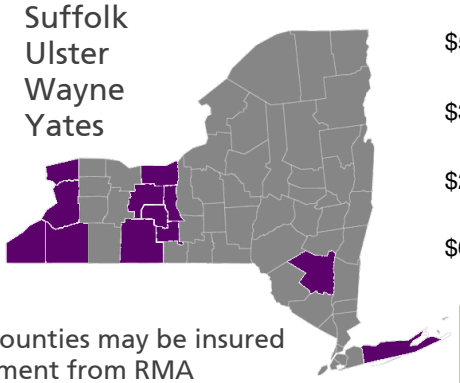
- **Aug. 15, 2017:** Premium Billing Date
- **Nov. 20, 2017:** Sales Closing, Policy Change, Cancellation, Termination Date
- **Nov. 20, 2017:** End of Insurance Period
- **Jan. 15, 2018:** Acreage / Production Report Date

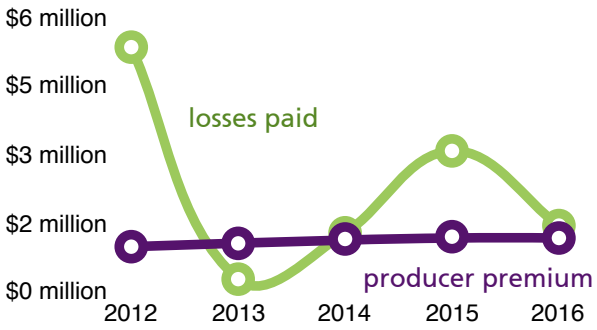
Over 40 grape varieties are insurable in these counties:

Cattaraugus
Chautauqua
Erie
Niagara
Ontario
Schuyler
Seneca
Steuben
Suffolk
Ulster
Wayne
Yates



Grapes in other counties may be insured by written agreement from RMA

NYS Grape Crop Insurance Performance



for every $1 grape producers spent on crop insurance premiums from 2012 to 2016, **they received $2.07** in losses paid, on average

Learn more & sign up:

Explore your personalized crop insurance costs and loss payments under different yield outcomes at ag-analytics.org. To sign up, contact a crop insurance agent. Find an agent using the Agent Locator tool at rma.usda.gov/tools/agent.html

Ag-Analytics.org
@aganalytics

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