Cornell Cooperative Extension
Lake Erie Regional Grape Program

PennState Extension

Lake Erie Regional Grape Program

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Building Strong and Vibrant New York Communities

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

Business Management

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

Cover Crops in Perennials: 2021 Edition

Cover crops pay because cover crops help control weeds. Total floor burn-down is proven to effectively increase vine size and yield in a dry year. Cover crops can be viewed as a tool to make effective total floor burn-down possible and less expensive. Historically, some growers have gravitated toward sod as a row middle management program. Now, I've observed, some growers are using cover crops in a similar way. In a dry year we do not yet know how or what to seed to control weeds without reducing vine size and yield. Like weeds, cover crops need to be terminated to avoid competition for water.

The past couple of years have shown the implementation of some very specific weed management strategies to target problems and reduce overall costs through cover crops. Now we have seen timely termination and reduced weed pressure in a great number of commercial vineyards. What we have learned in the last three years is that using cover crops to increase the effectiveness of total floor management is easily adapted in a commercial setting.

For example, without cover crops it is common to struggle to control marestail in row middles. One option would include mowing 2-3 times with a total cost of $40 - $50 per acre. This option does have a very low impact on cash flow as unpaid labor and tractor deprecation are a majority of the cost. When mowed very short there is some evidence that this does conserve some water even when grasses are allowed to grow all summer. A more effective strategy is the use of rely or cheetah type generic products. While this can be effective it represents the most expensive option. To make two applications of post-emergent weed control materials will cost $32 per grape acre. Application costs will vary between $15 - $30. A total cost for a typical dual tank sprayer would be $47 per acre. A cover crop program may reduce or eliminate the need for marestail control in row middles. Over the course of a year, with a post-emergent row middle program a grower should realize a savings of $15 per acre by switching to a lower rate of round-up on the first row middle herbicide application and eliminating the use of rely in row middles.

To increase the likelihood of realizing a savings by reducing marestail problems it is probably necessary to plant a cover crop seed mix that is vigorous in early spring. One of the better blends to quickly establish cover, control weeds and typically easier to establish is rye grass, radish, and buckwheat. This blend would cost about $18 per planted acre or $12 per grape acre. Switching rye grass to grain rye would lower the materials cost to $15 per planted acre or $10 per grape acre. In some trials, legumes did improve weed control but it does add substantially to the cost. By itself the actual cost in dollars does not represent a significant savings. However, the majority of commercial growers report far superior results.

The value of rye grass biomass is (at least) two-fold. Keeping the vineyard floor free of any competition between bloom and August 1st is very difficult. Many growers don't attempt to do this, other growers try and struggle. The costs of multiple round-up applications and the time required to cover acreage quickly enough creates challenges. Standing, chopped or crimped biomass that is thick enough continues to play a role in weed suppression.

While the termination timing on gravel does not allow for an accumulation of bio-mass that is impressive enough to replace urea use, it can also reduce urea needs. The impact of spring growth on clay soils when frost is not a concern can be most promising. Though water competition is a concern, these soils are generally not as prone to quickly drying out. A termination around bloom, sometimes later in a wet year, can expand the benefits of cover crop. It reduces the window of time for troublesome weeds to grow and can more than double the amount of nitrogen made available to the plant. More efficient uptake in urea may save between $5 - $10 per acre, but only if termination is timely. Much of this savings may initially come from more efficient uptake by the grapes. Eventually, increases in organic matter could offer significant savings.

When cover crop termination is early in dry years, LERGP studies showed larger berries and bigger crops. 2021 does show some potential to be a very dry year, though we aren't there yet. The benefit of superior weed control had an immediate impact of up to one ton per acre in yields. Modest increases in vine size also occurred. Potential yield for the following year improved due to increases in vine size. While net revenue increased by $216 per acre, it was very clear that these benefits were likely driven by specific weather conditions. In other words, we expect similar benefits once every 5-7 years to continue to justify making strong recommendations to use cover crops in vineyards. The ability of the soil to hold additional water this year may not so directly impact crop size with such obvious benefits if we continue to receive adequate moisture. As the science behind global climate change matures, the value of drainage and water holding capacity may increase. We might expect these drastic benefits once every 5 years. It is possible that we will see these benefits more frequently.

It remains challenging to place an economic benefit on improvements in soil health. Soil health changes slowly. It's impact on vine size is even slower than that. We know in non-perennial systems cover crops show impacts on soil health that would have a real benefit on vine size. Trials in those crops lasted longer and are also planted over 100% of acreage rather than 60%. Cover crops also perform differently due to the length of growing season. Our potential to grow cover crops, without interfering with vine performance is a bit shorter than some other crops. While we do not have direct evidence of long lasting benefits in grapes, we have plenty of reason to suspect well managed cover crops can have long-term direct benefits.

Ernst seed supplies a lot of seed for grape growers in this region. They have about 11 choices of clover, 7 choices of perennial rye grass and 26 other legumes, among other choices. The internet and other seed providers have even more choices. Suffice to say the very basic seed mixes discussed above are only the tip of the iceberg. Things can get complicated quickly if you head down the rabbit hole. That rabbit hole can be beneficial and as growers learn more they tend to adapt to mixes that do best on their farm specific soil types. Sometimes these mixes will save growers $1 - $3 per acre. Oftentimes they'll get better results and spend a bit (or a lot) more.

Lessons learned: From Local Growers and Here at CLEREL

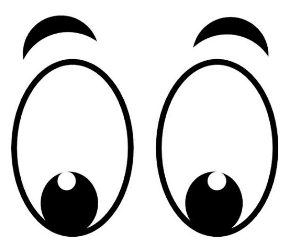
I would avoid legumes all together if soil pH is below 5.0. The cost and benefit of nitrogen fixation is razor thin. If soil conditions do not allow for successful stands a legume is not justified. Almost all cover crops will struggle in low pH conditions. Radish might help move lime down into the soil. Radish and an inexpensive grain or grass might be a better option. When soil pH falls below 4.7 it might make more sense to avoid cover crops altogether.

Crimping and rolling offered a real promise to improve the efficiency of cover crops. For the most part integrating the practice into vineyards has been challenging. By the time crops are ripe enough to crimp, termination should have already happened. The lack of flexibility in termination timing is basically a deal-breaker. If you find a used crimper, you might be able to use it occasionally to justify the investment. I'd let an inexpensive crimper find me, rather than spending a lot of time looking for one. If growers find a way to more reliably integrate the practice into termination, I'll be the first to let you know.

Buckwheat is a good back up to rye grass. Its allopathic effects can temper problematic weeds. It can also outcompete other seeds in the seed mix. It makes sense to lower seed rates with buckwheat, particularly legumes. This may allow you to control weeds less expensively. It may also reduce the progress toward other goals such as soil health and nutrient recycling. Buckwheat is also an excellent stand-alone crop for modest erosion prevention. It can be used in June and July to hold tilled soil together. While that shouldn't be a regular practice we all know that occasionally a vineyard floor is disturbed.

Picture 1: Seeding cover crops with a no-till seeder.

Picture 2 and 3: In one row terminated cover crop. In row two, applicator accidently did not plant cover crop. Plenty of visible marestail.



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Viticulture

Jennifer Phillips Russo, Viticulture Extension Specialist, LERGP

Timing of Grapevine Nutrient Uptake from the Soil and Nitrogen application

The following article is a review of scientific literature to support our recommendations of when to apply nitrogen (N) to your soil for optimal grapevine use, two weeks before bloom and up to four weeks after. In summary, vineyard uptake of fertilizer N may be enhanced by applying N between bloom and up to six weeks post-bloom rather than at budbreak. Based on soil and tissue samples, if more than 50 lbs of N are recommended, then a split application at two before bloom and up to four weeks after would be recommended. Later N applications resulted in more residual N in the soil profile at the time of postharvest sampling with potential for leaching, especially in short growing season regions like the Lake Erie AVA. The timing of nutrient applications should be optimized to increase the vine growth potential and decrease the potential of nutrient runoff and leaching.

Introduction

Nitrogen can be lost from the vineyard system through erosion, denitrification, harvesting grapes, and leaching. Erosion leads to the physical removal of organic nitrogen in the upper soil profile and denitrification is the conversion of nitrate back to gaseous atmospheric nitrogen. Grapes and sometimes wood infected with disease, or just as brush, are removed from the vineyard which also removes organic nitrogen from the system. It is important to understand these processes to develop nutrient application strategies for optimal grapevine use and environmental stewardship.

Excess nutrients in the environment leach out of agricultural systems into the groundwater and runoff into waterbodies. Aquatic and terrestrial plants both use nutrients for growth. Excess nutrients in aquatic systems causes eutrophication, or excess aquatic plant growth, which can form algal blooms. Some algal blooms of cyanobacteria produce toxins and can be fatal to aquatic and terrestrial biota. Harmful algal blooms can be detrimental to aquatic communities and cause trophic cascades. Decomposing algal blooms create oxygen shortages and can lead to anoxic conditions causing death in aquatic communities. Eutrophication can be minimized by regulating the nutrient sources, reducing the use of fertilizers, and proper soil management practices (Khan et al. 2014).

Nitrate leaching is an agricultural concern because excess leaching leads to soil acidification and potential groundwater pollution. Industrial and organic fertilizers both provide ammonium to the soil where the ammonium is oxidized to nitrate and potentially leached. Efforts should be made to make the most efficient use of nitrogen fertilizers by using the appropriate material, rate, and timing for the individual vineyard goals. Your soil cation exchange capacity (CEC) and profile play a role in the nutrient leaching potential. If you have a sandy soil profile with low organic matter (OM), then the sites for nutrient to bind are limited and the nutrients may be bound to the soil water and leach out. Soil management strategies of increasing pH to allow for tightly bound nutrients to be released, increasing soil OM where CEC is low to retain soil water in the soil, and targeted timing of nutrient amendments can improve nutrient leaching and ultimately nutrient availability for the vine.

Commercial grape production is directly related to vineyard water and nutrient availability and vine uptake. At 32,000 acres, The Lake Erie American Viticulture Area (AVA) is the largest grape production region in the eastern U.S. and 80% of the grapes produced are Concord, vitis labrusca, processed for the juice and jelly market and sold internationally, substantially benefiting the local economy.

The Great Lakes are the largest fresh surface water bodies on earth. Many biotic animals, including humans, rely on these waters for drinking. It is imperative that we keep these water bodies clean and free from nutrient contamination through anthropogenic sources including viticulture. The vineyards located in the Lake Erie Regional Grape Program involve the Lake Erie and Niagara AVAs and are located within two of the Great Lakes watersheds, Erie and Ontario. Understanding how grape vines store nutrients in permanent tissues, how much nutrient vines take up from the soil, and how nutrients are partitioned and redistributed throughout the plant is critical to the development of sound nutrient management practices (Pradubsuk et al. 2010) to help the future health of the Lake Ontario and Lake Erie as well as optimal production of your vines.

Grapevine Nutrient Uptake from the Soil

Establishing optimal nitrogen (N) fertilization programs for grapevines for optimal growth and reproduction will aid in reducing offsite impacts of nutrient runoff and leaching as well as provide the vine the necessary soil N when the vine needs it the most. 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. Studies to determine the latter, N fertilizer recovery efficiency, have been conducted with many factors such as: in fields, in pots, with different cultivars, in different growing regions, and nutrient amendments applied at different phenological stages. Researchers use a traceable isotope 15N-labeled nitrogen to discern between stored (reserve) N and N fertilizer amendments (15N) in the soil to track when growth uses stored or soil nutrient uptake. This work directly relates to when fertilizer applications should be timed.

The studies require whole vine harvesting to analyze total nutrient content of each vine part and the efficiency of vine uptake of the labeled 15N located in vine structures. These studies have provided a framework of determining that nutrients are taken up from the soil and have evolved to include the timing of applications and uptake efficiency. Grapevine growth, regardless of variety, generally remains constant, therefore, you can extrapolate information gained from many experiments to develop plans for your own varieities.

One study on 30-year-old Thompson Seedless grown in the San Joaquin Valley of California, looked at vines with drip or furrow irrigation and fertilized with 15N-labeled potassium nitrate or ammonium sulfate for two forms of N (nitrate versus ammonium). This study is important to fertilizer inputs because the form of nitrogen could potentially have different uptake efficiency rates, hence determining the optimal N fertilizer for vine growth which could lead to less runoff and leaching.

In this experiment, the fertilizers were applied shortly after bloom. A single application of 30 kg N/ha (26.8 lbs/ac) was applied because it was the amount removed for the crop the previous year. A set of drip irrigated vines were fertilized 10 times over a 20-week period during the growing season with labeled potassium nitrate in similar amounts. Whole vines were harvested, and all grapevine parts were dried. Then total biomass, N concentrations, and 15N of all vine organs, including the root system, were measured.

There were no significant differences in recovery efficiency, approximately 40%, between the two fertilizer types for the drip-irrigated vines or for the comparison of a single application of potassium nitrate to a split application of that fertilizer applied every two weeks. This indicates that the form of N fertilizer is not a factor in regard to uptake efficiency and nutrient leaching. The recovery of furrow-irrigated vines was approximately 12% (William 2015), suggesting that the method of fertilizer application is also a factor for uptake efficiency. Using this information in your practices would suggest that drip fertigation over the growing season would achieve a 40% recovery efficiency. I understand that this is not feasiable for all varieties, but some of our vinifera growers could increase their nitrogen uptake.

Hajrasuliha et al. (1998) also studied the fate of both 15N-labeled nitrate and ammonium fertilizers applied through drip irrigation in Thompson Seedless, but in 3-year-old vines in California. They applied 50 kg N/ha (~45 lbs/ac). Only about 21% to 23% of the fertilizer N was taken up by plant components during the growing season. Uptake of fertilizer N by above-ground plant components was not significantly different for the ammonium (24.2% of applied N) and nitrate (21.5%) applications. These numbers were similar to Dr. Terry Bates and Dr. Laiilang Cheng's work in Concords where they determined the vine's ability to take up soil nitrogen at an efficiency rate of 24%. This contrasts Williams results of 40% uptake in 30-year-old drip-irrigated vines. It is possible that the mature vines were more efficient at nutrient uptake than the 3-year-old vines. This contrast is important for nutrient applications for different aged vineyard plantings and drip irrigation versus soil applied granular nitrogen.

Conradie also used 15N-labeled to study the distribution and translocation of fertilizer N absorbed, but he added differential timing applications on Chenin blanc potted vines grown outside. One study he applied the labeled 15N during late spring and the other he applied early summer applications on 2-year-old Chenin blanc grapevines in South Africa. The differences between the two previous studies and this one is the cultivar, the age of the vines, location, and in these studies had sand culture in clay pots in the field. The purpose of the pots was to be able to recover all of the applied N that was not taken up by the vines or leached out into the soil profile. The purpose of these studies was to quantify the translocation and utilization of two different phenological stage fertilizer applications at "spring", immediately after bloom, and "summer", at the end of rapid shoot growth when-berries measured 8 mm (Conradie 1990 and 1991).

In the second growing season, labeled N additions were added in the Late Spring trial for a four-week period through drip irrigation to fruit-bearing grapevines. This created a pool of labeled N designated as "spring N". Then the vines were fed normally, sampled periodically, and analyzed over a period of 11 months (Conradie 1990). The other trial duplicated the Spring applied trial except the the labeled N additions were added at the end of rapid shoot growth to veraison called "summer N", in order to quantify the translocation and uptake. These vines followed the same normal fertilization, sampling, and analysis as the "spring N" trial for a period of 10 months (Conradie 1991). In the third growing season, vines were harvested at different phenological stages and the dry mass, absolute amount of N, spring N, and summer N determined.

At the start of the "summer" experiment, the shoots and leaves contained equal amounts of labeled N. This is in contrast to the spring-absorbed N, where leaves contained two times more labeled N than shoots. This data supports the suggestion that leaves are stronger sinks for N during the early part of the season during rapid shoot growth. During the post-harvest period, summer-absorbed N migrated from the shoots and leaves to the woody structures, with leaves showing a comparable loss and shoots a larger loss when compared to the data for spring-absorbed N. The amount of labeled N in the entire vine showed a loss of 7.3% between veraison and harvest and a further 7.3% up to the start of leaf-fall. This was more than the losses found for spring-applied N and has been attributed to the effect of root exudates and gaseous losses by leaves and shoots (Conradie 1990 and 1991).

It was clear that spring- and summer-applied N are utilized equally from veraison onwards, resulting in the clusters and the permanent structure containing equal fractions of the labeled pools (Conradie 1991). These studies suggest that late spring applied nitrogen was used to drive growth of vegetative and reproductive growth. Per Conradie, the fate of N absorbed during a specific period cannot be quantified in field trials because some of the applied N is retained in the soil and is absorbed at a much later stage, hence the use of the clay pots.

The previously mentioned studies have long growing seasons unlike ours. Another labeled N experiment conducted by Vos et al. (2004) investigated how timing of N application in a short-season region affects the nitrogen use efficiency (NUE) of V. labrusca grapevines and the fate of fertilizer N that is not used by the vines. They studied both Niagara and Concord grapevines. This trial varied because they used in field vines, controlled the double-labeled 15N amendments immediately followed by 2.5 cm of sprinkler irrigation and plastic application to control for rainwater. They later removed the plastic from the trial and conducted the Concord trial without it, due to possible changes in vine growth with varied soil temperatures triggering early root activation. Therefore, the Concord trial without plastic is focused on in this review.

Vines were pruned to a maximum of 65 nodes per vine and umbrella trained. The experimental nutrient timing application treatments applied 43.8 grams of double-labeled N per vine at either budbreak (BB) on May 14, bloom (BL) on June 9, or six weeks after bloom (6WPB) on July 29. Irrigation immediately followed and an additional 2.0 cm of irrigation was applied once in the growing season during a drought period on July 22. Harvest occurred on September 24 and all above vine tissue was collected on October 1. The roots were excavated on October 8 and 10. Soil Samples were collected 1, 15, 29, and 43 days after each fertilizer treatment to track movement and persistence of the labeled N in the soil. This experiment differed from earlier mentioned by short growing season in cool climates with the addition of late season nutrient application.

Yields in 2002 were typical of commercial levels in that region (overall mean 11.7 t/ha or 4.7 tons/acre). The dry matter of vines and individual vine tissues was not significantly affected by the time of N application. Excavation of roots to a depth of 90 cm indicated that 94.7% ± 2.5% of the roots recovered were in the top 45 cm of soil. The total N content of roots as well as the uptake and distribution of fertilizer N within vines was influenced by time of N application. The nitrogen use efficiency was significantly higher in the bloom (16.7%) and 6WPB treatments (14.8%) than in the budbreak treatment (9.8%) (Vos et al. 2004). These results indicate that in regard to timing of N fertilizer for optimum uptake and the potential to reduce anthropogenic nutrient pollution, should be applied at grapevine bloom. Partitioning of labeled isotope 15 fertilizer N taken up by the vines to the fruit, leaves, and roots was significantly influenced by the time of N application. The largest percentage of budbreak N application allocated to the leaves, more than Bloom and 6WPB. The largest allocation of bloom applied N was in the roots closely followed by the leaves, but the 6WPB allocated more N to the roots than bloom and less to the leaves than bloom.

Fertilizer N was present in the leaves of vines bordering treated vines immediately adjacent to, diagonally across in adjacent rows, and straight across in adjacent rows. The fertilizer N levels remaining in the soil three weeks after harvest in October were higher in the 6WPB as the time of application was later in the growing season. The 0 to 90 cm soil profile contained 13%, 35%, and 61% of the fertilizer N applied at budbreak, bloom, and 6WPB, respectively (Vos et al. 2004). Even though there was less labeled N in the soil after harvest in the budbreak application, this could be a result more opportunities throughout the growing season for erosion or leaching since the uptake efficiency was less than 10%.

The inorganic component of soil N varied considerably following fertilizer applications. On the day following all times of fertilization there was a higher proportion of ammonium-N to nitrate-N in the soil compared to later times of sampling. Levels of inorganic N rapidly declined two weeks after the fertilizer application except for the bloom N application, but there was less rainfall during that period. Precipitation during the 43 days after N applications totaled 19.3, 14.0, and 18.0 cm for the budbreak, bloom, and 6WPB treatments, respectively (Vos et al. 2004). The amount of rain throughout the entire growing season monitored would allow for more budbreak nutrient leaching opportunities over the later applications.

Grapevine Nutrient Partition and Redistribution

Different seasonal growth, carbohydrate, and nutrient patterns have been studied in different varieties, at different vine ages, climate, in different soils and under different growing conditions (Conradie, 1991, 1992. Vos et al., 2004. Williams, 2015. Hajrasuliha, 1998. Vos et al., 2004.). The patterns of grapevine growth, generally, remain constant. The growing season begins with bud swell, bud break, rapid shoot growth, bloom, fruit set, berry development, veraison, harvest, leaf fall, wood maturation, and dormancy. Another study conducted by Bates et al., (2002) destructively harvested three-year-old Concord grapevines at eight different phenological stages. This study added a level of nutrient concentrations in the whole vine and its parts at eight different times in the growing season.

To this end, N appeared to be mainly partitioned among woody tissues (32%–33%), leaves and shoot tips (25%–27%), and clusters (32%–34%) at harvest (figure 2 below). Based on nutrient uptake and redistribution patterns of N, P, and K, it is implicit that if fertilizer supplements are need, they should be applied before bloom, but not before budbreak because the grapevine has no need at this stage and excessive rainfall or irrigation may cause unwanted leaching of soluble nutrients. Split-application of fertilizers could enhance the efficiency of nutrient use in growth and production. In addition, fertilization is not required at postharvest for this crop in cool climate regions, as uptake does not occur after harvest (Bates et al. 2002).

Maintaining an appropriate nitrogen status is based on experience, vine performance observation, and use of bloom-time petiole analysis of nitrogen concentration. Once a deficiency is detected, it will require time to correct.

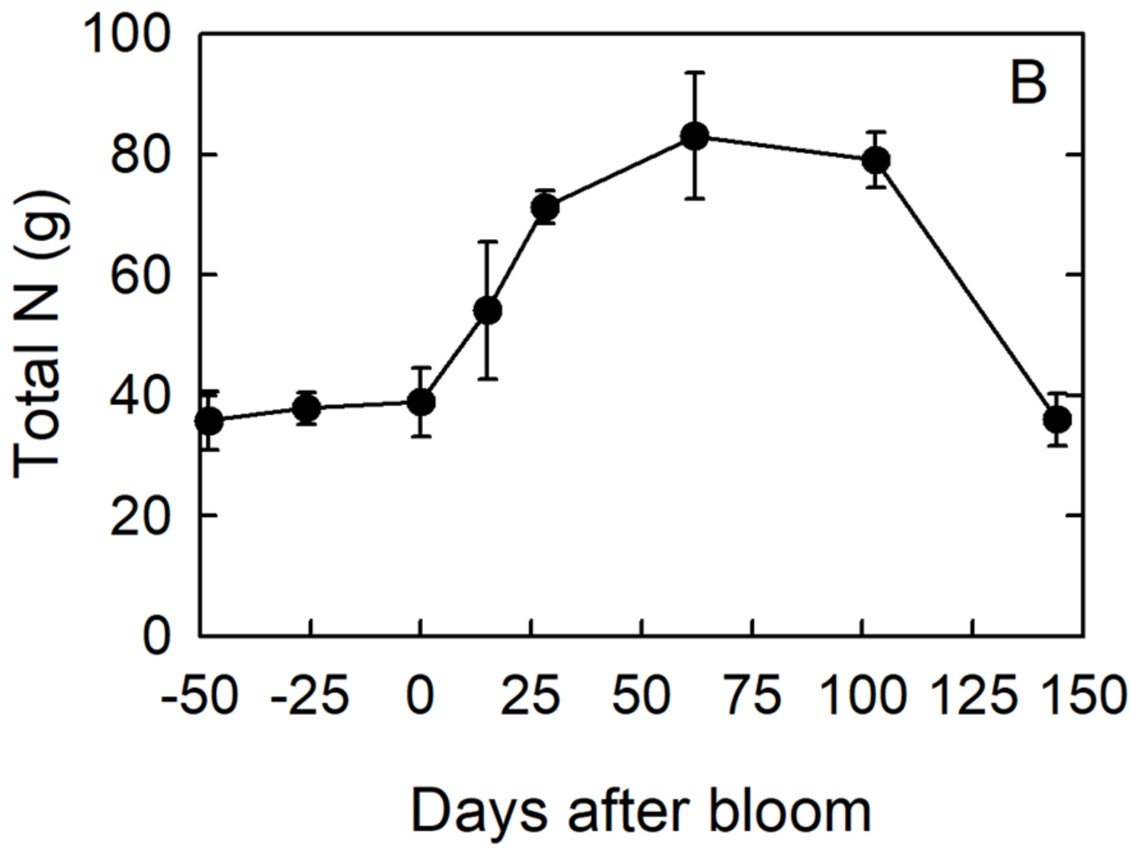

Figure 1. Graph of Total Grapevine N in grams at different points in the growing season

The above graph is from Dr. Terry Bates' research on Grapevine Mineral Nutrition. Note the beginning of the curve on the graph is at 0, which is bloom. Concord vines demand and will take up large amounts of nitrogen during periods of rapid growth and with sufficient transpiration rates. More specifically, bloom to veraison, which corresponds well with the curve beginning at bloom on the graph above. Remember that the nutrition reserve in the roots have fed the vines up to this point. We supplement nutrition during this period of rapid growth.

N appeared to be mainly partitioned among woody tissues (32%–33%), leaves and shoot tips (25%–27%), and clusters (32%–34%) at harvest. Based on nutrient uptake and redistribution patterns of N, P, and K, it is implicit that if fertilizer supplements are need, they should be applied before bloom, but not before budbreak. Nitrogen applied to the grapevines at budbreak may not be absorbed as readily as later in the season because the grapevines may not have a strong demand for soil-derived N at that time. Nitrogen applied at budbreak may be lost from the root zone before significant uptake occurs at bloom. Uptake and utilization of soil-applied N was slow during the period budbreak to bloom compared to the period fruit set to veraison.

A similar study investigated the seasonal patterns of macronutrient uptake and redistribution in whole 42-year-old own-rooted ‘Concord’ vines. The difference in this study from Bates et a., (2002) was the age of the Concord vines, the location, and the site was a furrow-irrigated fine sandy loam. The results showed that the seasonal dynamics of nutrient contents shared a consistent pattern: translocation of nutrients from woody tissues to actively growing organs at the beginning of the season; nutrient uptake from bloom to veraison (P and Mg in 2006), bloom to harvest (N, P, K, and Ca), or veraison to harvest (P and Mg in 2007); and nutrient movement to woody tissues occurring after veraison until leaf fall with no further nutrient uptake (Pradubsuk and Davenport 2010). These studies on how nutrients are partitioned and redistributed throughout the plant throughout the growing season are critical to the development of sound nutrient management practices to reduce nutrient runoff through erosion and leaching out of the soil profile.

The majority of N uptake that occurred at veraison and continued through harvest was largely driven by the large canopy and high crop load. There were sufficient N reserves in the woody tissues for the mature vines to use for growth in the early season. In addition, the long period of fruit ripening and short postharvest period in this cool climate facilitated a prolonged uptake period and rapid nutrient remobilization back to woody tissues during active vine growth (Pradubusuk and Davenport 2010).

Cheng and Xia (2004) studied young potted Concord grapevines to determine the use of N fertigation during active vine growth in summer and foliar urea application in the fall to alter reserve N and carbohydrate status to discern which drives vegetative and fruiting growth the following season. The findings determined that a large proportion of the N taken up during active vine growth is used for structural growth and is less available to replenish storage reserves. It also agreed with other studies that when vegetative growth stops, or slows down, then N taken up by roots will be used for storage, or reserves. Where the data differed in this study, was with the use of label N and fall foliar application of urea indicated that both vegetative growth and fruiting of young grapevines in the spring are determined by reserve N, and not by reserve carbohydrates. However, it appears that when extra N (foliar urea) was provided in the end of the previous growing season, it was used to convert some of

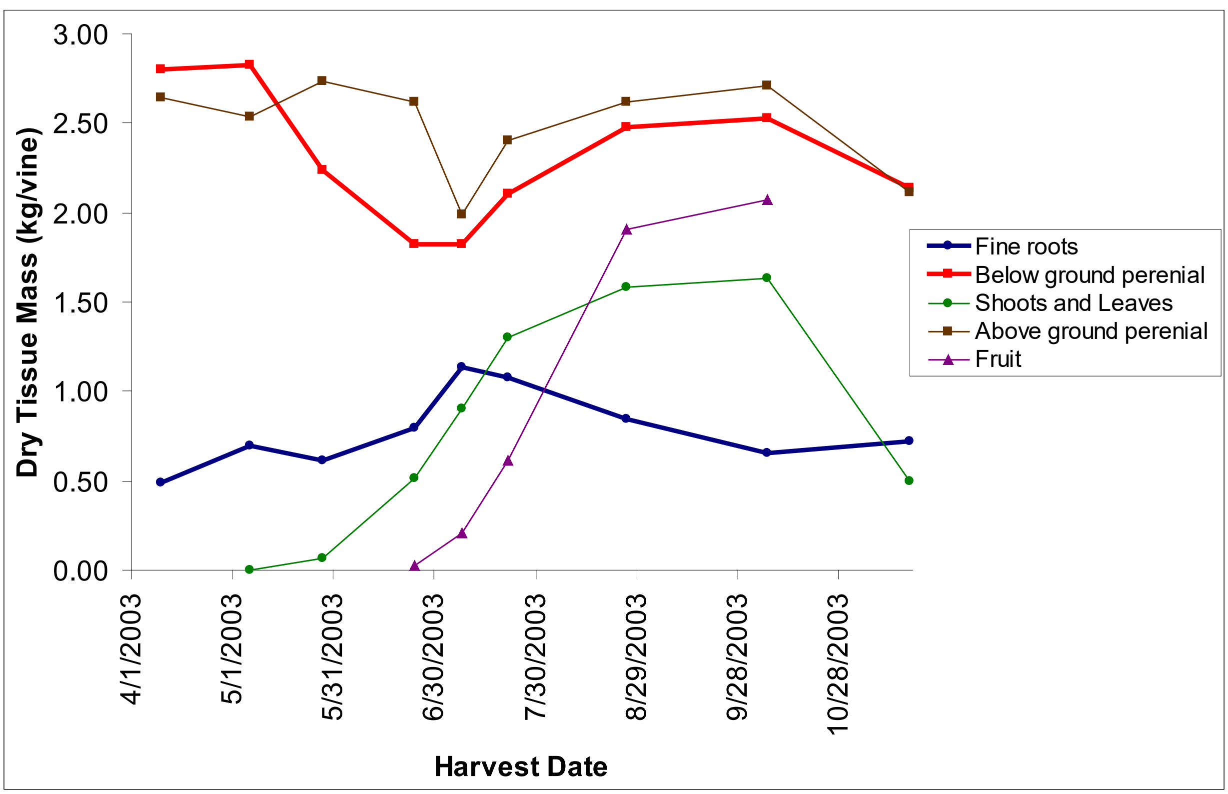

Figure 2. Dr. Terry Bates Graph of Dry Grapevine Tissue Conentrations for different points in the growing season

Vine Nitrogen Status Observations		
Nitrogen-Deficient	Adequate Nitrogen	Excess Nitrogen
Vines consistently fail to fill available trellis with foliage by August 1	Vines fill available trellis with foliage by August 1	Shoots fill trellis with an excess of foliage: shoots 8 to 10 feet long by mid-July
Crop yield is chronically low	Crop yields are acceptable	Fruit yields are low because there are few clusters, poor fruit set, or both
Cane pruning weights are consistently less than 0.25 lbs. per foot of row or per foot of canopy for divided-canopy training systems	Cane pruning weights average 0.3 to 0.4 lb per linear foot of canopy	Cane pruning weights consistently exceed 0.4 lbs. per linear foot of canopy (ex. 2.8 or more pounds of cane prunings for vines spaced 7 feet apart in the row)
Mature leaves are uniformly small and light green or yellow; leaf reddening may occur with red-fruited varieties, and leaf petioles my be unusually red	Mature leaves are of a size characteristic for the variety and are uniformly green	Mature leaves are exceptionally large and very deep green
Shoots grow slowly and have short internodes	Shoots grow rapidly and have internodes 4 to 6 inches long	Shoots grow is rapid, and internodes are long (6 inches or more) and possibly flattened
Shoot elongation ceases in midsummer	Shoots cease growth in late summer or early fall	Shoot growth does not cease until very late in the fall
Fruit quality may be poor, including poor pigmentation with red-fruited varieties	Fruit quality and time to maturation are normal for the variety	Fruit maturation is delayed
Bloom-time petiole nitrogen concentration is less than 1.0%	Bloom-time petiole nitrogen concentration is between 1.2% and 2.2%	Bloom-time petiole nitrogen concentration is greater than 2.5%
Information from Wine Grape Production Guide for Eastern North America, Tony K. Wolf, Virginia Tech. NRAES 2008.		

Figure 3. Vine Nitrogen Status Observations related to Nitrogen-Deficient, Adequate Nitrogen, and Excess Nitrogen in grapevines from Wine Grape Production Guide for Eastern North America, Tony K. Wolf, Virginia Tech. NRAES 2008.

the carbohydrates to proteins and amino acids in the vines, the reserve carbohydrates were better used for growth and development the following spring. The labeled nitrogen experiment found that current season N application did not affect remobilization of reserve N for new growth, but it plays an important role in sustaining vine growth and development from bloom to veraison (Cheng and Xia, 2004).

How Much Nitrogen is Enough?

The below table is Vine Nitrogen Status Observations related to Nitrogen-Deficient, Adequate Nitrogen, and Excess Nitrogen in grapevines (figure 3). Use this as a resource when making observations in your own vineyard blocks. Please note that we always recommend taking soil and tissue samples. Soil samples should be taken every 2 to 3 years. Sampling from any given area should be done at about the same time as in previous years. Samples must also be representative of the area in question. If using a management zone map, samples should be taken from all zones. Tissue analysis is a tool that reveals the concentration of essential nutrients or elements absorbed, or taken up, by vine tissues. Samples collected are then compared to standard grapevine tissue references from healthy vines at the lab and classified as either adequate, high, or low/deficient. Once you receive your results, fertilizer recommendations to increase nutrients that are low can be made with guidance from your viticulturist or the lab.

If nitrogen application is required, a good staring point is a rate of 30 to 50 pounds of actual nitrogen per acre. Research out of Michigan by Stan Howell indicates that mature healthy Concord vines need approximately 70 pounds of nitrogen per year. Further research (again out of Michigan) by

Tom Zabadal and Eric Hansen shows that bud break applied N fertilizer is only 10% efficient and bloom applied N fertilizer is a bit more efficient at 15-20%. Meaning, for every 100 pounds on nitrogen applied at bud break, only about 10 pounds is making it to the vines.

Dr. Nelson Shaulis and others held a long-term research from the West Tier in Fredonia, NY shows that own-rooted Concord vines (figure 4.) on soil with 2-3% organic matter achieve maximum productivity with 50 pounds of nitrogen fertilizer (figure 5). Putting on more nitrogen did not produce more crop. Further nitrogen research was conducted on heavy clay soil at the Betts' vineyard, where the organic matter is a bit higher at 4-5% (figure 6). There were no differences in vine growth with 0, 50, or 100 pounds of nitrogen applied. Note the graph below of Betts' Nitrogen Trial 7-year Cumulative Yield in tons; there is not a drastic difference in the sums. This suggests that there was enough mineralization in that soil to provide vine nutrition, and adding 100 pounds of nitrogen on that particular vineyard was wasteful.

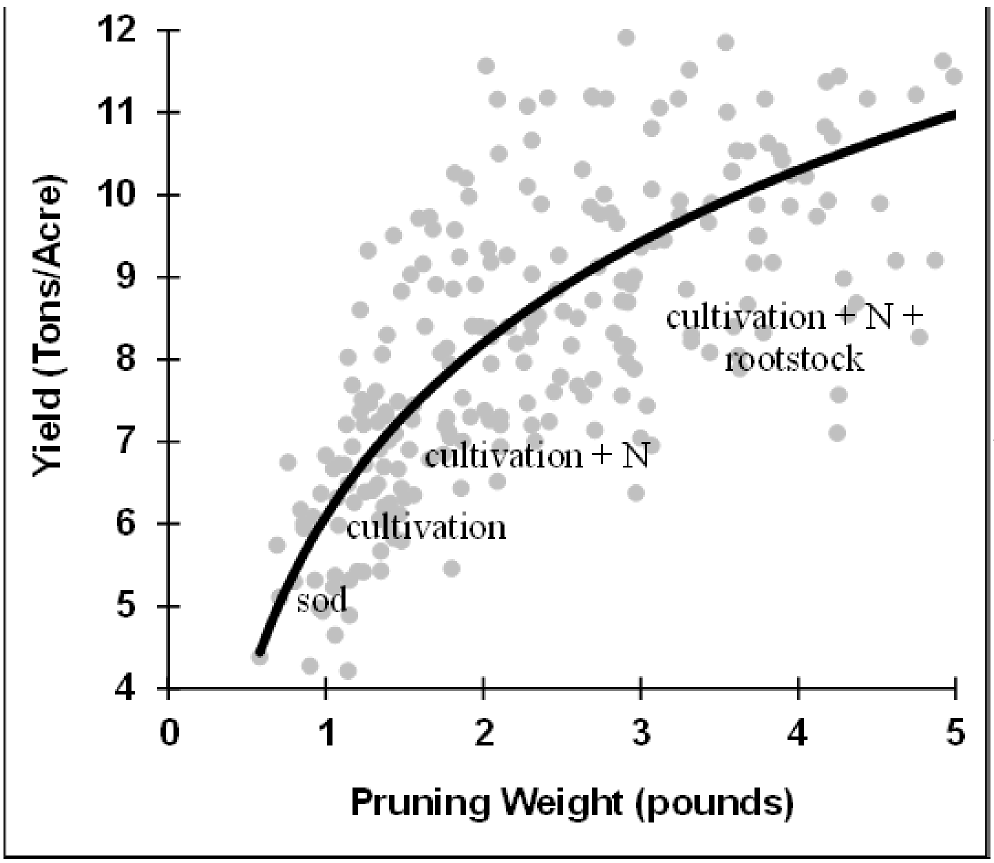

Figure 4. Shaulis West Tier Experiment graph of several viticulture practices and the impacts on vine size and yield potential.

The graph (figure 5) depicts the red circles as zero pounds of N applied, the black triangle is 50 lbs. of N applied and the yellow square is 100 lbs. The application of 50 pounds of N/acre increased pruning weights (vines size) and crop yield, but adding an additional 50 pounds of N/acre (100 lbs.) offered no further benefit. Our Concord grapevines in the Lake Erie region typically have less than three pounds of pruning weight and average less than 8 tons/acre. This study 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.

Dr. Nelson Shaulis's work of applying 0, 50, and 100 lbs of actual N to grapevines was conducted on gravel soil. Dr. Terry Bates repeated Shaulis's experiment on heavy clay with relatively high organic matter over seven consecutive years. Bates' work concluded that soils with high organic matter release

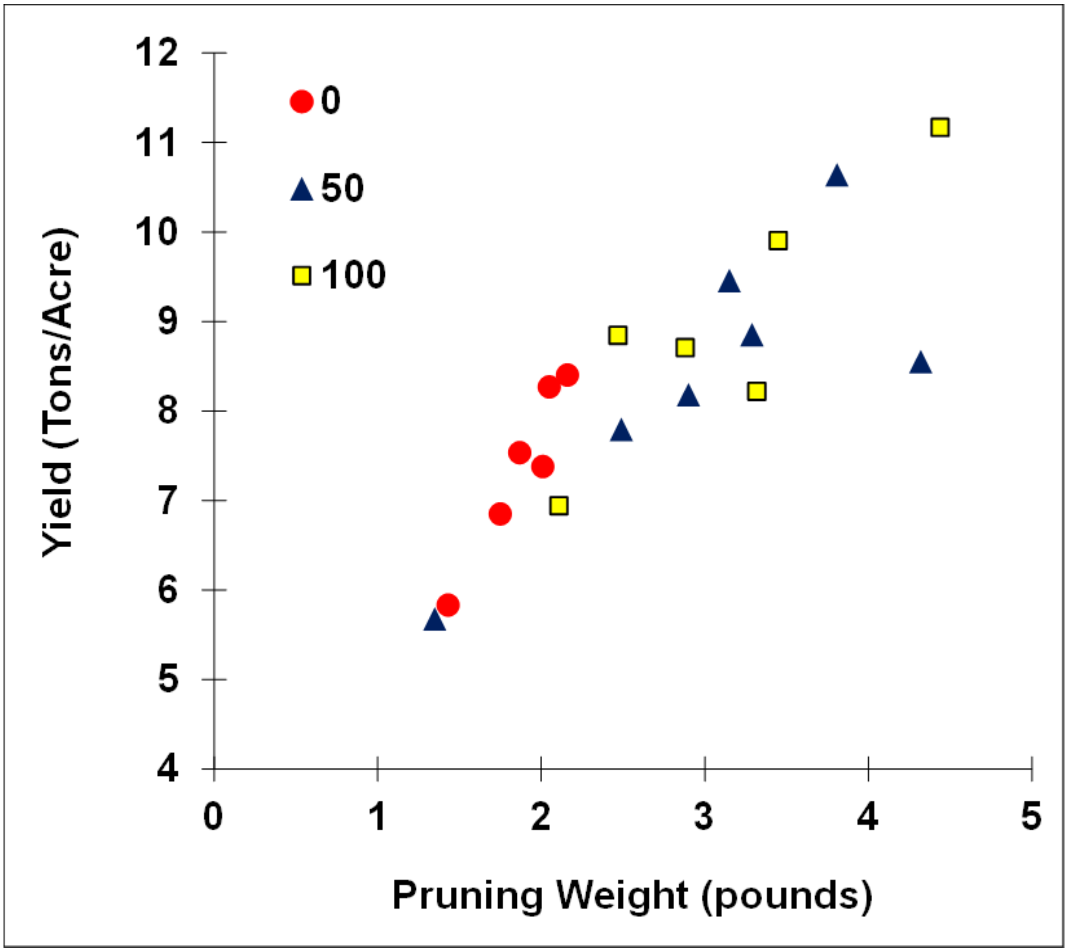

Figure 5.. Concord yields compared to pruning weights using three N rates (0, 50, and 100 lbs/acre)

more nitrogen and, thus, vines needed less supplemental nitrogen. As a general rule of thumb, for every 1% of organic matter in your vineyard soils equates to 15-20 lbs of mineralized nitrogen available for grapevines to take up from the soil.

Dr. Terry Bates gave a scenario in 2003 that fits this newsletter perfectly. "Say I have a healthy mature Concord vineyard with 3% organic matter. I figure that the vines need 70 pounds of N per year and that my soil is releasing approximately 60 pounds from mineralization. I need to make up 10 pounds of nitrogen through inorganic fertilizers. If I apply fertilizer only at bud break and get only 10% uptake efficiency, I need to put on 100 pounds of fertilizer nitrogen just to make up the needed 10 pounds. If I rely on reserves and organic matter in the pre-bloom period and apply nitrogen around bloom and increase fertilizer efficiency to 20% then I only need to apply 50 pounds of fertilizer nitrogen to make up the needed 10 pounds."

Conclusion

N applied to the grapevines at budbreak may not be absorbed as readily as later in the season because the grapevines may not have a strong demand for soil-derived N at that time. Previously mentioned studies have shown that 20 to 40% of N used for grapevine growth during this period is supplied from perennial vine structures. Uptake and utilization of soil-applied N was slow during the period budbreak to bloom compared to the period fruit set to veraison. Frost protection irrigations and spring rains can quickly leach sandy, or rapidly drained soils, and N applied at budbreak may be lost from

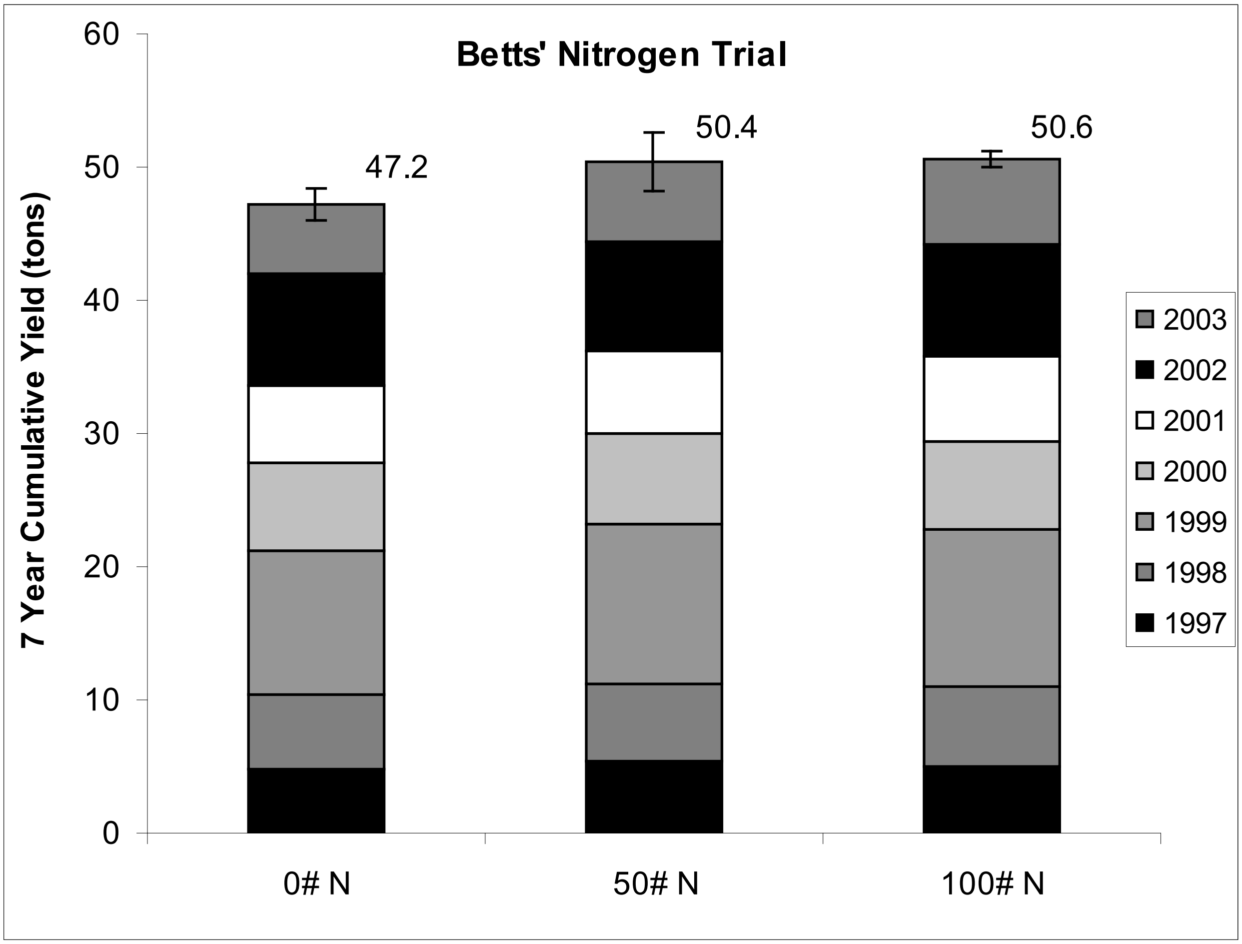

Figure 6. Dr. Terry Bates' Betts Nitrogen Trial 7 year cumulative yield in tons/acre at 0, 50, and 100 lbs of N applied

the root zone before significant uptake occurs at bloom. When leaching potential is high, fertilization should be delayed until bloom or later to minimize losses. A split application may be beneficial on soils highly susceptible to leaching. Nitrogen applied at veraison or post-harvest effectively increased bloom petiole nitrate levels the following year in longer growing season studies. When fertilizing post-harvest, the canopy should be healthy and functional; applications should be made before October in the San Joaquin Valley. The application of N during the dormant period is inefficient and not recommended in irrigated vineyards (Peacock et al. 1991).

In general, between bud swell and bloom the new shoot growth is supported by reserved carbohydrates and nutrients stored in the perennial woody tissue. Rapid shoot and berry development in the weeks after bloom prevents the replenishment of stored resources despite the carbon assimilation by photosynthesis and nutrient uptake by roots. Then shoot growth slows and fruit and wood maturation occur simultaneously. This maturation occurs at different rates dependent on environmental factors and management strategies. The period after harvest is considered the recovery period for the stored resources because any carbon assimilated through photosynthesis up to leaf fall and root nutrient uptake are not needed for fruit and can be dedicated to plant structures. Postharvest periods vary from climate and crop load.

1) Recommendations based on the literature:

The research validates the importance of establishing soil and plant tissue sampling programs; those in combination with management zone maps will go a long way to getting the best out of your vines and more efficient input applications.

Vineyard uptake of fertilizer N may be enhanced by applying N between bloom and up to six weeks post-bloom rather than at budbreak. Based on soil and tissue samples, if more than 50 lbs of N are recommended, then a split application at two before bloom and four weeks after would be recommended. Later N applications resulted in more residual N in the soil profile at the time of postharvest sampling with potential for leaching, especially in short growing season regions like the Lake Erie AVA. The timing of nutrient applications should be optimized to increase the vine growth potential and decrease the potential of nutrient runoff and leaching.

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Distribution and Translocation of Nitrogen Absorbed During Late Spring by Two-Year-Old Grapevines Grown in Sand Culture
W. J. CONRADIE 1990

Table 3. Seasonal changes of ^{15}N concentrations in the total N (TN) and insoluble N (IN) fractions of different organs of Chenin blanc/99 Richter (atom % excess ^{15}N).

Date	Phenological stage	Medium roots (> 2 mm)		Fine roots (< 2 mm)		Rootstock trunk		Scion trunk		Shoots		Leaves		Bunches	
		TN	IN	TN	IN	TN	IN	TN	IN	TN	IN	TN	IN	TN	IN
18 December	End of rapid shoot growth	0.406	0.392	0.553	0.486	0.326	0.280	0.510	0.430	1.199	1.130	1.051	1.009	1.352	1.202
8 January	Veraison	0.339	0.331	0.442	0.406	0.328	0.268	0.378	0.295	0.688	0.687	0.796	0.754	0.878	0.865
11 February	Harvest	0.207	0.212	0.344	0.354	0.231	0.192	0.295	0.235	0.393	0.380	0.481	0.498	0.706	0.637
21 April	Start leaf-fall	0.185	0.200	0.246	0.243	0.227	0.178	0.269	0.235	0.386	0.345	0.434	0.426		
20 June	End leaf-fall	0.185	0.200	0.248	0.261	0.239	0.186	0.238	0.221	0.275	0.283	0.402[b]	0.382[b]		
30 August	Budbreak	0.186	0.214	0.235	0.241	0.234	0.190	0.251	0.236	0.263[a]	0.243[a]	-	-		
6 October	Before bloom (200 mm shoots)	0.201	0.228	0.245	0.238	0.213	0.185	0.242	0.241	0.133	0.137	0.124	0.133	0.145	0.141
22 November	Two weeks after bloom	0.180	0.187	0.234	0.231	0.182	0.169	0.206	0.185	0.085	0.077	0.080	0.094	0.081	0.094
D value ($p \leq 0.05$)		0.042	0.040	0.064	0.072	0.030	0.029	0.035	0.036	0.130	0.150	0.131	0.139	0.077	0.083

[a]One-year-old shoots removed through pruning just before budbreak.
[b]Fallen leaves collected during leaf-fall.

Distribution and Translocation of Nitrogen Absorbed During Early Summer by Two-Year-Old Grapevines Grown in Sand Culture
W. J. CONRADIE 1991

Am. J. Enol. Vitic., Vol. 42, No. 3, 1991

Table 2. Seasonal changes of total N (% dry mass) and ^{15}N (atom% excess ^{15}N) in different organs of Chenin blanc/99 Richter labeled with ^{15}N at the end of rapid shoot growth.

Sampling date	Developmental stage	Medium roots (> 2 mm)		Fine roots (< 2 mm)		Rootstock trunk		Scion trunk		Shoots		Leaves		Bunches	
		N	^{15}N	N	^{15}N	N	^{15}N	N	^{15}N	N	^{15}N	N	^{15}N	N	^{15}N
2 December	End rapid shoot growth	1.04	-	1.43	-	0.56	-	0.54	-	1.06	-	3.01	-	1.70	-
2 January	Veraison	0.97	0.214	1.51	0.266	0.53	0.295	0.47	0.312	1.37	0.660	2.40	0.479	1.18	0.523
12 February	Harvest	1.03	0.168	1.56	0.188	0.58	0.188	0.49	0.226	1.38	0.440	2.47	0.304	0.92	0.467
27 April	Start of leaf-fall	1.14	0.171	1.56	0.148	0.62	0.162	0.50	0.175	1.22	0.219	2.05	0.276	-	-
17 June	End of leaf-fall	1.35	0.150	1.75	1.118	0.72	0.143	0.66	0.175	1.17	0.200	1.92[b]	0.268[b]	-	-
4 September	Budbreak	1.39	0.169	1.95	0.111	0.73	0.165	0.65	0.161	1.12[a]	0.187[a]	-	-	-	-
16 October	Before bloom (200 mm shoots)	1.45	0.107	2.15	0.115	0.59	0.193	0.61	0.185	2.34	0.039	3.77	0.085	[c]	[c]
25 November	Two weeks after bloom	1.21	0.098	1.90	0.093	0.57	0.098	0.47	0.085	1.13	0.034	2.24	0.043	2.24	0.043

[a]One year old shoots removed through pruning just before budbreak.
[b]Fallen leaves collected during leaf-fall.
[c] Bunches included with shoots.

PA Update

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

Spotted Lanternfly – (2021 Reminder and Update) –

Although there have been no established populations of SLF confirmed, **yet**, in the Lake Erie Region, growers should be prepared for their inevitable arrival. **Early detection is key**, when this insect arrives, to preventing/delaying this pest from establishing a foothold in the region. Growers and personnel at agriculture related businesses (e.g., ag chemical and equipment dealers) should know: how to identify all life stages of SLF, life cycle of the insect, current location of this pest and **how to report sightings**. This article provides information and relevant resources about this destructive pest.

Spotted Lanternfly – a new invasive pest

Spotted lanternfly, *Lycorma delicatula* (White), is a new invasive insect that is native to Asia. This planthopper was first discovered in the United States in Berks County, Pennsylvania in September 2014. It is suspected to have been introduced into southeastern PA on shipments of stone from China that were infested with egg masses.

The spotted lanternfly uses its piercing-sucking mouthpart to feed on sap from over 70 different plant species. It has a strong preference for economically important plants including grapevines, hardwoods and ornamentals. The feeding damage significantly stresses the plants which can lead to decreased health and potentially death. Consequently, SLF poses a serious economic threat.

It is important to note that tree-of-heaven, *Ailanthus altissima* is a highly preferred host plant of this insect and these trees provide ideal sites for monitoring for the presence of this invasive insect. Tree-of-heaven is a fast growing, invasive tree that is native to China. It originally was introduced to Philadelphia in the late 1700s for use as an urban street tree. It also was planted widely in the Baltimore and Washington, D.C., areas. From these regions, it spread and became a common invasive plant in urban, agricultural and forested areas. (For information concerning tree-of-heaven refer below to: **Resources**).

Spotted lanternfly: Life Cycle, Description and Feeding

In Pennsylvania, SLF has 1 generation/year and develops from an egg to a wingless nymph to a winged adult.

Figure 1. SLF egg mass. Photo – Emelie Swackhamer, Penn State

Eggs – SLF overwinter in the egg stage. Egg masses are comprised of about 30-50 eggs and are covered with a waxy secretion resulting in a gray-brown coloration which looks like a smear of mud on the surface where they are laid (Figure 1).

Nymphs – The nymphal stage has 4 instars. The 1st instar is less than ¼” long. The coloration of the first 3 instars is black with white spots and has been described as looking “tick-like” (Figure 2). The fourth instar is red and black with white spots and about ½” long (Figure 3). In southeastern PA, nymphs begin hatching in late April or early May.

Figure 2. Early nymph (actual size = 1/4"). Photo credit: PA Department of Agriculture.

<u>Adults</u> – The head and legs of the adult are black and the abdomen is yellow with black bands. The wings cover the body “tent-like” while the insect is feeding or resting on a surface (Figure 4). The forewings are gray with black spots (near the wing base), with black and gray markings near the tips. The hindwings are colorful and comprised of a red area with black spots, with a white band and black area near the tips. The hindwings are only visible when the insect is alarmed or in flight (Figure 5).

In southeastern PA, SLF reach adulthood around late July and are about 1” in length. Adults start to appear in vineyards in August, but high populations are not typically observed until mid–to-late September. The majority of an SLF population within a vineyard is observed on the edge. SLF adults begin mating in early fall and will aggregate in large numbers most commonly on tree-of-heaven. Females begin

Figure 3. Late nymph (actual size = 1/2"). Photo credit: PA Department of Agriculture.

Figure 4. Adult, wings closed (Actual size = 1 inch). Photo credit: PA Department of Agriculture.

Figure 5. Adult, wings open. Photo credit: PA Department of Agriculture.

laying eggs in late September or early October. Egg laying continues until females are killed by cold temperatures. SLF females lay at least 2-3 egg masses with about 30-50 eggs/mass. Females will deposit eggs on tree trunks, limbs or **any smooth surface** (e.g., vehicles, farm equipment, rusty metal, outdoor furniture, etc.).

Feeding - The spotted lanternfly has a piercing-sucking mouthpart which is used to extract phloem sap from plants. Feeding by large aggregations of this insect can reduce grapevine vigor, brix levels, cold hardiness (cv. 'Riesling') and can result in mortality of the host. In addition, the copious amounts of "honeydew" excreted from feeding SLF results in extensive sooty mold growth which covers leaves and contaminates fruit (Figure 6). Younger SLF instars typically prefer to feed on the more succulent parts of plants (e.g., stems, leaf veins). Older nymphs (fourth instar) and adults can feed on woody tissue such as trunks, limbs, and canes.

Figure 6. Sooty mold on upper surface of grape leaf. Photo – Erica Smyers, Penn State.

Spread of Spotted Lanternfly

The Pennsylvania Department of Agriculture (PDA), Penn State and USDA Aphis are all collaborating to address the SLF problem in Pennsylvania. Extensive surveys by PDA for detection/evidence of SLF are continuing throughout PA. The NYS Department of Environmental Conservation (NYSDEC) and NYS Agriculture and Markets are co-leading New York's SLF efforts, working closely with USDA Aphis and Cornell (NYS IPM program, NE IPM program).
Unfortunately, despite these extensive collaborations, SLF has now spread to at least 34 counties in Pennsylvania. In New York, there is an established population now on Staten Island and this past fall (2020) adults and egg masses were found near Ithaca, NY. SLF infestations are also present in Connecticut, Delaware, Maryland, New Jersey, Ohio, West Virginia and Virginia. (NYS IPM is keeping track of SLF current distribution in the eastern US (Click for updated map).
The most important continuing threat concerning long-distance dispersal of SLF is by movement of egg masses and adults on vehicles (e.g., cars, campers, railway cars) or contaminated materials from sites with SLF.

Quarantine

In 2014 PDA initiated a quarantine in 5 townships in eastern Berks County, PA. In subsequent seasons, due to the spread of SLF, the quarantine was expanded to include 13 counties in southeastern, PA. In 2020, 12 additional counties in PA were added to a state-imposed quarantine. So far, in 2021, SLF is currently found in 34 counties in Pennsylvania, all of which are under a state-imposed quarantine. The quarantine is in place to stop the movement of SLF to new areas within or out of the current quarantine zone and to slow its spread within the quarantine areas. The quarantine affects vehicles and other conveyances, plant, wood, stone products and outdoor household items.

The closest counties to Erie County, PA under quarantine include Allegheny, Beaver, Cameron, and Westmoreland counties. Cameron county is only 3 counties southeast of Erie County. Allegheny, Beaver, and Westmoreland counties are only 4 counties south of Erie County, PA. (see map in PA where SLF is currently found at the Penn State Extension spotted lanternfly website).

Reporting

Early detection is vital for the management of SLF. Personnel at ag related businesses should be inspecting incoming shipments/supplies/equipment (including pallets, posts), especially from quarantined areas, for the presence of SLF (i.e., egg masses, nymphs, adults). Growers should also check supplies/equipment, purchased from quarantined areas or from ag related businesses, for the presence of SLF. In addition, growers should be scouting throughout the season for the presence of SLF in and around your vineyards. Monitor tree-of-heaven and other highly desirable hosts (e.g., wild grapevines, black walnut) surrounding your vineyard to find potential sources of SLF.

If you observe an insect or egg masses that you suspect is SLF then **take pictures** (include something for scale such as a coin or ruler). If possible, **collect a sample** and place it in a freezer or in a jar with rubbing alcohol or hand sanitizer. **Record the location** of the find (address, intersecting roads, landmarks or GPS coordinates) and **immediately report it**. In addition, commercial grape growers in the Lake Erie Region, should also contact any member of the LERGP Extension Team.

PENNSYLVANIA

To **report a sighting**, go to: Have you seen a Spotted Lanternfly? Let's Check! OR use the PDA SLF Reporting Tool OR call the hotline at 1-888-422-3359.

NEW YORK

Report a sighting to: NYS Dept. Agriculture and Markets, using the Spotted Lanternfly Public Report OR email to spottedlanternfly@agriculture.ny.gov .

Management

Penn State Extension has developed a fact sheet concerning management of SLF in vineyards. This fact sheet provides identification, damage, quarantine, and management information. Insecticide options for SLF are available in this fact sheet, as well as, in the *2021 New York and Pennsylvania Pest Management Guidelines for Grapes*. In addition, Greg Loeb and Juliet Carroll, compiled a list of insecticides that are labelled for use on grapes in NY for SLF at:

In Greg Loeb's article "*Grape Insect and Mite Pests, 2021 Field Season*" (LERGP Newsletter, May 2021) he states that, "A couple of things to keep in mind regarding management of SLF in new areas of the invasion. First and maybe most important, it will take time for populations to build to a level that requires chemical control. So I expect you will have some time to get a pest management strategy organized if SLF is found in or near your vineyards. Second, the insecticides we have available are generally effective in killing either the nymphal and/or adult SLF stage."

Resources

Extensive information about SLF (e.g., how to identify, how to report an infestation, how to comply with quarantine regulations, etc.) is available below.

Spotted Lanternfly

Spotted Lanternfly Management in Vineyards (factsheet)

Penn State Extension - Spotted Lanternfly website

Pennsylvania Department of Agriculture - Spotted Lanternfly website

Spotted Lanternfly: detection and management in vineyards (from The Penn State Wine and Grape Team, June 17th webinar):
See this link for a PDF copy of the presentation
Spotted Lanternfly Management in Vineyards 2020 - June 17 Webinar recap

NYSIPM Spotted Lanternfly website

Spotted Lanternfly – Understanding its Ecology and the Threat (Tim Weigle, NYS IPM Program, Oct 17, 2019, 1:21:59)

Tree-of-Heaven

Tree-of-Heaven: Accurate Identification (Dave Jackson, Penn State Extension, Jan. 10, 2019, 3:46)

Identifying Tree-of-Heaven: Native Look-alikes (Dave Jackson, Penn State Extension, Sep. 18, 2019, 5:05)

Controlling Tree-of-Heaven: Why it Matters (Dave Jackson, Penn State Extension, Jan. 10, 2019, 3:52)

Tree-of-Heaven: Control Strategies (Dave Jackson, Penn State Extension, May 8, 2019, 6:36)

Have you seen a Tree-of- Heaven (NYS Dept. Agriculture and Markets)

Late Summer, Early Fall Optimal Time to Treat Tree of Heaven (Updated: August 20, 2020, Dave Jackson, Penn State Extension)

PA Update

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

Another season of unpredictable weather is upon us and it's time to review important disease management principles and tools to consider when optimizing your vineyard management programs this season.

First I would invite you to check out the NEWA website (**N**etwork for **E**nvironment and **W**eather **A**pplications) found at http://newa.cornell.edu, if you haven't done so already. On the home page, you'll see a map of the U.S. studded with the locations of hundreds of weather stations where historical and 'up to the hour' weather data can be viewed, and every year there are new weather station locations added to this ever evolving tool. The information is free (funded through the New York State IPM program) and very useful for anyone growing grapes in the Northeast. Click on a weather station nearest you (denoted by a leaf/rain drop icon) to get weather, insect pest, and disease information you need to make important management decisions that could save you time and money. Clicking on 'grapes' under 'crop pages' will give you access to forecasting models for all the major diseases, so you can see when you've experienced infection periods in your vineyard. You'll also find the grape berry moth degree day model that will help to improve your timing of grape berry moth insecticide sprays later this summer. Each model forecast is accompanied by helpful background information, disease management messages and explanations.

Frost damage: April 21-22 brought some very cold temperatures to most of Pennsylvania and other parts of the Northeast. Here along Lake Erie, temperatures dipped down to 27/28/29^{o}F in most vineyards; critical temperatures for damage to buds at that time. Many sites experienced below freezing temperatures for 15-30 hours. Farther from the lake, vines that were further along in development (beyond bud break) were even more vulnerable to damage. As the extent of the damage became clearer over the next few weeks, growers began to assess their vineyard blocks to estimate bud/shoot loss/damage, cluster numbers, and potential yield, which has helped them determine how to manage each block for the remainder of the season. It's also important to reporting damage/losses for crop insurance claims as quickly as possible; the earlier the better. Overall, the grape industry along the lake appears to be in good shape and prices per ton should remain high. But unfortunately for many growers along the southern edge of the grape belt, the late April cold sharply reduced their crop potential for 2021.

Weather: Spring precipitation is way down along the Lake Erie grape belt. This has been an advantage with respect to disease control. For example, Phomopsis lesions on Concord shoots are down this spring, thanks to having just a single infection period during early shoot growth (May 3-4) that barely left some light lesion development on nodes 1 and 2 on shoots, despite having no fungicides applied. Cold temperatures at the end of April persisted until about the middle of May which held shoot growth hostage for weeks. This could have been a recipe for disaster with respect to Phomopsis shoot lesions (remember 2017!), but it also remained relatively dry, except for wetting periods on May 7 and 9, which were too cold for infection, even by Phomopsis. As temperatures finally warmed in mid-May, shoot growth rocketed forward and those first few internodes and leaves on shoots quickly lost their susceptibility to Phomopsis and black rot. We ended up with a meager 1.95 inches of total precipitation in May at our location, about half what we normally get. Since then, our June precipitation has been down as well, with two wetting periods: June 2-3 and June 7-8, for a total of 0.49"; also well below average. As of June 10, we have accumulated about 220 growing degree days (gdds) in

June (ahead of average) and we now have 588 gdds as of April 1.

Phenology: Here in North East by the lake we recorded trace bloom for Concord on June 7, and 50% bloom on June 9. This is about 5-6 days ahead of average for us here. For us, this means that Concord bloom began about 515 gdds from April 1 (compared to our long term (22 year) average of 527), and about 44 days from 50% bud break (compared to our average of about 41 days).

Diseases: June rainfall has resulted in two infection periods for all the major diseases; Phomopsis, black rot, powdery and downy mildew. Scouting here has revealed relatively little disease so far, but it's important to discuss what is happening out in the vineyard and what we need to look for and do during the next few weeks that are critical for protection of your fruit. As we approach the timing for the first post bloom spray, remember that **this is the most important spray of the season!!** Fruit of all grape varieties are most susceptible to all the major diseases from the time that flower caps come off, to about 3 weeks later. For this reason, do not stretch the interval between the immediate pre-bloom and first post bloom spray beyond 14 days (less is better). If this means spraying again during late bloom, then so be it…spray during late bloom (rather than wait until after bloom) to keep that interval to 14 days or less. *This is a no brainer*; use best materials you can afford, spray every row, maximize coverage with adequate gallonage per acre, etc.

Scouting for black rot on leaves in the fruit zone is important as it will reveal your risk of fruit infection during bloom and early fruit development. Start your scouting in places that are most at risk of this disease (you know your blocks better than anyone). Lesions in the fruit zone are the result of the May 3-4 infection period and would have been controlled by an early shoot spray of mancozeb (applied mainly for Phomopsis). These lesions are in prime position to release spores onto developing fruit during rain periods after capfall. If you see black rot leaf lesions in the fruit zone, **be warned** that first and second post bloom sprays of ziram, and/or sterol inhibitors, will need to be applied in a timely fashion to avoid crop loss from black rot, especially if conditions turn wet. For wine grapes, you can continue to rely on mancozeb products for good black rot control. Although I have discovered such lesions on our farm, they are rare, and I suspect the incidence of such lesions belt wide is very low in most juice vineyards. New black rot infections from the wetting periods of June 2-3 and 7-8 will become manifest the week of June 13th, as it generally takes from 10-14 days from infection to symptom expression.

Scout for downy mildew on leaves near the ground, especially sucker growth. The pathogen that causes downy mildew overwinters on the ground and will most likely strike susceptible tissue low on vines, first. "Oil spots" on leaves now would most likely be the result of the infection period on June 2-3, especially on susceptible varieties like Niagara and Catawba. At our farm, the June 2-3 wetting period left some unsprayed sucker shoots, sporulating with downy mildew. Symptoms can show up in as little as 4-5 days from the infection period, so infections from the more recent rain period of June 7-8, could become visible as early as June 12-13.

Scout for powdery mildew on cluster stems and leaves at this time. If you see the powdery sporulation of the fungus on clusters or leaves during the pre-bloom period, that is a red flag for a potentially tough time controlling mildew on your fruit this year. Again, always put your best materials on now, during the lead up to bloom and the first/second spray after bloom. *Best materials for powdery mildew* on juice grapes for the first post bloom spray could include Quintec, Vivando/Prolivo, or Endura on Concord. Revus Top is a good material for Niagara, which may need the extra protection against downy mildew. **Do not rely soley on** stylet oil, strobilurins (Sovran or Abound) or sterol inhibitors (tebuconazole or tetraconazole products) for powdery mildew control at this time. Remember: Teb and tetraconazoles and strobies are great for black rot, but resistance has rendered them too weak on powdery for reliable control of that disease at this critical point in the spray season. After the first post bloom spray, reassess your situation by scouting and closely watching the weather forecast. We have only had about a handful of powdery mildew infection periods this spring and so I don't anticipate more than modest disease pressure at this time in the season. Nevertheless, I repeat: do not depend on tebuconazole products or the strobilurins for protection against powdery mildew at this critical time, even on Concords and Niagara. Resistance to these materials is widespread and something more is needed through bloom and early fruit development, in order to control powdery mildew (see the materials mentioned above). For the other diseases, use a tank mix with a mancozeb product, pre bloom, and switch to ziram in the post bloom period to pick up black rot, Phomopsis, and downy on Concord. However, ziram is weaker on downy than mancozeb, and for Niagaras you may want to add another ingredient to the first post bloom spray, like a phos acid or Reason (or Revus/Revus Top if not used pre bloom), to pick up the downy if disease pressure is high (if rainfall picks up).

For wine grapes, the heavier hitting FRAC 7s like Aprovia (for powdery only) Aprovia Top (powdery and black rot), or Luna Experience (powdery and black rot) along with a sulfur tank mix (for wine varieties that are not sensitive to sulfur), is a good idea, especially if you've been having unsatisfactory control of powdery with the standard fare of Quintec/Vivando. But for these newer FRAC 7s, cost can be a major deciding factor, and none of them will control downy mildew. Pristine is also still on the table, but if you have powdery mildew strains with strobilurin resistance (and yes, we have confirmed strobilurin resistance from powdery mildew strains in Erie county PA), you will only get powdery control from the Endura component (boscalid) of Pristine; all the more reason to tank mix with sulfur. And, unlike the sterol inhibitors, (like tebuconazole that will still control powdery to some extent), resistance to strobilurins renders them pretty much ineffective against powdery, at any rate. However, the strobilurin component of Pristine is still going to control black rot and probably downy mildew too (no resistance confirmed yet…yet), whereas Endura alone will not control these other diseases, and will have to be applied with a mancozeb product or something else for black rot and downy on wine grapes.

And lastly, for premium wine varieties (V. vinifera), now is the time for leaf removal in the fruit zone. Leaf removal can be done by machine or by hand and generally provides sizable reductions in bunch rot on rot susceptible wine varieties (Riesling, Vignoles, Pinot noir and gris, Chardonnay, etc). It can even help improve control of other disease as well, like powdery mildew. A preliminary trial we ran last season on several Riesling clones, compared two different timings of mechanized leaf removal (at just before bloom and about two weeks later (about early fruit set)) with no leaf removal. Using air pulse technology to remove leaves, both timings provided for about a 50% reduction in harvest rots, with no reduction in yield. So, timing didn't matter, but the decision to apply leaf removal resulted in a 50% reduction in rots over not applying it at all. Not only does leaf removal reduce fruit disease (by improving exposure of fruit to light, air, and pesticide penetration), but it improves fruit quality, and may even reduce manual harvest costs (the clusters are easier to see and remove if you're hand harvesting).

Extension Programs

Kimberly Knappenberger, Viticulture Assistant, LERGP

NEWA

Finally! There is a new Onset HOBO station in Erie County. You can find it on the NEWA website at, or look for the Brant station when you are on the website. It is located near the corner of Morely and Milestrip roads in Brant and has been reporting data from that area since May 27th. This station has been generously provided to the Lake Erie Regional Grape Program from the New York State Integrated Pest Management program. Dan Olmstead was able to get funding to be able to supply the Lake Erie Region and the Finger Lakes Region each with a new HOBO station to place in an underserved area. These stations are set on a 3 meter tripod and include all of the usual sensors required to report to NEWA: temperature, relative humidity, rain, solar radiation, wind speed and direction, leaf wetness, as well as air pressure.

We are very excited to have this station in Erie County and hope it will be an asset to the growers in that region.

The Grape Commodity Survey is Under Way

This week marked the beginning of the annual Grape Commodity Survey. New York State Ag and Markets in conjunction with Cornell Cooperative Extension's NYS IPM Program and Grape Programs in the main growing regions of New York State – Lake Erie, Finger Lakes, Long Island and the Hudson Valley regions – have set the traps in vineyards and nurseries for the target moths for this year. If you see something like the scene in the photo, that is probably one of these surveys in progress. This year the target moths are European Grape Berry Moth, European Grapevine Moth, and Christmas Berry Webworm. The target moths are set by NYS Ag and Markets who determine which pests need to be included in the survey according to the commodity and the potential damage to that commodity. In addition to those pests, each region is tasked with scouting for Spotted Lanternfly so it can be detected as early as possible. This survey will continue through the growing season and traps will be collected in early September.

VIP

Fast Fact about the Vineyard Improvement Program: Abandoned vineyards are a tremendous source of pest infections to local commercial vineyards. This program is designed to help remove those sources and make that land productive. See the website at or contact Kim at ksk76@cornell.edu.

Is "Carbon Farming" Coming to New York State?

by Kitty O'Neil, PhD, CCA

In March of this year, the NYS Senate passed S4707, a bill to establish a tax credit for farm businesses implementing certain practices known to reduce greenhouse gas emissions, among other benefits. The bill was referred on to the NYS Assembly and it currently is under consideration in the Assembly Agriculture Committee as A2042. Legislation aimed at addressing climate change while also protecting our state's soil, air and water has been introduced by various NYS governmental bodies before. Previous policies and investments such as the Climate Leadership and Community Protection Act (S6599, signed by Governor Cuomo in July 2019), have established benchmarking and emissions targets for reductions into the future. This is also the policy that set up renewable energy goals for the state. Many expect additional programs and investments in many different strategies by our state and federal administrations, aimed at mitigating climate change factors, over the next few years. Many are working to ensure these new policies benefit farms who will play a key role.

The current bill under consideration, if passed as currently written, would award tax credits of varying amounts, based on the magnitude of expected greenhouse gas benefits, for adoption of accepted and standardized NRCS conservation practices, such as:

- decreasing the frequency of fallow phases in crop rotations,
- using reduced-till, no-till or strip-till planting methods,
- including legume or non-legume cover crops with subsequent fertilizer reductions,
- improving fuel efficiencies of combustion engine farm equipment,
- managing manure applications for reduction in fertilizer needs on cropland,
- converting annual cropland to grass and legume forage crops
- planting trees or shrubs for silvopasturing,
- using prescribed grazing plans,
- many more strategies

Senate bill S4707 and Assembly bill S2042 are not law yet. But if and when they are passed and implemented, they would begin to compensate farms for using quite a few different practices that will benefit the entirety of the state, national and worldwide populations. There is much left to figure out in terms of how calculated greenhouse gas emissions will translate to dollars, and how farms may be able to take advantage of these opportunities. But it is encouraging that economic incentives are planned to help farms to adapt and mitigate, counteracting the economic forces that resulted in current practices.

Additional Resources:

1. NYS Senate Bill S4707.
2. NYS Assembly Bill S2042.
3. NYS Climate Leadership and Community Protection Act, S6599 of 2019.
4. NRCS Practice Standards for Greenhouse Gas Emissions Reduction and Carbon Sequestration,

For more information about field crop and soil management, contact your local Cornell Cooperative Extension office or your CCE Regional Field Crops and Soils Specialists, Mike Hunter and Kitty O'Neil.

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Our Mission

"The North Country Regional Ag Team aims to improve the productivity and viability of agricultural industries, people and communities in Jefferson, Lewis, St. Lawrence, Franklin, Clinton and Essex Counties by promoting productive, safe, economically and environmentally sustainable management practices and by providing assistance to industry, government, and other agencies in evaluating the impact of public policies affecting the industry."

Building Strong and Vibrant New York Communities

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