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Upcoming Events:

Viticulture Short Course June 4-5 Bryan TX. Registration Closes May 29th.

Vine Training Workshop June 8th 9-:30. Grayson College No Registration required.

For more information on times, locations or costs please contact your regional Viticulture Program Specialist

In this issue:

Welcome to our latest issue of Texas Winegrower. We hope you find something inside to both interest and inform. We've attempted to cover a variety of topic areas from pre-plant decision making, vineyard maintenance and disease management to understanding and controlling vineyard disease.

The mission of Texas A&M Agrilife Extension is '**Improving the lives of people, businesses, and communities across Texas and beyond through high-quality, relevant education***"* The Viticulture and Enology team strive to utilize this newsletter as a vehicle for that mission. It is however, not our only avenue for outreach. In addition to taking calls, emails, and making site visits to answer grower concerns, we hold workshops, tailgate meetings, short courses and serve as speakers at educational events across the state year round. In addition, we conduct applied research in multiple growing regions to gain information that we hope will help increase the knowledge base and meet growers evolving needs.

Our website offers information available in fact sheets, past presentations, and articles as well as links to purchase publications. The website is undergoing construction as we update the presentation of our materials and add new content. However it will remain online during this process so that you can access everything that is currently available. Please check back as we continue to improve our website. It can be found at:

https://aggie-horticulture.tamu.edu/vitwine/

Viticulture Short Course

Please mark your calendars and register for the Texas A&M AgriLife Extension Advanced Viticulture Short Course, to be held June 4th and 5th at the Hilton Garden Inn in Bryan Tx.

Topics will include Water Relations and Quality, Irrigation, Vine Water Status, Soil Fertility, Soil and Tissue Testing, Emerging Varieties and more. Lunch will be provided on site for both days and Dinner will be provided at Peach Creek Vineyards on June 4th.

Registration closes May 29th and is limited to 75 participants, so register early in order to ensure your seat. For more information please contact Fran Pontasch. More information on page 20. Register at agriliferegister.tamu.edu/productListingDetails/2580. Conference hotel registration can be found at secure3.hilton.com/en_US/gi/reservation/book.htm?execution=e2s1

Pre-plant Decision Making

Rootstocks. What are they and do you need one?

Michael Cook

A rootstock is defined by Jim Kamas in his book *Growing Grapes in Texas* as a genetically distinct cultivated variety of grape used to induce or reduce scion vigor or to overcome specific soil limitations. The reason we can even talk about rootstock use in grapes stems from the fact that within the *Vitis* genus most species can be easily propagated asexually from either hardwood cuttings and/or green stem cuttings. They are also graft-compatible with each other, meaning you can "fuse" one grape cultivar onto another, either by grafting or budding.

Grapevine that was Omega bench grafted. Image courtesy of Fred Rouleau and Mercy Olmstead.

The purpose of a rootstock is simple, to enhance the performance of the scion, or the grape cultivar situated above the rootstock that will provide the grape canopy and fruit. Unfortunately, not all grape species are graft-compatible. One example would be the use of native muscadine as a rootstock with the bunch grapes. Because many common rootstocks are derived from native Texas *Vitis* species, there are options available to growers that can help overcome the varying challenges we face across regions.

Though we can obtain most varieties as grafted vines, is it all really necessary? In many cases, yes. In fact, one of the most notable accomplishments in grape history was the success Thomas Volney Munson of Denison, Texas along with other horticultural pioneers had in using native North American grape species as rootstocks in France to save their wine industry from complete annihilation from the introduced aphid-like soil-borne pest known as phylloxera. The grape species utilized as rootstock were selected, collected, and shipped to France because they were tolerant of phylloxera whereas the European varieties were susceptible. Without grafting rootstock onto those European cultivars, you would not be enjoying that glass of Bordeaux wine today.

Fast forward to the present and rootstocks are commonly used in vineyards across the globe, often in conjunction with European scions. One reason for this is because European cultivars are not native to the Americas and are not well adapted to our soils and the plethora of pests that reside within them, and internationally many of these pests have been introduced and now pose significant threats. Some of these soil-borne pathogens and pests include nematodes, phylloxera, and cotton root rot.

Other challenges that a rootstock may help overcome include physical and chemical soil restrictions such as poorly drained soils, high calcium bicarbonate levels, and high sodium concentrations. With over 1,300 soil series

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found in Texas, there certainly will be sites that are better suited for grapes than others and more often than not a rootstock will be of economic benefit.

Still, some growers choose to plant their vineyards with own-rooted vines, which means they are not using a rootstock. This most commonly occurs in the Gulf Coast and East Texas regions where hybrids are being cultivated. Hybrid cultivars, such as Black Spanish and Blanc du Bois have been bred to include native American genetics and are thus more adapted to our soil conditions. Just because one is growing a hybrid grape however does not mean there is no benefit in using a rootstock. Recently, there has been a shift with producers who are growing own-rooted Blanc du Bois on alkaline soils to grafting their vines to improve vine health and fruit production. Other growers choose to grow *V. vinifera* as own-rooted vines in areas where freeze injury could result in death of the above ground portions of a vine. This allows a grower to retrain the vine when it re-emerges from the root, something not possible in a grafted vine. The economic advantage to this is in the event of vine death due to freeze, it is not necessary to purchase and plant new vines. At the end of the day a grower should assess the risk to return of planting own rooted vines versus grafted.

A mature grafted vine exhibiting differences in vigor between the scion and rootstock.

If a grower decides to use a rootstock the next question that must be asked is which is the optimal one to select? Choosing the correct rootstock for your site can be overwhelming as there are so many options available. One mistake made by many new growers or established growers expanding their vineyard acreage is to order a cultivar they are interested in that is grafted onto a rootstock that is not appropriate to the site. There are many rootstocks to choose from and their performance varies greatly.

If you contact a nursery that provides grafted stock they will often provide you with a general rootstock performance table that showcases the varying characteristics of a specific rootstock. For example, a widely available rootstock used commonly in Texas is 1103 Paulsen, which is adapted to a wide range of soil types. This rootstock is a cross between *V. berlandieri x V. rupestris* grapes and has high tolerance to phylloxera, good tolerance to drought conditions and salinity but poor resistance against the Dagger nematode. It is also a vigorous rootstock and can therefore induce vigor onto the scion. This can be either beneficial or problematic depending on the vigor of the scion. Conversely, 101-14 Millaret Et De Grasset is a cross between *V. riparia x V. rupestris* and has good resistance to both the Root Knot nematode and the Dagger Nematode but poor salinity tolerance. It also tends to be a moderately vigorous rootstock. For growers to make a sound decision of whether or not they should utilize a rootstock and if so, which rootstock to select with their scion, they should contact their regional viticulture program specialist. The Texas A&M Viticulture and Fruit Lab located in Fredericksburg has

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recently performed an exhaustive study on rootstock performance in sites situated across the state. This information can be very helpful in providing pertinent, Texas specific, rootstock performance. While there is no silver bullet, the use of a rootstock can greatly improve the adaptability of a wine grape cultivar that otherwise would not perform well in certain parts of Texas and is a very useful tool to have in the toolbox.

Rootstock	Phylloxera Resistance	Nematode Resistance	Drought Tolerance	Salinity Tolerance	Lime Tolerance	Vigor Potential	Soil Adaptation
1103P	High	Med-High	Med-High	Medium	Med	Med-High	Drought & Saline Soil
5BB	High	Med-High	Medium	Medium	Med-High	Medium	Moist Clay
110R	High	Low-Med	High	Medium	Medium	Medium	Acid Soils
SO4	High	Med-High	Low-Med	Low-Medium	Medium	Low-Medium	Moist Clay
101-14 Mgt.	High	Medium	Low-Med	Low-Med	Low	Low	Moist Clay

While not an exhaustive list of all available or recommended rootstocks, this chart is an example of a typical chart published by many wholesale nurseries, hi-lighting rootsocks commonly used in Texas.

These photos were taken on the same day, at Fredericksburg Viticulture and Fruit Lab. The same scion grafted to different rootstocks in a dry year demonstrates the difference rootstock can have on a characteristic like timing of budbreak. These dramatic differences are not observed in a typical year, and it is not yet clear if the vines that broke later will produce a normal crop. Photo courtesy of Bri Hoge.

Vineyard Maintenance

Managing Fungal Pathogens (Part I)

Justin Scheiner

This is the first of a two part series addressing some of the concerns and points of confusion surrounding the proper selection and use of fungicides in the vineyard. The appropriate selection, timing and application of fungicides is an integral part of any successful viticulture program. Growers must understand the fungal pathogens that can affect vineyards in their regions and familiarize themselves with appropriate spray programs to manage those threats.

Many growers substantially underestimate the damage fungal pathogens can do to commercial grape production. Fungal pathogens pose a significant threat to both fruit and foliage throughout Texas. The single most important tool for fungal disease control in commercial grape production is fungicides, and fortunately there are many options to choose from. However, knowing which fungicide(s) is right for the job and when to make an application can be a challenge, particularly for new grape growers.

When considering your spray program, think about how much you know about your tractor. You know what each gear, lever, and button is/does and you should know that level of detail about your fungicides because choosing the wrong product or spraying at the wrong time can literally be the difference between having a crop or not.

For example, downy mildew is a significant challenge in the Gulf Coast, and almost every year someone loses their entire crop to it. An all too common reason is the use of Rally® (myclobutanil) for downy mildew control. Rally® is a great fungicide that most growers use, but it is not efficacious against downy mildew. ***The term efficacy refers to the activity or effectiveness of a fungicide against a specific pathogen.***

Rally® is highly efficacious against black rot and powdery mildew, but not downy mildew. There are very few products (e.g., Pristine®) that are active against all of the major fruit and foliar fungal diseases, and quite a few (e.g., phosphorus acid, spray oil) are only effective against a single fungal pathogen. When choosing a fungicide(s), it's critical to understand which disease(s) it controls and how well.

	Downy Mildew	Powdery Mildew	Black Rot	Phomopsis
Rally®		√	√	
Pristine®	√	√	√	√
Phosphorus acid	√			

Complete fungicide efficacy and use tables can be found in the [2018 Texas Grape Pest Management Guide](). Guides can be purchased online from the Texas A&M Agrilife Bookstore.

Another important aspect of fungicides that can be easily overlooked is the physical mode of action, or in other words, when does it need to be applied to be effective; before an infection event (infection event = tissue wetness from rain events, heavy dew, or high humidity) or after. A fungicide that has protectant only activity pro-

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vides protection from the point of application forward, but will not provide "reach-back" to control infections that were previously initiated. Most protectant fungicides offer limited to no reach-back. In contrast, a post-infection fungicide controls disease most effectively when applied after the infection has begun, but before symptoms are visible. This group of fungicides work best when applied several days up to a week after an infection event. Many post-infection fungicides have limited forward (protectant) activity.

Protective (days)[a]	%Disease Control [c]	
	Abound	Nova
5	90	65
8	93	39
11	66	0
Post-infection (days)[b]		
3	39	95
7	42	87
10	15	39

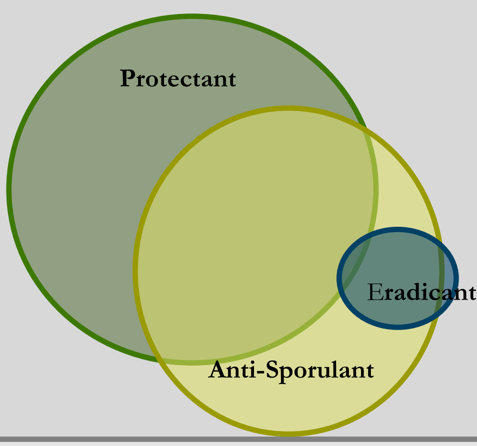
[a] Sprays were applied indicated number of days before infection with black rot spores.

[b] Sprays were applied indicated number of days after infection with black rot spores.

[c] Percent control relative to the unsprayed check

The table to the right is from a study conducted by Dr. Wayne Wilcox, a retired plant pathologist from Cornell University. He compared the efficacy of "Abound", a strobilurin fungicide in the same class as "Flint", (Group 1 fungicides) to myclobutanil or "Rally" (Group 3 fungicides). Myclobutanil was formerly sold in the east under the name "Nova".

The study compared efficacy based on when the application was made. Both fungicides have very good efficacy against black rot, and in this study when they were sprayed 5 days before infection with black rot, Abound provided 90% control while Nova (Rally) provided 65%. When applied 11 days before infection, Abound still provided 66% control, but Rally provided zero. The opposite occurred when the two products were sprayed after the infection event had already occurred. Rally had superior control while Abound was limited. Clearly, Abound works best when applied before the infection event (protectant) and Rally after (post-infection).



Some fungicides have significant **anti-sporulant** activity. That is, they significantly reduce sporulation of the fungal disease when applied to infected tissue. This activity helps reduce future spread of an existing infection. Very few fungicides, however, have **eradicant** or curative properties. That is they kill existing fungal colonies. In general, only a small number of powdery mildew fungicides have the capacity to eradicate existing fungal colonies, and these materials have very limited **protective** activity. This is why a well planned fungal protection plan is worth the effort, as a larger arsenal of dependable options are available.

The **mobility** of a fungicides refers to its physical location on or inside of tissue after application. **Contact** or **surface active** fungicides such as mancozeb and sulfur ***remain only on the outside of plant tissue***. This generally means they are susceptible to wash off by rain, although some are quite tenacious, additionally, rapidly growing shoots quickly "outgrow" coverage (i.e., leaves that develop after spraying are not protected). Most contact fungicides are toxic if they enter plant tissue, therefore should not be mixed with materials that aid in plant tissue penetration (e.g., oils).

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Systemic fungicides enter plant tissue and may move a short distance (**locally systemic**), from one side of the leaf to the other (**translaminar**), or in few cases long distances through the plant. These materials resist wash-off once rain-fast which generally requires at least four hours of drying time after spraying. However, using systemic material is not a substitution for poor coverage, which is a common reason for failure to adequately control disease.

The biochemical **mode of action** of a fungicide refers to the site at which the fungicide kills the pathogen. Broad spectrum fungicides have multiple target sites allowing them to kill a broad range of pathogens and decreasing the risk of pathogen resistance. ***Resistance*** refers to the propensity for fungal organisms to develop the ability to survive a fungicide they were previously sensitive to. This occurs through natural genetic mutations, and therefore resistance management is an important aspect of a fungal disease control program. Many fungicides kill or target one single site in the fungal organism, and this increases the potential for a fungus to develop resistance. These materials should be rotated with other biochemical modes of action accordingly, and limited in use. Rotation reduces the fungicide selections available for each infection event. Rotating with a fungicide that has a different mode of action, ensures that resistant pathogens do not survive and multiply. Fungicides are labeled with a resistance group or **FRAC (Fungicide Resistance Action Committee)** number that indicates their biochemical mode of action. It's important to note that groups of similarly acting chemicals (family) are labeled with the same resistance number, and therefore kill in the same way. Properly rotating and tank mixing different resistance groups ensures the long-term effectiveness of important fungicide tools. Note: fungicides that act at multiple target sites such as mancozeb and captan are not assigned a FRAC number due to their low risk of resistance.

All pesticides have a **restricted entry interval (REI)** and a **pre-harvest interval (PHI)**. The REI refers to the length of time after application that workers may not enter the treated area unless wearing the ***personal protective equipment (PPE)*** outlined on the label. The REI's of common vineyard fungicides range from a few hours to several days and can be vary for specific activities in the vineyard. For example, the REI for Oxidate is "until sprays have dried" while Pristine carries a 5-day REI for cane work. The PHI refers to the minimum length of time required between the last application and harvest. PHI's range from 0 days (e.g. Oxidate) up to 66 days (mancozeb).

One final area of possible confusion is the use of **adjuvants**. Spray adjuvants are chemicals that are added to a spray solution to enhance pesticide performance. There are several types of adjuvants that range from defoaming agents, spray buffers, oils, and compatibility agents, to coloring agents, and surfactants. Most commonly, surfactants or "wetting agents" are used in vineyard spray operations. Surfactants change the surface tension of water causing it to spread out more on a leaf or berry rather than bead up. Some products come with surfactants built in or others may indicate on the label that a specific surfactant be used. If you intend to use a surfactant read the product label to determine what, if any should be added. Not following the instructions on the label is a violation of the label and considered an illegal use of the pesticide. If in doubt, contact the manufacturer

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about using an adjuvant with their product.

A note on spray buffers and pH of the spray solution. When you mix a pesticide with water in your spray tank, it immediately begins to decompose or break down. Some products break down slowly over months while others may break down much more rapidly. An important factor that affects chemical decomposition is the pH of the spray solution. Perhaps the most extreme example is captan. At a pH of 5, the half-life (when half of the chemical has broken down) of captan is 32 hours. At a pH of 7, its half-life decreases to 8 hours, and at a pH of 8, the half-life is only 10 minutes. That means if you mixed up a tank of captan and your spray solution had a pH of 8, most of the fungicide would be degraded before you finished spraying. For most products, a slightly acidic spray solution (pH 4-6.5) is best. The pH can be lowered with acidifier adjuvants, or other acids. To determine how much to add per gallon or tank, incrementally add the acidifier to a gallon of water while measuring the pH.

When you make your next pesticide purchase, remember to look at the active ingredient. Just like an over the counter headache medicine, ***some fungicides and insecticides have multiple trade names for the same active ingredient (e.g., mancozeb).*** Brand named products are often more expensive than the generics, although the two may be indistinguishable with regard to effectiveness.

If you really want to compare apples to apples when purchasing fungicides, you should determine the cost per application of the product. How? Calculate how many acres can be treated with the container by dividing the volume or weight of the container by the volume or weight of an individual application.

For example, a 20 ounce bag of product A is used at a rate of 4 ounces per acre and is sold for $75.00 per bag.

A 20 ounce bag of product B is used at a rate of 2 ounces per acre and is sold for 100.00 per bag.

Product A– 20 ounces per bag ÷ 4 ounces per acre will treat 5 acres. At $75.00 ÷ 5 = $15.00 per acre to treat.

Product B- 20 ounces per bag ÷ 2 ounces per acre will treat 10 acres. At $100.00 ÷ 10= $10.00 per acre to treat.

If you do this for all fungicide products you will likely find a 4- to 5-fold difference in cost per acre.

While this article covered some of the most important aspects of fungicide use, there are still other important aspects to consider. In the next newsletter, Part 2 of this article will discuss spray intervals, rates, tank mixing or compatibility, pesticide formulations, and product shelf-life.

In addition to the Texas Grape Pest Management Guide, for sale online at the Texas A&M AgriLife Extension Bookstore; One of the best resources for information on fungicide use are fungicide workshops and talks covering fungicide use offered at grower meetings held by Texas A&M Agrilife Extension across the state and throughout the year. Please contact your regional Program Specialist for information on when and where these events are held.

Vineyard Maintenance

Grapevine Nutrition and Fertilization

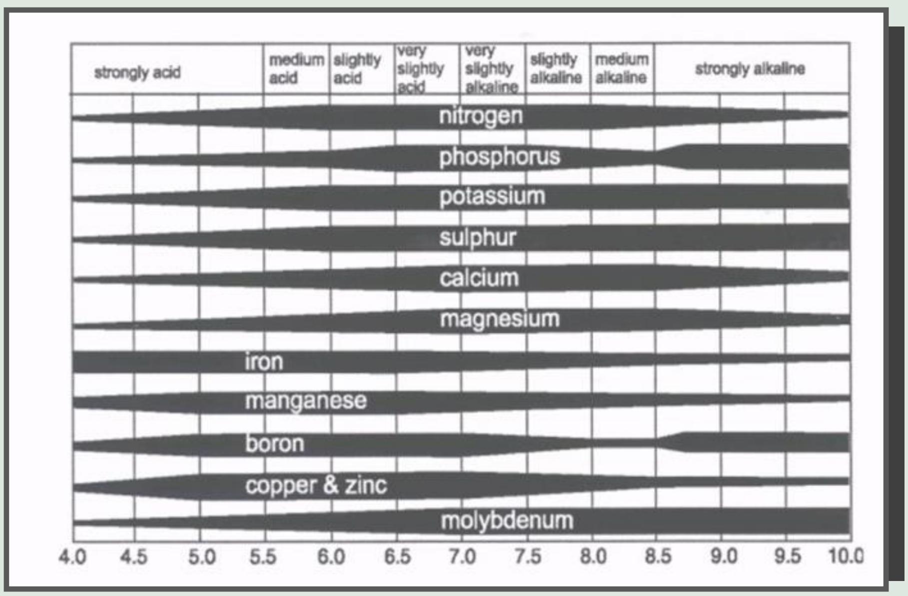
Fran Pontasch

This article is limited to discussing five mineral nutrients that are of concern to wine growers in Texas:

macronutrients - nitrogen, (N) potassium (K), and magnesium (Mg), and

micronutrients - zinc (Zn), and boron (B).

Vine health, yields, and grape quality are optimal when these nutrient elements are maintained throughout the vineyard at levels that are adequate, not excessive. Nutrients are primarily absorbed from the soil by grapevine roots. Having a baseline awareness of the chemical makeup of the vineyard's soil and what the grapevine roots have access to is very useful for assessing fertilizer need. Whether nutrient elements are naturally present in a soil or added by a fertilizer, they are most available to soils with a neutral pH. Soil pH dictates their subsequent uptake through the roots for integration into grapevine metabolism. High pH irrigation water also interferes with nutrient uptake, particularly during hot dry months when the demand on the irrigation system is high.



Soil and water reports help us keep tabs on the pH and nutrient status a vineyard, but tissue tests are most helpful for determining a fertilizer program. Because nutrients are constantly being translocated throughout the vine, collecting samples at random timings during the season can be misleading. Tissue testing is most informative when grape leaf petioles are collected at either full bloom or 70+ days after bloom. Some growers will choose one or the other while a few growers may sample at both. At full bloom, petioles are collected from leaves subtending the basal cluster of primary bearing shoots. From 70 days post-bloom through early fall (as long as the canopy remains fully functional) petioles should be collected from the recently matured leaf (most distal fully sized leaf) of a primary bearing shoot that is well exposed to sunlight. Collect two petioles per vine from 49-50 vines chosen at random from a block.

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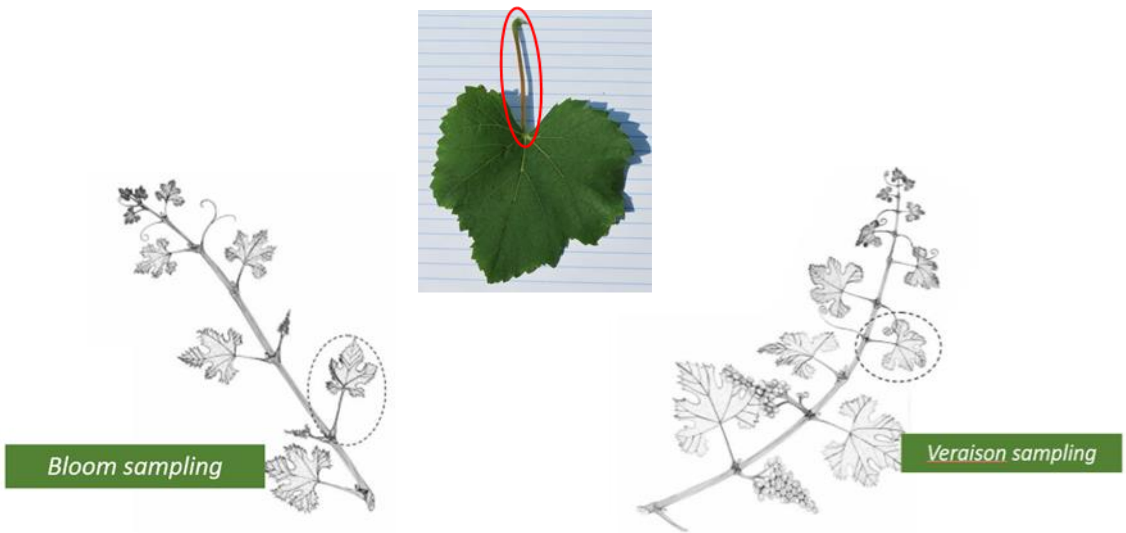

Drawings by Adrienne Mills for use in " Sampling Guide for Nutrient Assessment of Irrigated Vineyards in the Inland Pacific Northwest by Pacific Northwest Extension publications. 2011 © Washington State Universtity

Field observations should be supplemented with a lab analysis of dried plant tissue either leaf or petiole, or both. The lab analysis gives us an inside look of what the vines are doing at the time the tissue was sampled. Comparing the lab results with the vines' visual appearances will confirm or disclaim field observations.

Tissue sampling.

- Collect separate samples for different varieties, rootstocks or blocks.
- Wash off fertilizer and fungicide residues using **phosphate free soap**.
- Triple rinse with distilled or deionized water, allow to dry.
- When fully dried, submit to a reputable laboratory for analysis
- Consult your extension viticulturist to help you interpret results

Target Petiole Values

Nutrient	Bloom	Veraison
N	1.2-2.5%	0.8-1.4%
P	0.15-0.4%	0.1-0.3%
K	1.5-3.0%	1.5-3.0%
Ca	1.2-3.0%	1.0-3.0%
Mg	0.5-0.75%	0.5-1.0%
Fe	30-100 ppm	30-100 ppm
Zn	30-100 ppm	30-100 ppm
Mn	25-1,000 ppm	100-1,000 ppm
B	25-100 ppm	30-100 ppm
Cu	6-25 ppm	6-25 ppm
Mo	0.5 ppm	0.5 ppm
Na	<1,000 ppm	< 1,000 ppm

Image from J. Kamas "Growing Grapes in Texas" Texas A&M University Press ©2014.

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Look for patterns of symptoms while observing nutrient deficiencies.

Patterns, such as -

1. **Are symptoms in younger or older leaves, shoots, berries, clusters?**
2. **Do symptoms affect one vine, a few vines, a vine row, or cultivar block?**
3. **Does vine vigor or yield appear to be affected?**

Nitrogen (N). Nitrogen is integral to grapevine photosynthesis, growth, and structure, and is the nutrient applied most to grapevines. Nitrogen is highly mobile in the soil and vines, and may be most efficiently applied in small amounts. Vines deficient in nitrogen have pale, green leaves, weak growth and overall low vigor. A visual analysis alone can be misleading since similar symptoms can occur in drought and in vineyards with problematic soils (compaction, impaired drainage). Excess nitrogen is definitely easier to identify than a nitrogen deficiency. Nitrogen in excess promotes lush rapid growth of shoots with long internodes and large, dark green leaves. Lush shoots produce abundant laterals, causing the canopy to be become quite dense and shady in the fruit zone. Shadiness produces a set of problems by contributing to low bud fruitfulness, fungal disease, reduced fruit set, and increased pH in harvested grapes. The shoots with long internodes can be weak becoming flattened bull canes. Pruning and cultural costs are higher for overly vigorous vines.

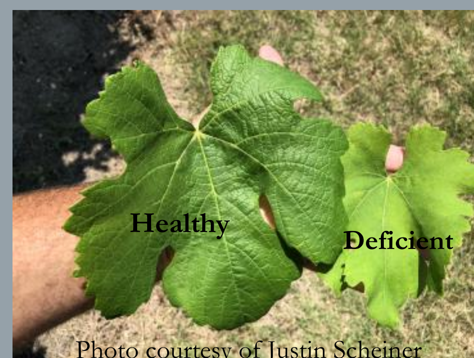

Photo courtesy of Justin Scheiner

Chart Courtesy of Jim Kamas

Material	% N	Comments
Anhydrous Ammonia (NH_3)	82	Very volatile lq/gas
Urea	46	Volatile dry material
Ammonium Nitrate (NH_4NO_3)	34	Less volatile
Ammonium Sulfate ($(NH_4)_2SO_4$)	21	Volatile high pH soils
UAN 28-32	28-32	Volatile injected via drip

Nitrogen is commonly applied to vineyards after vines have an active canopy a few weeks before bloom. Large applications of nitrogen right before bloom can lead to a reduction in fruit set. While applications of granular fertilizer to the vineyard floor make nitrogen available to a large portions of grapevine roots, movement into the root zone is rainfall dependent and are more common in spring when rain is more likely. Some granular forms of nitrogen fertilizers are volatile on high pH soils and may be lost without timely rains soon after application. Subsequent seasonal applications of nitrogen are commonly made through the drip system where small, frequent doses can help a grower achieve a healthy, balanced canopy without causing excessive

Vineyard Maintenance

vegetative vigor. Some growers apply relatively small amounts of nitrogen in late fall for uptake by roots growing through the dormant season. These broadcast applications are moved into the root zone by fall rains and can also benefit the growth of winter cover crops.

Potassium (K). Potassium is important for increasing fruit size, soluble solid transport into the berries, promoting root growth, and maintain osmotic potential and water status within the vines. Potassium is mobile within the vine.


Potassium Deficiency on White Variety

Symptoms of potassium deficiency tend to appear on leaves midway up shoots during the bloom to véraison period when potassium is in high demand. In addition to affecting foliage, potassium deficiency can lead to inadequate movement of soluble solids to fruit resulting in sub-standard quality and shelling (fruit falling from clusters before they are fully ripe. Because heavily cropped vines can lead to a potassium deficiency the following year, the later petiole sampling time can help a grower prevent deficiency from occurring the following season. Excessive potassium increases wine pH, tartrate precipitation, oxidation and spoilage, while decreasing color.

Potassium Fertilizers most often used:

- Potassium sulfate 43% K Most popular; should be applied in fall so that fall rains can begin to move potassium into the root zone.
- Potassium chloride 51%K Availability, low cost but can cause chloride toxicity in many varieties.
- Potassium + Magnesium sulfate (Kmag) 21.5% K, 10.5% Mg, supplies both K and Mg in the ratio we look for in a balanced petiole level.

Potassium and Magnesium are competitors. Potassium accumulates in the soil and leads to an antagonistic effect on the uptake of magnesium. Magnesium deficiency becomes worse when potassium is applied at larger amounts than removed by the crop.

Magnesium (Mg). With magnesium being the central atom of chlorophyll (the green pigment responsible for light absorption), its deficiency affects photosynthesis, (the vines' ability to convert light energy for plant usage). Deficiencies in magnesium show up first in basal leaves along the margin, then moves inward between leaf veins. The loss of green pigment causes leaves of red varieties to become mottled and tinged with red, while leaf margins in white grape varieties become white or creamy. Symptoms often begin after bloom, mainly in high pH soils or poorly drained soils, and vineyards that fertilize potassium heavily. Severe cases of magnesium deficiency can progress from chlorosis to necrosis and cause abscission of basal leaves needed for fruit maturation.


Magnesium Deficiency on White Variety

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Epsom salts (magnesium sulfate, 20%Mg) can be applied as a granular fertilizer or dissolved and injected through the drip system to help overcome Mg deficiency. Many *vinifera* grape varieties have waxy cuticles that prevent Epsom salts from being a useful product for foliar treatment of deficiencies.

Zinc (Zn). Zinc serves as a catalyst in many very important metabolic pathways, including those involved with cell elongation.

Zn deficiency appears at berry development where berries will develop unevenly, or may fail to develop altogether (shot berries).

Shoot growth becomes stunted with shortened internodes, sometimes growing in a zig-zag pattern, with an increase of lateral growth.

Photo by Jim Kamas

Zinc deficiency can be found in vineyards with coarse sandy soils where zinc content is low or those with calcareous soils, where zinc is unavailable. Excessive phosphorus fertilization can also exacerbate zinc deficiency.

On neutral or acidic soils, zinc sulfate can be banded under the trellis. On alkaline soils, zinc chelate can be added with fall fertigation and foliar sprays of zinc sulfate can be applied starting at one inch shoot growth through the end of bloom to help mitigate foliar and fruit set problems.

Boron (B). Boron is essential to successful pollination and fertilization. Clusters on boron deficient vines may have poor fruit set and shot berries. The shoots become stunted and appear bushy, with small yellow mottled leaves. Many Texas soils show slight boron deficiencies, while others, on soils formed from boron rich marine sediment can be higher than normal With mild deficiencies, foliar applications of boron of 0.5lbs of actual boron per acre are most effective in the immediate pre-bloom period. With more pronounced deficiencies, an additional spray two weeks before bloom can further improve fruit set. Soil applications of 3-5 lbs of actual boron per acre, banded in the fall provide a more long-term solution to boron deficiency. Sodium borate (20%) boron is the most common material used to overcome boron deficiencies

Understanding and Managing Disease

Understanding the Significance and Control of Pierces Disease

Jim Kamas

The maturation of the Texas wine industry over the past ten years has been in part due to the decrease in the incidence and severity of Pierce's disease in central and north Texas. While the management techniques developed to reduce vector feeding and mitigate vine-to-vine spread have greatly assisted in combating this disease, there is no doubt that extended drought and late freezes did more to impact vector populations than we previously realized. The more we learn about Pierce's disease, the more we start to understand why the disease pressure has been cyclic; weather is cyclic. Here we are in 2018, and while it is dry across the state now, the last three growing seasons have had average to above average rainfall with numerous high rainfall episodes throughout the spring and summer months. The result has been rebounding sharpshooter numbers across most of the state. Both the pathogen and the primary vectors are endemic to our state, which means the pathogen is perpetually present, so more vectors means greater disease pressure. It has been alarming that many relatively new grape growers across the state do not even have injection units tied into their irrigation systems, much less understand the disease cycle they are facing.

From field observations, grower reports and increased positive test results from the Texas Plant Disease Diagnostic Lab, we know that the incidence of PD is once again on the rise. Our fear is that what we have observed is simply the "tip of the iceberg". Because of the variability of grape varieties in expressing disease symptoms after they have been infected there is always a delay in our ability to fully detect the extent to which a vineyard may be infected. With 'Cabernet Sauvignon' for example, it may take three years for first expression of foliar symptoms in a vine after it has been infected. This means that an infected vine or vines may remain in place in a vineyard, serving as a pathogen source before a grower ever knows there is a problem. By the time the disease becomes apparent, the question becomes, in addition to the vines showing us symptoms, how many other vines have already been infected?

Fifteen years ago, we held grape grower meetings where we talked about nothing but Pierce's disease, today, to most, its either an experience they did not have or a memory that has faded over time. With a greater concentration of vineyards across the state, there is increased likelihood that Pierce's disease could once again pose a significant threat to our industry. How do we avoid repeating the epidemic we faced 20 years ago? My suggestion is simply raising grower awareness and encouraging each other to not become complacent with what we perceive to not be a former threat. Re-read the work done in Texas and the management guidelines https://aggie-horticulture.tamu.edu/fruit-nut/files/2010/10/Texas-Grape-Growers-PD-Management-Guide.pdf. If you are growing susceptible grape cultivars in an area of moderate to high risk, inject imidacloprid, rogue infected vines, and pay close attention to vector populations, and talk more experienced growers in your region. Stay alert, symptoms will begin to appear with the stress of summer heat and crop load. Become familiar with the symptoms of Pierce's disease and submit a few suspected vines for testing. But most of all, raise your awareness and take action when needed.

Vineyard Infrastructure and Mechanical Systems

Understanding Chemigation

Bri Hoge

Chemigation is the injection of chemicals used in crop production or chemicals for irrigation maintenance, into irrigation water for delivery to the crop or field. It provides growers with a more cost-effective and efficient use of systemic pesticides and supplemental nutrients. In addition, it can be more convenient for the applicator, limits worker exposure, prevents leaching losses if heavy rainfall follows application, thus reducing the possibility of environmental pollution.

Chemigation with Simple Siphon Mechanisms

Simple siphon mechanisms can be constructed in irrigation head houses or within individual blocks of the vineyard. By-pass units can be installed in irrigation main lines that allow for siphon hoses to be attached and material injected from open containers. Normally, valves restrict the flow of irrigation water through the injection device. During injection, the main line is closed and the injection loop is opened, diverting water into the loop. Tubing attached to a "T" will draw material into the irrigation system. While not as precise as mechanical dosing units, with appropriate attention to detail and monitoring of irrigation of timing and logistics, these simple mechanisms can accurately deliver effective chemical applications. Mechanical or electrical injection devices are also available that can simplify material injection.

When starting an injection application, start the irrigation process and time how long it takes water to begin flowing at a sustained rate at the most distant emitter. Begin the injection process and make sure chemical containers are completely drained, then add some water to rinse the holding tank. Once that has also been drained, continue running the irrigation system for at least as long as it took from the start-up of the system to the time the injection began. Special agricultural dyes are available which can be added to the mix tank to make it easier to know when the insecticide is in the system and when the irrigation lines have been thoroughly flushed.

Photo Jacy Lewis

Vineyard Infrastructure and Mechanical Systems

(Continued from page 15)

Available Equipment Options

There are a few options for injection systems:

Differential pressure tanks (Batch Tanks) connect at a point of higher pressure than the outlet. They are simple to use and setup and low cost, but the concentration of the chemical decreases over time as it is diluted by water entering the tank.

Venturi injectors are tapered constrictions which creates a sufficient negative pressure (~20%) to draw the chemical into the system. This method also provides simple use and setup and low cost, but they're not quite as accurate as a positive displacement pump. As the liquid level in the supply tank drops, the suction head increases, which results in decreased injection rate. This issue can be ameliorated by the addition of an additional small tank on the side of the supply tank.

Positive displacement pumps are powered by electricity, gasoline, or water. This type of pump is the most accurate and easily controlled, but they cost much more than the above simple setups. There are two types: proportional and constant rate. The former provide a constant dilution ratio, while the latter provide an injection rate independent of the irrigation system flow rate. Some examples of positive displacement pumps are diaphragm pumps, water driven injectors, or solutionizer injector.

Some Considerations for Uniform and Effective Chemigation

- It's highly recommended that vines be well watered (at or near field capacity) at least a week prior to the first application. When soil is dry, pesticides such as nicotinoids are more likely to be bound by soil particles than taken up by vines.
- Uniform distribution of water through a drip irrigation system is essential for accurate dosage, so make sure all lines have been thoroughly flushed and all emitters are flowing to specifications. Injecting acid through drip lines is commonly used to remove calcium and mineral buildup.

Before injecting chemicals through a drip system, make sure a backflow prevention device has been installed and is working effectively. This prevents potential backflow of agricultural chemicals into a water tank and contamination of ground or municipal water supplies. There are several different devices for backflow prevention available.

When installing an irrigation system, it is a good idea to work with a licensed irrigation specialist in order to be certain your backflow prevention device meets local codes and provides for a safe injection system.

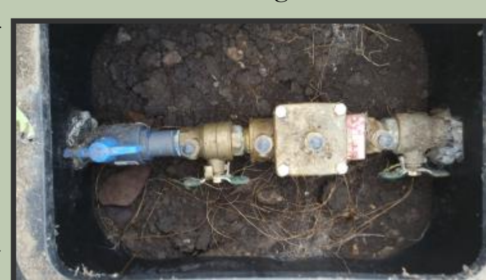

Photo Jacy Lewis

Vineyard Maintenance

Grapevine Fruit Thinning
Pierre Helwi

One of the most critical management practices for grapes is crop load management. In fact, many grape varieties tend to be overly fruitful, producing more fruit than the vine can ripen. Carrying a large crop can result in reduced vine size and health, so carful thinning to balance fruit production to vegetative growth is one option.

The over-cropping phenomena is dependent on multiple factors. Some of these factors can be accounted and adjusted for on the front end in order to reduce or avoid the need for future fruit thinning. Soil fertility plays an important role in the vegetative development of the plant. A naturally rich soil can cause vine over-cropping. Similarly, poorly chosen rootstock scion combinations can contribute to this problem. This can be ameliorated during vineyard establishment with variety and or rootstock selection, as well as vine spacing. After establishment, floor management and fertility programs can be adjusted to help control vigor. Finally, weather has a major influence on flower initiation and on vine architecture. While weather is outside the growers control, understanding how it is likely to affect flower initiation can give a grower valuable information about the likely need for fruit thinning which can put them ahead in decision making.

It is important to point out that fruit thinning is a task that can potentially be avoided. On established vines, crop load can also be managed during dormant pruning in the winter in order to prevent or reduce the need for fruit thinning later in the season

Fruit thinning consists of eliminating flowers and/or grape clusters in excess of what the plant can produce in a quality fashion, and any other clusters emerging later in the season in order to achieve the desired yield and to achieve uniform ripeness. Clusters on short shoots, distal clusters on average-sized shoots that bear two or three clusters and tangled clusters are good candidates for removal. This operation changes the source (vegetation) and sink (fruits) relationship, without reducing the leaf area, causing the plant to concentrate its activities on the regulation of production.

Fruit thinning is a tool for controlling yield which can help to compensate for excess vigor. When making decisions about fruit thinning, considerations must be made regarding the ideal estimated yield and the operational costs associated with thinning. See Box 1.

Box 1.

Estimated yield (tons/block) = Vines per block x Clusters per vine x Average cluster weight (lb) x 1/2,000

There are two ways to thin fruit: manually or chemically. Chemical thinning products are rarely used and the manual method is often preferred.

Given its cost, fruit thinning is an operation that must be carefully considered and the systematic use of thinning is to be avoided. The market and desired fruit quality will influence a grower's decision as to whether or

Vineyard Maintenance

not to reduce their crop load. An action can be justified on plots producing high quality fruit that can demand higher than average prices but may not be cost effective on plots producing standard fruit.

Benefits of fruit thinning

- Eliminate a potential over-crop situation, even if vines were pruned correctly
- Adjust crop yield to reach a balance between fruit and canopy in order to optimize fruit quality and vine health
- Improve ventilation and reduce susceptibility of bunch rots in crowded cluster areas
- Achieve optimum ripeness and quality of remaining clusters

Drawbacks to fruit thinning

- Labor intensive and potentially costly
- Risk of removing too much fruit resulting in over decreased yields and/or reduced quality
- Imprecise timing of thinning may not render the desired result
- Market factors may cause the fruit thinning to not be cost effective even when the desired results are realized

The majority of scientific studies demonstrate that fruit thinning can significantly reduce yield potential while possibly increasing bunch and berry weights. Cluster thinning can also improve berry quality by increasing sugar content and decreasing acidity improving phenolic maturity with higher levels of anthocyanins and tannins in the berry, with a likely improvement in grape aroma potential. Studies also show a positive impact of fruit thinning on wine quality with improved color intensity, phenolic content, and terpenes level. Important to note, some studies mentioned contradictory results.

Intensity of fruit thinning

The volume of crop thinning is based on vine capacity to ripen the fruit, which is dependent on the cultivar, vine health, weather conditions and local climate as well as geographic location of the vineyard. Some studies show that cluster thinning by 30% or less before bloom has no significant effect on yield due to the compensation for the removed crop by producing larger berries on the remaining clusters. On average, 50% of clusters need to be removed to achieve a 30-35% reduction in yield. It is important to understand that thinning to very low levels can cause under-cropping resulting in poor fruit quality and an uncompensated for reduction in yield.

Vineyard Maintenance

Timing of fruit thinning

Fruit thinning can be done any time from pre-bloom through just prior to harvest . The timing of the procedure is a vital factor in the success of this operation:

- **Pre-bloom:** it can improve fruit-set resulting in full and large clusters. However, this can increase the susceptibility to bunch rots later in the season mainly for tight clustered varieties. In regions that commonly experience severe weather in the spring, it is not recommended to cluster thin too early in the season due to the high risk of crop losses from weather conditions.
- **Shortly after fruit-set:** this can increase cluster compactness and size due to a compensatory increase in the size of remaining berries.
- **4-6 weeks after bloom through prior to harvest:** it is used to achieve greater precision in targeting final yield goals and to promote ripening and quality of remaining clusters.

In addition, vine vigor is a determining factor in timing:

- In **weak vines**, removing clusters early in the season (shortly after fruit set) should improve berry development in the remaining clusters. Waiting until later in the season may put stress on canopy growth due to the competition between shoots and fruits for carbohydrates and nutrients.
- In **healthy higher vigor vines**, it may be more beneficial to maintain higher fruit levels for a long period of time to keep the canopy growth in check so as to allow more sunlight into the canopy and reduce canopy management costs.

In Conclusion

Thinning has been found to improve fruit ripening and the accumulation of sugars and anthocyanins in many areas, but especially for low vigor vines. However, viticulture practices should be fine-tuned to achieve optimal crop level to vegetative growth (vine balance) so cluster thinning can be minimized or avoided.

Fruit thinning is a catch-up technique used by the grower to try to improve the potential quality of the harvest by allowing the leaves to feed a smaller number of bunches. The quality of the harvest should not rely solely on corrective techniques. Improving quality requires a global approach to controlling yield and vigor. This starts with vineyard establishment (site selection, soil preparation, choice of the variety and the rootstock…) and then during the season with pruning, fertilization, irrigation etc.

A detailed article on Vine Balance by Brianna Hoge can be found in our previous newsletter; volume II – Issue 1 (February 2018).

Educational opportunities

ADVANCED VITICULTURE SHORT COURSE

WHEN: JUNE 4 & 5

WHERE: HILTON GARDEN INN
3081 UNIVERSITY DR. EAST BRYAN, TX 77802

JUNE 4

10-10:50AM	Water Relations in Viticulture
11-11:50AM	Water Quality
12-12:30PM	Lunch onsite
12:30-1:20PM	Irrigation Budgeting
2:30-3:20PM	Monitoring Soil Moisture
3:30-4:45PM	Measuring Vine Water Status
6:30PM	Dinner at Peach Creek Vineyards

JUNE 5

9-10:00AM	Tour of TAMU Research Vineyard
10:30-11AM	Vineyard Soils and Terroir
11-12:00PM	Soil Fertility
12-12:45	Lunch Onsite
12:45-1:45PM	Understanding Soil and Tissue Testing
2-3:00PM	Fertilizers
3:15-4:00PM	Grapevine Rootstocks and Emerging Varieties

TEXAS A&M AGRILIFE EXTENSION

REGISTRATION:
$150 per person
includes catered lunches
and beverages and a dinner.

REGISTRATION DEADLINE: May 29

PLEASE REGISTER AT:
https://agriliferegister.tamu.edu/

Seating is limited to the first 75 registered participants.

FOR MORE INFORMATION:
Fran Pontasch
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SPEAKERS:

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Dr. Jake Mowrer, Associate Professor & Soil and Water Resource Management Specialist

Charles Swanson, Agricultural Engineering Program Specialist

Jim Kamas, Associate Professor & Viticulture Specialist

Bri Hoge, Hill Country Viticulture Program

Michael Cook, North Texas Viticulture Program Specialist

Dr. Pierre Helwi, Assistant Professor & Viticulture Specialist

Fran Pontasch, Gulf Coast Viticulture Program Specialist

Dr. Justin Scheiner, Assistant Professor & Viticulture Specialist

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We welcome your questions or comments! Please address all comments or inquiries to:
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We hope you have enjoyed this issue of our statewide newsletter. Our goal is to provide timely information on topics of relevance to winegrape growers in Texas. We strive to provide updates on scientific research, expert information on pest and disease management, vineyard best practices, and information on opportunities to attend Extension program events.

First and foremost, we want to produce a newsletter that is relevant and provides information that you as part of the winegrowing community are interested in. We welcome your comments and suggestions and are particularly interested in topics you would like to see covered in future issues. Please let us know what you think.

Thank you for your support of our program, and allowing us to help you to address your growing needs.

Cheers,
Jacy L. Lewis
Editor

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