

FINGER LAKES

Vineyard Notes



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Newsletter #2

April 20, 2011

Identifying Nutrient Deficiencies in the Field

Hans Walter-Peterson
Finger Lakes Grape Program

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If you are a grape grower, you have most likely had this happen at least a few times: You're walking down a row or riding on the tractor when you notice that some of your vines don't look right. The leaves are a little discolored, or the shoots aren't growing the way that they normally do. What's going on? Is it insect damage? A virus? Nutrient deficiency?

Being able to diagnose vine problems purely by visual cues can be challenging sometimes. Certain types of injury or deficiency can look similar to each other, which can lead to a misdiagnosis and spending money on solutions that don't work. In this article, I want to give a quick overview of how nutrient deficiencies develop, what to look for when diagnosing visual symptoms of nutrient deficiency (given the general theme of this newsletter), and symptoms of a few of the more common deficiencies that we see in the Finger Lakes.

How deficiency symptoms develop

Nutrient deficiencies can develop for a number of reasons, including inadequate supply in the soil, droughty or extremely wet soils, poor rooting depth or improper soil pH. When this happens, vines begin to employ some strategies to conserve nutrients, and in some cases remobilize nutrients from one portion of the vine to another where the demand is greater.

Nutrient deficiencies will impact various aspects of the vines' physiology, and will therefore be expressed in different parts of the vine. Understanding how the different nutrients are used in the vine can help to provide some insight as to whether a given symptom is the result of a nutrient problem or something else. For instance, poorly ripening fruit can be a symptom of several different problems, but knowing that potassium is very important in the movement of sugars from the phloem tissue into the berry would give you a possible direction to investigate further.

One of the most common places for nutrient deficiencies to express themselves is on the foliage. As we all know, leaves do all of the work of producing and exporting the raw ingredients that make up the sugars, acids, and other compounds that we ultimately want in the grapes. These factories require a lot of raw materials themselves in order function properly, and if there is a deficiency of any of them, it will often be expressed in the leaves.

One important concept to remember when considering the cause of a particular symptom that is visible on the leaves is that some nutrients are “phloem mobile”, which means that they can be mobilized from older, mature leaves in order to supply the shoot tip or younger leaves which will be taking over the majority of the work from the older ones. For these elements, deficiency symptoms first develop on the older leaves near the base of the shoots, because they have started to send those nutrients to the younger leaves so they can remain fully functional. On the other hand, there are a few nutrients that generally are not mobilized by older leaves, and therefore symptoms of deficiency in those nutrients will usually first appear in the younger leaves or the shoot tip.

Phloem-immobile nutrients** **Phloem-mobile nutrients**

Calcium	Nitrogen
Boron	Potassium
Molybdenum	Magnesium
Manganese	Phosphorus
Iron	Chloride
Copper	Sulfur*
Zinc	

* Sulfur is sometimes listed as an immobile element as well. It is capable of some movement in the plant.

**These elements are generally considered to be relatively immobile in most plants, but there can be small amounts that are transported in the phloem. Calcium and boron are usually considered immobile.

Distinguishing nutrient symptoms from other causes

As mentioned earlier, nutrient deficiency symptoms can sometimes resemble those expressed as the result of other problems in the vineyard like pest damage, environmental issues, or physical damage (tractor blight, anybody?). When trying to determine the cause of any specific symptoms, consider a few questions:

Are leaf symptoms on basal, middle, or apical leaves on a shoot?

As mentioned above, this can help to at least eliminate a few possibilities, and give some direction for further questions or fact-finding.

Are the symptomatic vines in one distinct area, or scattered throughout the vineyard? Are they only along vineyard edges?

Nutrient deficiency symptoms are usually found on vines in one specific area, as they are often dictated by variety, rootstock and/or soil type. Symptoms developing on vineyard edge rows or panels often suggest pest or disease pressure first, or some other non-nutrition issue (e.g., shading by woods).

What time of year are the symptoms appearing? What have the weather conditions been like?

Unless they are severe, nutrient deficiency symptoms on leaves won't usually appear until after bloom. One notable exception can occasionally be seen when nutrient demand in the vine can't be met under cool growing conditions in the spring and leaves begin to yellow somewhat, a condition sometimes called 'spring fever'. The return of warmer weather will usually alleviate the symptoms. In some cases, deficiencies can cause irregular shoot growth or poor cluster development or fruit set, which can be observed prior to bloom.

Do the leaf symptoms show any kind of pattern (between veins, margins)?

Some deficiency symptoms show very distinctive patterns on the leaves. Discoloration between the main veins is often an indication of a nutrient problem, whereas a burning or chlorosis (discoloration) along the leaf margins could be caused by a number of issues, including burning from excessive spray deposition gathered at the leaf margins.

Deficiency symptoms for selected nutrients

Nitrogen (N)

Nitrogen is one of the mobile elements discussed earlier, so early symptoms would start to show in basal leaves, however it is often the case that N deficient vines will just have an overall light green appearance throughout the vine. Other symptoms can include reduced shoot growth, shortened internode length, and smaller leaf size. Consider other environmental conditions that may produce symptoms similar to N deficiency, such as drought or excessive rainfall, pest pressure such as mite feeding, or excessive shading of leaves which can also cause them to yellow.

Potassium (K)

Vines that are deficient in K will also show symptoms on older leaves first, as they transport their K content to the younger ones (see photo). Symptoms will usually appear later in the growing season, starting at the leaf margin and gradually work inward between the veins. Tissue may turn brown and die, or may be red in certain red-fruited varieties. Vines that are deficient may also have reduced vigor, poor fruitset, and have difficulty ripening a crop.



Concord shoot showing potassium deficiency in basal leaves (left), gradually disappearing in apical leaves (right).

Magnesium (Mg)

One of the primary functions of Mg in the vines is to be the central atom in the chlorophyll molecule. A shortage of Mg, therefore, will result in less chlorophyll production and a yellowing of the interveinal leaf tissue. The discoloration can be quite pronounced as it progresses, leaving the veins and immediately surrounding tissue green (see photo). These symptoms will also first appear on older basal leaves. The symptoms can sometimes be confused with potassium deficiency, so a petiole test is often recommended in order to be certain of the diagnosis.



Mg deficiency on Corot noir vine. Both red and yellow discoloration are visible on the leaves.

Phosphorus (P)

As with the other three elements discussed here, phosphorus is a mobile element in the plant and therefore symptoms will first be expressed on older leaves. Typical symptoms include reddening between the veins in red-fruited varieties (see photo), and yellowing discoloration in white varieties, particularly at the leaf margins. Severe deficiencies will result in reduced vigor, poor fruit set, or increased numbers of blind buds the following year. Symptoms can sometimes be confused with leafroll virus or mite damage in red varieties. Phosphorus availability is significantly reduced at low soil pH, so the addition of lime over several years to raise pH is often recommended to alleviate this.



P deficiency on Noiret leaf

Conclusion

Knowing what to look for and what questions to ask can go a long way in determining whether foliar symptoms that you see in the vineyard are the result of nutrient deficiencies or not. Unfortunately, these symptoms can often resemble those expressed as the result of other problems including pest damage, environmental issues such as rainfall amounts or temperatures, or site characteristics. The only full-proof way to know is to have good information from soil and petiole tests to guide your decision-making on the best course of action to alleviate the problem.

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Nitrogen & Potassium in Vineyards

Michael Colizzi

Finger Lakes Grape Program

If you are thinking about adding some fertilizer to your vineyard this spring it's important to know which products are best. Nitrogen and potassium are two of the most common fertilizers to add. We are going to explore some of your options for adding these nutrients in the coming growing season. Always keep in mind that the correct fertilizer program for maximum yield may lower quality, and that a fertilizer program for the highest quality may lower yields.

When compared to most other crops grapes do not have a high nitrogen requirement. High levels of nitrogen in grapes can cause problems for winter hardiness, disease and insect susceptibility, fermentation, and vine balance. Not having enough nitrogen can affect the vines' winter hardiness along with reducing yield. The most efficient way to apply nitrogen is through split applications. Apply half of the nitrogen in the spring just prior to bloom and the other half about 3-4 weeks later. This will ensure that the nitrogen is available when the plant is able to take it up and the plant needs it most, reducing the amount that is lost to leaching. Plants use nitrogen for photosynthesis, amino acid production, and as a building block for DNA along with many other important tasks.

There are over a dozen forms of nitrogen fertilizers available. The four most common forms used in grapes are: urea, calcium nitrate, ammonium sulfate, and calcium ammonium nitrate. The amount of actual nutrient in a fertilizer is expressed as a percentage. This number is important when calculating fertilizer rates based off of soil test recommendations. Urea usually has 46% actual nitrogen in it, ammonium sulfate has 21%, calcium ammonium nitrate has 27%, and calcium nitrate contains 15%.

The uptake of potassium and many other nutrients can be reduced in soils with low pH. If vineyard soils are not at the proper pH adding nutrients will just be a waste of money. At harvest half of the plants total potassium levels are located in the fruit. During harvest five pounds of potassium are removed for every ton of grapes harvest. You will have to make a potassium addition to offset this. It can be through either synthetic fertilizers or natural sources such as pomace.

There are three forms of potash commonly used in grapes - potassium chloride, potassium magnesium sulfate, and potassium sulfate. Its purest fertilizer form is potassium chloride which contains 60-62% K_2O . It is often referred to as muriate of potash. Potassium sulfate, which contains 50% K_2O , can double as a source of sulfur. Potassium magnesium sulfate contains 22% K_2O . Both potassium and magnesium are cations and compete with each other for cation exchange sites in the soil. Cation exchange capacity or CEC is the ability of a soil to attract and retain positively charged ions in the soil. If potassium occupies

a large percentage of the CEC then the soil will not be able to attract or retain magnesium or other cations, which could lead to a magnesium deficiency.

No two vineyards are the same, and therefore what one block needs another may not need. Sample each block separate and amend accordingly. A vineyard is constantly changing so routine soil and petiole tests are essential for maintaining good vine health.

Vit 101: Top 5 Nutrients Every Grower Should Know

Michael Colizzi

Finger Lakes Grape Program

Spring is upon us, and its time to think about replenishing the nutrients your vines removed from the soil last season. Before you just run out and buy any old fertilizer make sure you know what your plant needs, it may not need anything at all. Using both soil and petiole samples to determine what nutrients need to be applied is a good idea.

When most people think about fertilizers the first nutrient that comes to mind is nitrogen. Nitrogen is a great fertilizer when used properly. If used improperly it can throw vines out of balance and adversely effect crop quantity and quality. Plants use nitrogen in all major functions including photosynthesis, amino acid production, and as a building block for DNA, just to name a few. As a result of its role in photosynthesis, plants with nitrogen deficiencies will exhibit chlorosis (yellowing) on the older leaves first as well as a reduction in shoot length and yield. All of the phloem-mobile nutrients (N, P, K, Mg, Cl, & Mo) will exhibit deficiency symptoms on the older leaves first, because plants move those nutrients out of the older leaves to supply the young ones. Excess nitrogen can also increase a plant's susceptibility to disease and insect damage. It can also decrease the winter hardiness of a vine.

Phosphorus is another macronutrient essential for plant growth and development. It is present in the energy storage molecules of plants. This energy is considered the currency of life and drives all the plant activities. Without phosphorus, plants would not be able to function properly. Before the deficiency reaches a dire level the plant will exhibit chlorosis of basal leaves, which could include reddening of leaves on red grape cultivars. Reduced berry set and yield could also be observed. One of the most common causes of phosphorus deficiency in eastern vineyards is low soil pH.

Potassium is involved in many of the major plant functions. Its most important role in grapes is as an osmotic agent. Simply put, it helps things dissolved in water pass through plant membranes. For vines with low potassium levels, sugars are not able to move through the plant properly. This could lead to low brix numbers at harvest or a delayed harvest. The main thing to remember about potassium is that by harvest, half of the plants total potassium

levels are located in the fruit. At harvest, five pounds of potassium are removed for every ton of grapes harvested. Potassium deficiencies generally show up late in the season on basal leaves, and include interveinal chlorosis and necrosis.

The final macronutrient I wanted to address is magnesium. Two of its key roles are as the central atom of chlorophyll, and being an activator for all major enzymes in a plant. Chlorophyll is vital for photosynthesis, which allows plants to obtain energy from sunlight. If the plant is lacking chlorophyll due to a magnesium deficiency it will not be able to grow and develop properly. Deficiency symptoms include chlorosis of the basal leaves and yield reductions.

Boron seems to be one of the most talked about micronutrients. It is responsible for the movement of sugars across membranes, much like potassium. It also works with calcium for cell wall formation, and is used in pollen germination. Deficiency symptoms include premature death of shoot and root tips, deformed berries, poor fruit set and low brix levels.

A vineyard soil is always changing so what was added last year may not be what is needed this year. Soil and petiole tests should be taken regularly to determine what nutrients need to be added and at what rates.

	Plant Available Form	Functions in Plant	Deficiency Symptoms	Fertilizers
Nitrogen	NH_4^+ and NO_3^-	Photosynthesis, Amino Acid Production, DNA Building Block	Chlorosis of Basal leaves Yield reductions	Calcium ammonium nitrate Ammonium sulfate Calcium nitrate & Urea
Phosphorus (Phosphate)	H_2PO_4^- HPO_4^{2-}	Energy Storage	Chlorosis of Basal leaves, Leaf Reddening in Red Grape Cultivars, Poor Berry Set, & Yield Reductions,	Triple Superphosphate, Monoammonium phosphate (MAP), Diammonium phosphate (DAP)
Potassium (Potash)	K^+	Helps water dissolved molecules pass through plant membranes	Interveinal and marginal chlorosis and necrosis of basal leaves.	Potassium chloride (muriate) Potassium sulfate Potassium magnesium sulfate
Magnesium	Mg^{2+}	Central atom of chlorophyll Enzyme activator	Chlorosis of Basal leaves, yield reductions	Epsom salts Potassium-Magnesium Sulfate (Sul-Po-Mag)
Boron	H_3BO_3	Helps sugars move across membranes, Cell wall formation, & Pollen germination	Death of shoot and root tips, deformed berries, & low brix levels.	Boric Acid Borax Foliar Sprays

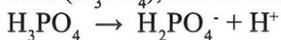
Question from the Field: Do foliar fertilizers that contain phosphorous also provide some control of downy mildew? Is there a difference between those materials and fungicides like Phostrol or Rampart?

Hans Walter-Peterson

This is a question I get at least a couple of times every year. First and foremost, if a material is not labeled to control a particular disease or pest, then it should not be used as part of your pest management program. Not only is it illegal to do so, but materials that are not labeled as pesticides have not been subjected to multiple years of testing and trials to determine how effective they are. Keep it simple – use foliar fertilizers as fertilizers and pesticide materials as pesticides. Don't bother trying to squeeze multiple uses out of one single product.

To the particular question at hand, yes, there is a small but major difference between phosphorous-containing foliar fertilizers and 'phos acid' fungicide products. The difference lies in the type of phosphorous (P) compound that is used in each of the products, and what forms they are converted to once they are inside the plant (ready for a short chemistry lesson?).

The primary form of P that plant roots take up from the soil and use as a nutrient is called 'phosphate', in the form of dihydrogen phosphate, or simply phosphate (H_2PO_4^-). Fertilizers will usually contain P in the form of *phosphoric acid* (H_3PO_4), which breaks down to phosphate:



Once inside the plant, the phosphate ion is quite stable, and can easily be transported throughout the plant via the phloem.

The form of P that is contained in fungicides is *phosphorous acid* (H_3PO_3). Even though the name and the formula look almost identical to phosphate, it does not work in the same way inside the plant. Phosphorous acid dissociates into a different form, called either *phosphite* or *phosphonate* (HPO_3^{2-}), which cannot be used by the plant as a nutrient. There are no known biochemical paths in plants that will convert phosphite to phosphate, or vice versa. The small difference of one oxygen and one hydrogen atom between the two types of ions makes a big difference as far as the plant is concerned. It is phosphonate that has been found to be very effective against organisms like downy mildew and phytophthora.

In a situation like this, it is critical to understand just what you are getting when purchasing materials for disease control or fertilizer that are phosphorus-based. If you are told that a foliar fertilizer containing P will provide both nutrients and some level of disease protection, be highly skeptical. In order for one product to both fertilize and

provide disease protection, it would need to contain the two different forms of phosphorus discussed here. Currently, I am not aware of any 'phos acid' fungicide available in New York that does.

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NEWA Updates - Weather-driven Grape IPM Forecast Models and Decision Aids

*Juliet Carroll and Tim Weigle,
NYS IPM Program, Cornell University*

The IPM applications for grapes in the Network for Environment and Weather Applications (NEWA) have been greatly improved. The focus of the work was on the grape berry moth degree day model, on making improvements to the displays and pest management messages for the grape diseases powdery mildew, black rot and Phomopsis cane and leaf spot and the DMCase model for grapevine downy.

Greg Loeb, Cornell University grape entomologist, helped us develop the companion text on pest management for the grape berry moth degree day model. The text describing management practices was developed for the appropriate degree day ranges for the first, second, and third generations of grape berry moth. The web page design, degree day time-frames, and pest status messages were finalized by Loeb, Weigle, and Carroll with input from Mike Saunders, Penn State University, and Rufus Isaacs, Michigan State University. The biofix to start the model, is *Vitis riparia* bloom date. The grape berry moth degree day model went live in May 2010.

The NEWA grape berry moth model was used to time pesticide applications in research blocks and grower vineyards in a project being conducted by Loeb and Weigle, Cornell University, and Saunders, Timer and Muza of Penn State. Results of the model were used to provide information to growers in the Lake Erie region, which was particularly helpful due to the extremely warm 2010 growing season that resulted in a fourth generation of grape berry moth. The grape berry moth phenology model has been utilized

by grape growers in the Finger Lakes, the Lake Erie region and was being explored on Long Island.

Wayne Wilcox, Cornell University grape plant pathologist met with us to develop text describing the disease management practices for the appropriate vine phenology stages to accompany the infection events tables for the powdery mildew, black rot, and Phomopsis models. The web page design, vine phenology time-frames, and infection event messages were finalized by Carroll, Wilcox and Weigle. The grape diseases information was programmed by the Northeast Regional Climate Center for the NEWA website. The model pages are currently undergoing internal review and will be launched in mid-April in time for the 2011 growing season. Robert Seem and David Gadoury, Cornell University, plant pathologists, helped us improve the grapevine downy mildew model, DMCast, and re-program it with the Northeast Regional Climate Center (NRCC) into their database and displayed in the NEWA website frame. The simulation model went live in April 2010.

All the grape forecast models can be accessed from newa.cornell.edu/index.php?page=grape-diseases: Click on “**Pest Forecasts**” on the blue menu ribbon on the NEWA website, newa.cornell.edu, and then click on “**Grape Forecast Models**” on the drop down list. The grape forecast models will utilize NWS forecasts to push disease risk messages into the projected weather future to greatly enhance IPM practice and Extension alerts to growers. Information from the NEWA grape forecast models and weather data were utilized by Extension educators in their newsletter articles to support IPM practice and prevent crop losses.

Investigation of leaf wetness algorithms may pave the way to augmenting or phasing out the use of leaf wetness sensor grids for NEWA models. Because leaf wetness sensors are not standard measurements gathered by weather instruments, this will allow the geographic coverage for plant disease forecasts to expand significantly, not only for grapes but for other crops. We tested the leaf wetness algorithm used by the Maryland Grape Growers Association and found it to provide a reasonable, if not better, estimate of leaf wetness as compared to leaf wetness sensors, validating their use of this algorithm to support grape IPM practice in their region. We are currently pursuing the use of an improved fuzzy logic model for NEWA, developed also at Iowa State University, for estimating leaf wetness.

NEWA’s degree day tables were expanded to accommodate an April 1st accumulation start date, available from newa.cornell.edu/index.php?page=degree-days, which is utilized for grapevine and berry development by viticulture extension specialists, researchers and grape growers in NY. The berry curve, growing degree days (base 50F), has been used for Concord grapes to provide estimates of overall crop development in the Lake Erie region. Viticulturalists

Bates and Creasap Gee have been analyzing the berry growth curve for hybrid grape varieties which assists growers in determining crop thinning and harvest windows in the Lake Erie Region. These new tables will contribute to improved crop management estimates in grapes.

Ten grape growers and one researcher purchased and installed weather stations in vineyards to connect to NEWA. In NY: Thirsty Owl Wine Company, Hosmer Winery, Three Brothers Winery, Shalestone Vineyards, Lamoreaux Landing Wine Cellars, Standing Stone Vineyards, Zugilbe Enterprise LLC, Swedish Hill Winery/ Blue Water Vineyard, Wagner Winery, and the Hudson Valley Laboratory. In PA: Harbor Creek. Six additional weather stations are slated for installation in 2011 in the Lake Erie Regional Grape Program’s region.

The NEWA system was utilized to document severe weather events for crop insurance purposes – severe hail storms in 2009 in the Finger Lakes region and a series of late spring freezes in May 2010 throughout the fruit growing regions. During spring of 2010, a series of freezes occurred in May throughout the fruit growing regions, causing damage to grape vineyards and data collected by the NEWA system was utilized to document these events.

Our goal is to provide state-of-the-art, weather-driven grape IPM forecasts and viticulture decision aids to viticulture industries through the Network for Environment and Weather Awareness (NEWA). We created the grape berry degree day model web pages, upgraded the grape disease model web pages, identified an improved method for estimating leaf wetness events, improved growing degree day outputs for grapes, and sourced and served information on critical freezing temperatures. NEWA’s improved IPM forecast model outputs will support Extension information delivery and enhance grape IPM, reduce pesticide inputs, and prevent crop loss. The impact of this grape NEWA project will be to enhance the sustainability of vineyards, minimizing environmental impact, and maintaining profitability.

UPCOMING EVENTS

Spring Grape IPM Meeting

Thursday, May 19 3:30 – 6:00 PM

Doyle Vineyard Management Farm

10223 Middle Road, Hammondsport NY

This meeting is always a great opportunity to get your pest management questions answered right as the season is getting underway. Some of the usual suspects like Andrew Landers, Greg Loeb, and Wayne Wilcox will be speaking on their respective specialties once again this year. We will also hear from Hugh Fraser from Ontario, who has done a lot of work over the past several years on how to properly set up and use bird cannons. Many of the material suppliers who service the region will also be on hand to provide information on new materials and formulations that they have available for use this year. We have applied for NY pesticide recertification credits. As always, the meeting will be followed by social time and a tasty BBQ dinner.

Please let us know if you are coming so we can plan for enough food for everyone. Please call our office at 315-536-5134 or email Mike Colizzi at mac252@cornell.edu and let us know how many will be attending, and your pesticide certificate numbers. There is no charge for those who are enrolled in the Finger Lakes Grape Program for 2011. There will be a \$5/person charge for those who are not. We look forward to seeing you in May!



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Finger Lakes Grape Program

Ontario, Schuyler, Seneca, Steuben, and Yates Counties

County Office Building

417 Liberty Street • Penn Yan, NY 14527

Comments may be directed to

Hans Walter-Peterson

Viticulture Extension Educator

Finger Lakes Grape Program

315-536-5134

hcw5@cornell.edu

Cornell Cooperative Extension

Finger Lakes Grape Program

417 Liberty Street

Penn Yan, NY 14527

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