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College of Agricultural Sciences
Cooperative Extension

High Quality Hybrid Wines

Viticulture and Wine Making

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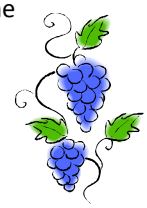
My Experience with Cold Hardy Hybrids

- Vermont
- NE Pennsylvania
- Minnesota

Style and Price

- Who are your customers?
  - Rural palate
  - Wine snobs in the city
  - The Missouri hybrid example
- Wine goals
  - What are goals of the industry?
    - PA example: regional recognition and respect
  - Seeking vinifera look-alikes
  - As an industry, have you decided on a particular style and type of wine when the consumer thinks “Nebraska”?

Viticulture and Wine Making Goals



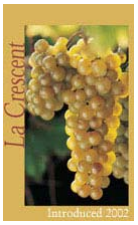
- #1. You must believe this! Hybrid grapes can make <u>really</u> good wine
- But… can you push vinifera or hybrids into vinifera-like wines (do you even want to?)
- Optimize fruit maturity every vintage
- Maximum cold hardiness in all varieties
- Produce fruit and vines that are health and free of defects
- The same viticulture principles and practices support all of these objectives!
- Aromatic white wines will be the best. Red wines will always be a struggle for real quality
- This is truly farming on the edge. You have to be a better grower than the guy in California or Australia

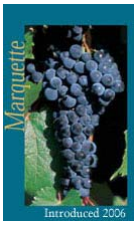
Hybrid Varieties: Cornell

- Whites
  - Valvin Muscat: characteristic muscat flavors but can have bitterness
  - Traminette: no substitute for Gewurz but it makes a nice, spicy wine
  - Cayuga White: great base and blending wine for many basic whites
  - Chardonel: no substitute for Chardonnay but can make nice wines
  - Vignoles: late harvest botrytised wine can be delicious
  - NY 76 and 81: in the field and showing great promise!
- Reds
  - Noiret: moderate to excessive vigor but wines can be balanced and attractive
  - Corot Noir: deep red color with berry and cherry fruit aromas
  - GR-7: big yields, grapey flavors, high acid

Hybrid Varieties: Univ of MN and Swenson

- Whites – incredible aromatic white wine varieties
  - La Crescent: wow! Intense peach, apricot, apple aromas. Great balance and acid structure. Who needs Riesling?
  - Frontenac Gris: another wow wine! Tropical fruit, citrus, very versatile for dry to sweet and ice wines
  - Prairie Star: Blending can make this a terrific white
  - St. Pepin
- Reds
  - Marquette (1211): lower acid, good color and less grapey flavors. There is a lot of optimism for Marquette
  - Frontenac: lighter color with high acid and medium body
  - St Croix





Other Hybrids to Consider

Whites

- Vidal Blanc: benchmark white variety. So versatile
- Seyval Blanc: blended, it can make an elegant wine

Reds

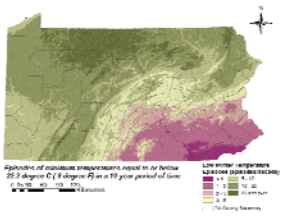
- Chambourcin: late variety, if crop is managed it can make a rich, dark wine
- Chancellor: DM magnet, but can make sophisticated red
- What about Baco, Foch, Landot, etc?

Cold Hardy Vinifera

- Riesling, Chardonnay, Rkatsetelli, even Cabernet Franc

Hybrid Viticulture: so much we do not know

- You must be a better grower to make good wines: farming on the edge
- Grow it like a native or vinifera variety
- Site selection is so important to maximize temperature and light
  - Soil: grow a small to modest size vine.
    - Well to excessively well drained soils
    - Moderate nutrient levels
  - Climate: macro, meso and micro are all critical
  - Aspect
  - Slope
  - Local and absolute elevation



- Vine density and spacing: what is the best spacing?
- Training and trellis system: cane or cordon, high or low, single or divided, there is so much to explore and answer

Hybrid Viticulture, con't

- Short season: get the fruit ripe, fast (reds and whites)!
  - Rootstock selection (when appropriate) to shorten the vegetative cycle
    - Chambourcin, Vidal Blanc, Traminette
  - More leaves (taller, not fatter or denser canopy)
  - Heat. The grapes need heat! Sunlight on the fruit. Drive biosynthesis to develop mature flavors, color, tannin and respire acid.
    - Leaf removal and shoot thinning and positioning
    - Fruit wire height (see trellis and training)
  - Crop level: not too much! But not too little. Adjust crop according to the wine style and crop estimates
  - Canopy management: hybrids need it too!

More Viticulture…

- Cold hardiness: even with hybrids it is a must! Do not stress the vine. Get it to shut down as early as possible
- Nutrient deficiencies, especially Mg
  - Regular soil and tissue analysis are critical
- Disease tolerance to resistance: a compelling reason to grow hybrid grapes <u>anywhere</u>
- Dedicated growers and vintners, even more so than with vinifera: a commitment to quality in the vineyard and cellar

Hybrid Winemaking: still so much to learn

- Reds: are we banging our heads against a wall?
  - Fruit ripeness and maturity
  - Grapey, sometimes foxy, flavors
  - Acid, acid, acid. How to manage acid
    - Blending to lower acid
    - Deacidification
- Reds and Whites: make the best wine possible!
  - Balance! Acid, alcohol, flavors, tannin
    - First in the vineyard, then the winery
  - Blending to improve the wine. Whatever it takes.
    - Frontenac with Cabernet Franc
    - Chambourcin with Merlot
    - Seyval Blanc with Riesling
  - Always! Truth in labeling.
- Beware the sharing of hoses and equipment!

Hitting the Jackpot. Aromatic Whites!

- Great, world-class wines are possible
- They are just what consumers love to drink
- Lower in alcohol – fruit doesn't have to get as ripe as reds
- Easier to grow, higher yields, tolerates botrytis better
- Wider picking window
- Broader flavor and style palette
- Edelweiss?

Economics of Growing Hybrid Wines

- Development and maintenance costs are lower, but so are grape prices
- It's getting better: best hybrids selling for $20+ in PA
- Yields vs. price
- Grapes: between natives and vinifera. Chambourcin and Vidal are on top
- Pricing of MN and CU hybrids? Look to the bottle price.
- It is still mainly a hand sell in the tasting room
- Educate the consumer. Make a mix of hybrids from sweet to dry

Growing Better Hybrid Wines

VITICULTURE

- Critical site selection
- Different varieties
- Raise the viticulture bar
- Try different yields
- Be patient. Wait for quality at harvest
- Work closely with the winemaker(s)
- Love your vines

WINE MAKING

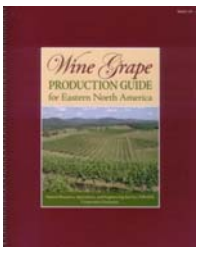
- Work with the grower to improve grape quality
- Don't be afraid to wait for quality
- Strive for balance in the wines
- Practice critical blending
- Taste benchmark wines
- Love your wines

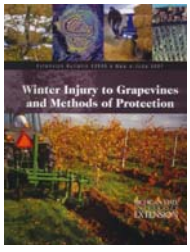
Tasting Impressions

- Geo Spencer
  - Traminette
  - Edelweiss
  - Frontenac Gris
- James Arthur
  - Frontenac
- 5 Trails
  - Edelweiss
- Cuthills

Educational Resources

- Get to know Dr. Bruce Reisch: http://www.nysaes.cornell.edu/hort/faculty/reisch/grapeinfo.html
- University of Minnesota: http://www.grapes.umn.edu/wine.html
- Lincoln Peak Vineyard, Chris Granstrom, a very thoughtful grower and wine maker: http://www.lincolnpeakvineyard.com/index.php
- Nurserymen are good sources of information but cross check: Double A Vineyard, Grafted Grapevine, Wiemer, Lincoln Peak, Northeastern Vine Supply. Check out their web sites for information





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QUESTIONS?

Swenson ripening in the sun

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If you would like to receive my viticulture e-newsletter, send me your contact info at mlc12@psu.edu

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Canopy and Fruit Zone Management for High Quality Wines and Vines

In any given growing season there are probably no two management areas that can affect the outcome of grape quality more than proper canopy and fruit zone-crop management. Many of the critical quality decisions such as variety, clone, rootstock, vine density and spacing, trellis and training systems have already been made. These decisions will converge into a vine of a particular size and balance which now has to be managed according to the targeted style and price point of the wine being produced. In the best of all worlds, the resulting vines are in perfect balance and very little intervention or manipulation must be done. But this is the rare case, perhaps only witnessed in vineyards with ideal terroir, such as a great vineyard like Romanee-Conti or Chateau Lafite-Rothschild. These vineyards virtually balance themselves. In the absence of canopy and crop balance, the grower must apply viticulture practices to guide the vine and fruit into balance with the result being perfectly mature fruit for wine making. As wine growers we have two key objectives:

- To produce optimal mature fruit for wine making
- To fully acclimate vines to maximum cold hardiness

Canopy and yield management begin before any vines are planted. The concept of vine size and balance are important to achieving a manageable canopy and fruit zone. The grower is trying to balance the vegetative and reproductive processes of the vine. The site, of course, will have the greatest impact on vine performance. Proper site selection and evaluation will provide valuable insight into the growth habits of the vines. If the site is fertile with ample rainfall it is likely a large vine will emerge with lots of foliage and fruit. In fine wine production, however, a small to moderate size vine is preferred, one that will focus less on producing leaves and more on ripening fruit, which is our desire as wine growers. We want a site that will support these objectives.

In practice canopy management involves pruning, shoot thinning, suckering, shoot positioning, leaf and lateral removal, hedging and any other practice that manipulates shoots and leaves. Within each of these practices is tremendous nuance and variability in why, how, where, what and when the practices are performed. Good canopy management begins with careful and proper vine training with special considerations given to canopy architecture such as overall canopy height and fruit wire height. These dimensions will have great implications for the performance of canopy and fruit.

Pruning sets the tone for canopy and crop while the vines are still dormant. Pruning severity will affect just about every parameter of the canopy from shoot length and number to distribution of shoots within canopy. Of course, it will affect crop level also. Pruning is the first attempt in the season to balance the vine's foliage with the crop size. Guidelines set by Richard Smart and

others help the grower to determine if the vines are in relative balance. The system of balanced pruning developed by Nelson Shaulis is another way of measuring the balance of mature vines. It is important to pay particular attention to the head and apical parts of the vine to prevent shoot and cluster crowding in these areas. Renewal spurs should be minimally used and always in the proper position.

As shoots begin to grow suckering and shoot thinning allow the grower to adjust shoot numbers to achieve optimal distribution, density and leaf area to ripen the expected crop. It improves canopy configuration by limiting shoot density and is the first effort to regulate crop size. In most cases, double shoots are thinned to the single, primary shoot. Watersprouts on the upper part of the vine and suckers below are removed. Shoot thinning usually is done when shoots are relatively short.
Shoot positioning will improve the canopy performance of almost any training system whether single or divided, vertical or horizontal. As with shoot thinning, shoot positioning seeks to improve canopy configuration and reduce the amount of shading created by overlapping shoots. In its most rigorous form, individual shoots are fixed to wires with ty tape or branch locks to keep them in position, vertical and evenly spaced. These canopies are ultra-efficient and looks very neat and tidy. But this is an expensive practice that can be justified on high priced red wine vineyards. Otherwise, shoot positioning usually involves hand labor of separating and placing shoots in the preferred direction.

Wire moving is also a key part of shoot positioning. If it is done properly and in a timely manner, it can greatly enhance canopy architecture and reduce the amount of hand positioning needed. Timing is probably more critical for wire moving than any other canopy management practice. Wires are moved during the "grand period of growth" when shoots, if conditions are right, can grow a five centimeters a day! If done too early, the shoots will not stay in place. If too late, it becomes necessary to bend and tuck shoots which often leads to breakage. Movable catch wires are preferable over fixed wires so they can be pulled away from the canopy and used to sweep shoots inside the wire and into an upward position. In most cases, 2-3 pairs of movable catch wires are adequate for this task. Shoots can be held into place with wire clips or the aforementioned branch locks.

Leaf removal may be the most complex and controversial of canopy management practices. The purpose of removing leaves is to open up the interior of the canopy to light and air to help promote fruit ripening and reduce disease pressure. If correctly done the benefits to grape quality can be dramatic. While the potential benefits are readily accepted, exactly how to achieve them is not. The timing, severity and method can different widely according to local philosophy and conditions. If there is a typical scheme, it is to remove leaves opposite clusters on the morning side of the vine shortly after fruit set. Timing, in this case early removal, is important so the berries will not get sunburn. If cool and wet conditions prevail, leaves on the afternoon side may be removed. Variations include very early removal of basal leaves as practiced in Piedmont to help with early season disease control, to no leaf removal at all in the case of an extremely well-balanced canopy or high temperature/light conditions in a very warm to hot region. Cooler regions tend to pay much closer attention to leaf removal, early in the season for disease control and later for fruit ripening benefits. In some cool areas such as Long Island, as the ripening period stretches into mid to late October and the sun lowers on the horizon

and days are cool, the fruit zone will be completely stripped of leaves to increase the temperature of the berries. The additional heat helps to drive temperature dependant metabolic processes responsible for the maturation of flavor, color and phenolic compounds, as well as continue to dissipate methoxypyrazines.

Leaf removal can also take the form of lateral removal, which is sometimes preferred to retain basal leaves that protect fruit from sunburn, yet still open the interior of the canopy. Tunneling is a practice where lower, interior leaves are removed. This must be done by hand and is time consuming and therefore expensive. It is generally required in higher vigor vines with bigger canopies.

There are a variety of mechanical leaf removers with an astonishing array of different removal mechanisms, from using pulsed air bursts to shred leaves, to fans and blades, rollers that pull leaves into cutting knives. The trick is to remove the correct amount of leaves in the proper location and not to cut off or damage fruit. It is surprising how easy it is to bruise berries if they are brushed by a hand or machine.

On a vertical shoot position system other late season canopy management practices include hedging, often on sides and over the top. The application of bird nets will also have an effect on canopy configuration and not always for the better, but it needs to be taken into consideration.

It may be necessary to repeat any of these practices later in the season to get the best and desired effect. For example, leaf removal may require an early, mid and late season pass. Crop thinning may also require multiple passes in order to get the crop size just right.

Of course, all of this work, especially if done by hand, is very expensive. The fastidiousness of the work is usually strongly correlated to the price of the wine in which the grapes are destined. In most cases, high priced red wines get the most attention. But even Concord grapes will benefit from proper and timely shoot positioning.

Insect, disease and other abiotic causes such as frost, hail, lightning, wind damage will also impact the vine canopy during the growing season and must be accounted for when considering the amount of leaf area necessary to ripen the grapes. If excessive damage occurs the crop must be adjusted to reflect the remaining foliage's ability to fully ripen that fruit.

Canopy and fruit zone management are two distinct concepts and practices yet they are intimately intertwined and anything done to one will affect the other. Crop size can affect vigor of a vine and is sometimes used to slow down the growth/vigor of a vine, sort of an anchor that drags along the bottom. The canopy represents the solar panels that catch sunlight to convert to sugars that create alcohol that gives wines texture and balance. The sugars also are used for energy to drive plant metabolic processes, including those that synthesis flavor, color and phenolic compounds that characterize each variety. The canopy is also host to the fruit zone in which clusters nestle comfortably throughout the season. As discussed earlier, the manipulation of the canopy has a direct effect on fruit chemistry, composition and quality.

Correct management of the fruit zone is important for disease control and to promote ripening. One of our stated goals is to achieve fully mature fruit for wine making. There can hardly be a single more important contributor to that goal than the correct regulation of crop size. The amount of crop is determined by the quality, style and price point of the wine. For super premium reds, a vine may be expected to ripen 1-2 kgs of fruit. But for a white wine or a fighting varietal red, it may carry 5-10 times that amount of fruit. It all depends on the wine goals and economics. The job of the viticulturist is to set the proper crop size and make sure conditions are right for getting it ripe. No matter what the grower determines the optimal crop size to be, only fully ripe fruit can make good wine.

Fruit zone management encompasses practices aimed at preventing disease and promoting maturity. Disease can quickly compromise wine quality or destroy a crop completely. Cluster positioning is very important to both disease reduction and fruit ripening. It begins with proper pruning, especially the placement of spurs. While pruning for production is always an important goal, pruning for position is just as important. Equal distribution of clusters throughout the fruit zone is ideal. Certainly no clusters should be touching. If they are, then shoot crowding is probably also a problem and canopy balance needs to be assessed. Visually, all of the fruit should be in a narrow band, equidistant from the fruiting wire depending if it is the basal or apical cluster.

Leaf removal in and around the fruit zone is where canopy and crop management merge. This is where timing and method can have a significant impact on fruit quality. It should be managed very carefully.

Crop estimating is the only way to accurately measure the amount of fruit on a vine and if it is necessary to remove fruit in order to get the remaining fruit completely ripe. Crop estimating is explained in an accompany article.

In regard to cold hardiness, it is the good fortune of the wine grower that virtually everything done to promote full fruit maturity, mainly the nurturing of a well-balanced and healthy vine, will help to promote vine acclimation and maximum cold hardiness. One of the goals in a cool to cold climate is to get the fruit ripe and off the vine as early as possible to beat the first fall frost, hurricanes, birds, deer or other harvest threats. Once the fruit is off the vine it can devote its full attention and energies to hardening off for the winter. With that accomplished, the vine and grower can look forward to another productive vintage.

There is a lot of written materials about canopy and fruit zone management. Dr. Mark Greenspan, a viticulture consultant in California has written numerous fine articles on the topic which you can find on his web site www.advancedvit.com/. But the best way to learn about these important practices is to see and do them at vineyards where they work. How can you tell if they work? Taste the wines. In vino veritas.

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Canopy and Fruit Management for Quality and Cold Hardiness in Quebec

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Temperance Hill Vineyard
Willamette Valley, OR

Pindar Vineyard
North Fork of Long Island

Fruit Research and Extension Center
Adams County (near Gettysburg)

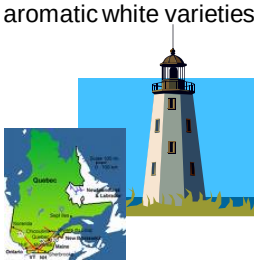
The challenge for all viticulturists:

How to get the tannin, color, alcohol and flavor curves to intersect at optimal degrees for each component before the weather runs out or other conditions force the harvest (methoxypyrazines can also be considered)

Examples: Continental vs. maritime climates or warm/arid vs. cool-cold/wet-humid

- California – too much heat, alcohol is out of balance, flavors deficient
- Long Island - very cool, Cabernet Sauvignon often lacks full flavor profile, tannins can be harsh
- Oregon – climate change has pushed ripeness until PN character is upset
- Germany - cool evening temperatures retain acidity for aromatic white varieties
- Quebec – cool and short ripening season
  - Cold winters
  - variety choice is critical – what grows vs what sells

  Finding warm and dry vineyard sites



Viticulture Goals for Fine Wines

- Assumption: We are trying to grow the best wine possible under the environmental conditions of the vineyard
- Optimal maturity fruit for wine making: get the fruit ripe as soon as possible so the vine can get the wood ripe for winter! Shorten the vegetative cycle
- Maximum mature wood for over wintering
- Red wine and white wines: same qualities, different approach

How to get there? Kees van Leuwen has the answer…

- Small berries with size set after fruit set
- Shoot growth cessation just before veraison

How to achieve these goals?

- Control soil moisture
  - Site selection for macro and meso climate and soil physical and chemical
- Limit exchangeable nitrogen in the soil
- Variety, rootstock and climate interactions
- Viticulture: drain tile, irrigation, cover crops, etc.

Good canopy and crop management practices promote all of these goals!

How Much Management can you Afford?

- Understanding the importance of wine style and price point
- The relationship between viticulture and bottle price
- Quality exists at all levels of wine
  - Native, hybrids and vinifera
  - Production, fight varietal and ultra-premium
- Assess the true condition and potential of your vineyard
  - Uniformity and sychronicity
  - Winter injury
- "Fussy" viticulture: growing fine wines requires attention to detail

Concept of Terroir: You have it..but can it make good wine?

- Soil properties: physical, chemical and biological
- Climate at the macro, meso and micro levels
- Plant materials including species, varieties, clones and rootstocks
- Viticulture is our input into the terroir equation and includes canopy and fruit zone management as vital components
- Understand your terroir
- What are best grape varieties and wine styles for this terroir
- Identify a regional Quebec terroir
- Who can you learn from?
- Who are your benchmarks?

Hybrid Grape Viticulture

- Canopy management in hybrids: up, down, sideways?
- Standard practices or are they different?
- How can you make the wine better?
- Fruit zone and crop management in hybrids: what makes a difference to quality?
- What is the correct yield per vine for best wine?
- Old vs. new viticulture

Uniformity and the Utopian Vine

- Just imagine…
  - A vine you prune and then walk away from it
- We want everything to be the same and the right size:
  - Leaves – small to medium size
  - Shoot length – 1 – 1.5m
  - Internode length – 60-80mm
  - Berry size - small
  - Cluster size – small for the variety, ideally loose
- Strive for uniformity between vines and vineyard blocks
- The enemies of uniformity:
  - Winter injury, diseases, tractor blight, poor viticulture, row direction, soil and mesoclimate variability, etc.

What does a good canopy look like?

… you know it when you see it. It is the most visually striking part of the vineyard so do it well.

- It will enhance your reputation and the price of your grapes
- The canopy includes:
  - Shoots
  - Fruit
  - Permanent vine parts
  - The trellis system

Why are canopy and fruit zone management strategies important?

- In a cool to cold climate EVERYTHING is more important!
- Cool climates made better AND worse wines
- In any given year, no viticultural practices can impact the final outcome of fruit quality more: you can do it!
- Enhancing the microclimate of the vine: entry of light and air into the canopy environment offers…
  - Lower incidence of almost all diseases by reducing humidity levels and allowing wind to dry out leaves and fruit
  - Allows sunlight to penetrate into the canopy interior for more efficient photosynthesis
  - Affects fruit zone temperature range allowing more efficient biosynthesis of essential compounds
  - Helps to reduce levels of methoxypyrazines in clusters

Vine Size and Balance

- Balancing the vegetative and reproductive needs of a vine…
  - Getting the vine to do what WE want it to do, not what it wants to do
- Water is the key. It affects everything
- …then everything else
- Size matters: Big vines and small vines and quantity and quality
- Example: 1m X 1m in Bordeaux vs. 3m x 1.7m in NJ
  - 9 sq ft vs 45 sq ft of soil

Vine Size

- Big vine
- Medium vine
- Small vine

Vine Density and Yield per Vine

- Getting closer and closer
- What is the relationship between yield and quality?
- What is the fastest way to the bank?
- How much is quality of site a factor?

Canopy management starts before you plant the first vine…site selection and evaluation

- Soil analysis for vine vigor potential: low to moderate vigor soils are the best!
  - Low pH, low nutrition, well-excessively well drained, lots of rock
- Climate: how much rain and what is the distribution
- Vine density: between rows for quantity, between vines for quality
- Type of trellis system: single or divided
- Selection of variety, clone and especially rootstock
- Aspect/row orientation, slope, and elevation
- The vineyard environs: + and -

Canopies come in all shapes and sizes: each has specific requirements to make it work

Single canopies:

- Vertical shoot position
  - Head trained, cane pruned
  - Cordon trained, spur pruned
- Goblet – head trained, cane pruned
- High wire cane or cordon: excellent for hybrids!

Divided systems:

- Scott Henry or Smart-Dyson
- Geneva Double Curtain
- Lyre

Successful Canopy Management…

Begins with pruning to a balanced vine

- Correct early training and superstructure development
- Evenly spaced spurs or well-placed canes
- No more than 2-3 buds per spur
- Canes < 1m in length for most varieties
- Short to medium internode length
- Keeping the head area open
- Keeping the area between cordons or canes open
- Elimination of renewal spurs in cane pruning

Into the growing season…

- Shoot thinning and suckering at 2.5-7.5cm
- Shoot positioning on VSP and hanging systems at 40-60cm and again when needed
- Moving wires vs. tucking shoots. Locking shoots.
- Lateral removal
- Leaf removal after fruit set and again at veraison if necessary
- Hedging the canopy on sides and top X times per year
- 
  Timing: It all hinges on timing and availability of adequate and skilled labor. Be prepared! Understand the weather.

Suckering the head for uniform shoot density

Leaf pulling strategies

- Sunlight/warmth pushes ripening, manipulate shade/exposure to create optimal environment
- Morning side early season
- Afternoon side prior to veraison if sunburn is not a threat (leaf removal will lower MPs)
- Post veraison: more aggressive removal if rain and temperature affect ripening

Too much unless it is deep into harvest

The end game: when it really counts

- Veraison to harvest: water matters most!
  - Just enough stress to get the vine's attention
  - Too much stress is bad!
  - Be ready to act
- Shoot growth cessation
- Small leaves
- Yellowish-green color
- Small berries and clusters
- Uniformly ripe berries

Visual Indicators

Growing Slowing Stopped Dead Tip

Courtesy of Mark Greenspan, Advanced Viticulture

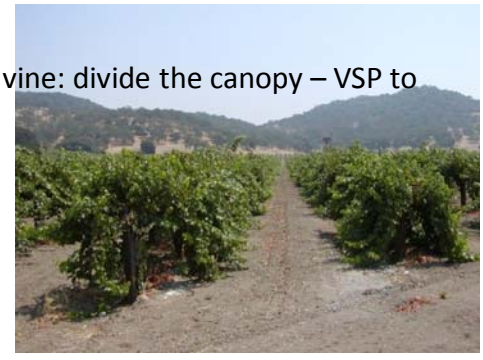
Challenging late season, cool climate viticulture at Newport Vineyards in Rhode Island.
They cannot afford not to be perfect every year!

Getting in the ballpark: Smart rules

- 12-16 buds per pound of pruning weights
- 3-5 shoots per linear foot of trellis
- 0.2-0.4 lbs of pruning weight per linear foot of trellis. If over 0.45 consider dividing the canopy
- 2-3 inch internode length
- 15-20 leaves or 36-40" shoot length
- 1-1.5 leaf layers
- 80-100% exterior leaf exposure
- 50-100% fruit exposure
- Leaves: small basal and mid shoot, slightly dull and pale green

Taming the rambunctious vine

- Taking away water and nutrients: Site selection – soils
- Rootstock choice
- Drain tile
- Cover crops
- Kicker or vigor-diversion canes
- Hedge multiple times
- More linear feet of wire per vine: divide the canopy – VSP to Scott Henry or use GDC



Fruit Zone Management: creating a microenvironment for fruit to ripen

Cold climate viticulture on the Niagara Peninsula

Fruit Uniformity

- Uniformity and synchrony are the keys to quality. Strive for them.
  - Uniformity of composition/quality
  - Uniformity of ripeness
  - Uniformity in space:
    - Areas of the vineyard (soil and topography)
    - Sides of the trellis (divided canopies, especially)
    - Within the vine ("big vines", especially)
  - Uniformity in time: Synchrony
    - Ripeness simultaneous throughout vineyard
    - Flavor and mouthfeel ripenesss simultaneous with sugar and acid ripeness

Rubber Hits the Road: Post veraison vine physiology

Temperature

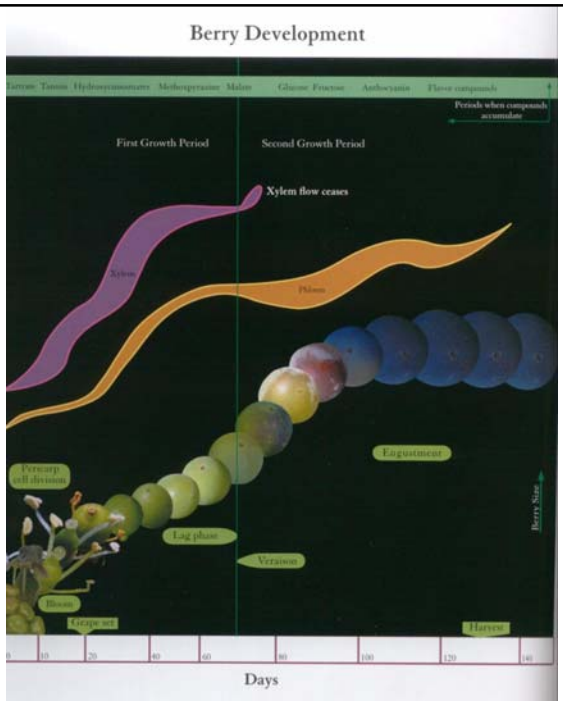
- enzymatic processes
  - flavor compounds
  - phenolic compounds
    - color
    - tannins
- finding the temperature sweet spot in the fruit zone

Water and Nutrients

- essential for all processes
- the right amount at the right time

Light

- photosynthesis
  - sugars
    - brix
    - fuel for metabolism



Getting heat and sugar to the berry

- Fruit wire height
- Canopy height
- Canopy efficiency
- Aspect and slope
- Soil properties
- Yield per vine < 1kg

45mm fruit wire, 1m between vines

Crop Level

- Experiment with cropping trials on your vineyard, each block, within blocks
- Thinning to one cluster per shoot as a starting point on red hybrids and vinifera
- Crop estimate at lag phase
- Thin aggressively prior to veraison, each subsequent pass has less impact on fruit ripening
- Continue to thin unripe (wings, berries, clusters) and diseased fruit
- Sort grapes all the way to the fermenter – sort pre/post crush

What is the right crop level?

- First… ask yourself, "why am I doing this?" What is or will be out of balance.
- What is the target style and price of wine? What is the correct crop level to achieve it?
- Consider the economics of thinning – loss of fruit vs. loss of wine quality and price
- General guidelines for varieties:
  - Cabernet Sauvignon 3-6 t/a
  - Pinot Noir < 2.5 t/a
  - Chardonnay 3-6 t/a
  - Riesling 2.5-4 t/a

Crop Estimation: Just Do It

- Growers universally hate to do it
- You need a statistically accurate sampling such as lag phase sampling
- You need to develop data over time
- Eventually, if you are smart and good, you can guesstimate fruit on the vine
- Pick a system and stick to it. Same time, same person, same vines, same method, each year
- Try for +/- 5% accuracy

Some excellent reference resources:

Questions and Observations about Quebec

- Goals of wineries and the wine industry in Quebec
  - Reputation for quality wines: local, regional, national, international?
  - Parker and the Wine Spectator: vinifera only please
- Old vs. new viticulture: training and trellising, vine density, canopy and crop, site selection and rootstocks.=
- Viticulture at -35C: what is possible?
- Are Seyval and M. Foch truly the best wines you can grow?
- New hybrid varieties from UMN and Cornell
- Reds: too high acid and grape flavors
- Aromatic white wines: yes!

PENNSTATE College of Agricultural Sciences

QUESTIONS?

Mark L. Chien
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If you would like to receive my e-newsletter
Please send your contact information to
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Soil Management and Fertilization

I once asked Kees van Leeuwen, the esteemed viticulturist at Chateau Cheval Blanc in St Emilion what were the keys to making great red wine. In a terrifically matter of fact statement, he said all you need to do is limit water and nitrogen. It turns out that in Bordeaux and Eastern North America, that is no mean feat. Kees' ultimate goal is to do two things in the vineyard, set small berries at fruit set and stop shoot growth before veraison. It sounds so easy but it is oh so difficult.

In arid regions, like California and much of Australia and South America, it is simply a matter of turning the water on and off. Not quite so easy here, where Mother Nature has a much larger role in our viticulture. In fact, that is the greatest impediment to fine wine in the East, uncontrolled water. Nutrients, like N, are a secondary concern because they need water to move into the plant. Even so, we do not want a vineyard site that is too fertile, which simply exacerbates our problems with vine vigor.

If you talk with almost any vigneron in France they will tell you that soil is the secret to great wine. This would be hard to dispute since the greatest wines come from France. The French understand their soils like no other viticulturists in the world. If you then go to California, they are much more nonchalant about their soils. In fact, soil is merely a convenient medium in which a vine is grown, simply add water and fertigate and the grapes will appear. With viticulture tools like deficit irrigation, arid region viticulturists are able to fine tune the performance of their vines like a Swiss watch.

In continental climates like Europe and Eastern N.A. unpredictable rainfall, especially after veraison, can be catastrophic for wine quality. In fact, if you track vintage ratings in Bordeaux there will be an easy and comfortable correlation between early harvest date (warm and dry) and the higher rank of vintage quality. In reductionist form, we can say that warm and dry makes fine wines whereas wet and cool makes, well, not so fine wines.

If one considers the components of terroir – soil, climate, plant and viticulture, it may be argued that soil is most significant contributor to wine quality. But unlike the French, who have studied their soils for centuries, we know precious little about ours. Only in a vague sense do we know what sites may be suitable for fine wine production. The soils should be well to excessively well-drained with low to moderate nutrient availability. Soils should be healthy and promote the growth of a healthy, if not small to modest size vine. Can the constituent parts of this soil be defined and quantified? Even in France, they are just beginning to understand their soils from a scientific perspective. In the past, they simply planted grapes and the best wines came from the best vineyards, end of story. At Cheval Blanc, Kees is studying the subtle differences between sand, clay and gravel soils and how they influence wine quality.

We can suggest to a grower that vines will grow well in a pH range from 5 to 8, organic matter in the range of 2-5%, and a range of plant available water, cation exchange capacity, percent rock content and these all represent significant guidelines. Ultimately, however, it is the complex interactions between soil-climate-plant and how we choose to farm the vines that will determine the quality of the wine that appears in the bottle. Guidelines are useful. They set the boundaries inside which we can comfortably and safely grow vines and be relatively assured of good wine. Then we can decide how much we want to push the limits in order to achieve greater stature in the wines. The more we can control and manipulate, the easier it is to achieve our goals. That is the main difference between arid and humid wine regions.

In an emerging region like Quebec, there is a great process of discovery that must take place to understand where the best wines can be grown. It begins with the basics, such as soil chemistry, which is the easiest to measure and manipulate. However, it is important to realize that we live in an agricultural world controlled by agronomists and we are not growing corn or soy bean. Therefore, our ideas and objectives must be shaped by in a viticultural context where maximum yield is not the ultimate objective. Wine growers seek to balance yield with quality and that is where the soil is so critical to the quality formula. It is important when considering soil management and fertility to keep these principles in mind. The manner in which soil will be used to achieve a specific wine style and price point must be understood even before the site is selected or vines are planted. A site and soil for $10 fighting varietal white wine will be very different from one that is intended to produce a $40 bottle of red wine.

A soil management plan begins with site selection and evaluation. Soil and climate should be analyzed in detail for suitability for the species/varieties of grapes and the style of wine being produced. A soil can be evaluated by just standing on it, but it helps to go deeper, of course. But you can tell a lot about a soil just by looking at the topography and existing vegetation, finding out where the wet spots are around swales or springs or looking to see where the grass is growing tall or rocks protrude. Knowing the history of a field can also reveal a lot about the soils, like finding out the corn yields in certain sections of a field will speak to its fertility. The more you can learn about the soil before a vine is planted, the better you will be able to manage both the soil and the vines.

Most growers are comfortable with the soil chemistry analysis which is done routinely even for yards at home. The results of a soil test are just a set of numbers on paper and the wisdom in interpreting the data will determine whether the wine quality objectives will be met. An agronomist and a viticulturist will have a different view of the data. A wine grower seeks a viticultural interpretation of the data. Soil pH below 5 may indicate a potential problem with aluminum toxicity or a soil high in magnesium will lack structure and cause problems with potassium uptake. These are the kinds of problems that need to be detected and treated before vines are planted.

A fine example of the influence of soil pH and rootstock can be seen in research done in Western New York by Dr. Terry Bates. He designed an experiment that looked at the interaction and impact of low pH, 3 rootstocks and own-rooted vines, on four different varieties. The results were dramatic, as much for the influence of pH as for soil physical features and their impact on

rootstock performance. By mixing and matching the right variables, significant improvement in wine quality can be achieved.

Next a backhoe or deep soil core sampler is needed. Soil samples should be taken at various depths. While the effective root zone for most varieties is around 36", we know roots can go much deeper. Soil chemistry can dramatically affect root growth so it is helpful to have a profile wherever the roots may be. The soil pit will expose the soil physical properties for close examination. Most wine growers are looking for soils that promote drainage in order to fulfill Kees' wishes for small berries and terminated shoot tips. Drainage can be promoted in many forms in soils, from high rock content, to sandy soils and even to clay soils with properties that promote drainage. The pit will allow the soil viticulturist to detect any severe physical impediments to root growth such as hard or fragi-pans. If discovered, they can either be treated or avoided altogether.

Soil biology is the least understood part of the soil complex. We know that it is an incredibly rich ecosystem with countless organisms, large, small and microscopic plying the paths between particles and aggregates. Their roles in the soil-root interface are beginning to be better understood. At this time, most growers try to avoid doing harm to this biological system by avoiding the use of harmful practices like too much cultivation or the overuse of herbicides. We do not yet know or appreciate what we can do to enhance the soil biology or what the interactions are between soil organisms and plants. We recognize, however, that there are specific soil pests and diseases that can cause problems in vineyards such as phylloxera, nematodes, soil-borne pathogens, not to mention vertebrates like gophers and woodchucks.

Once a soil is properly analyzed many viticulture decisions can be made such as variety and rootstock assignment, training and trellis system, vine density and spacing, irrigation, tile drainage, cover crops and pre-plant site amelioration.

Soil erosion is one of the most significant problems in agriculture and everything should be done to minimize the effects of erosion. Fortunately, vineyards can be designed to prevent soil erosion. To a large degree, this involves the control of water movement across the surface. The USDA Natural Resources and Conservations Service has specialists that can analyze your field for erosion potential and design mitigation projects with surface and subsurface diversion and drainage that will help to reduce the effects of soil erosion. The wine grower should also consider the need for tile drainage to improve wine quality, quite apart from large scale erosion prevention systems. In Ontario's heavy clay soils, almost all vineyard are installed with drain tile. This helps to moderate the effects of summer and harvest rainfall on vine vigor. All of these soil projects should be planned and designed before the vineyard is installed.

Oddly, drip irrigation for fine wine production needs to be considered in modern vineyard installations. As much effort that goes into removing excess water from the soil there can be a reverse effect of creating water deficiency if a drought year occurs. Then it will be necessary to supplement natural occurring soil water with irrigation, which can also be used as a fertilizer delivery system. Installing drain tile and drip irrigation can be very expensive. They are the price we pay for living in a very unpredictable climate.

Prior to planting and trellis installation is the best time to apply soil amendments. For example, lime and compost spreaders are big and wide and need an open field to operate. A field is cleared and prepared in the year before planting. Weeds are controlled through a variety of means from herbicide to cultivation. Bioremediation methods such as rapeseed and sudan grass can help to suppress parasitic nematodes and also add organic matter to the soil that will improve tilth. Large rocks, stumps and other obstacles should be removed.

Soil examination may recommend ripping the soil to loosen compaction or break up hard pans. The standard method for ripping is to use a 1-1.5m shank in two directions. In California, it is now common to use a vibrating, winged plow to rip on the vine row. This implement lifts and fractures the soil and gently lays it back in place. It creates an even soil environment for vines to grow which promotes uniform growth. Whenever any kind of soil cultivation is done, ripping, plowing, harrowing, discing or dragging, it should be done when soil moisture conditions are just right and minimally to avoid compaction. No matter how hard you try to avoid compaction, during the vineyard development process soils will be run over and the soil surface will be pulverized, often into a fine powder that once it gets wet, will form a hard layer that may be impermeable to water. It may be well worthwhile to top dress and cultivate a vineyard with compost before planting to restore soil structure.

Once a vineyard is planted, care for the soil must continue, although it becomes more difficult. Organic systems stress the use of non-synthetic fertilizers such as cover crop legumes and compost to maintain soil structure and fertility. Performing soil analysis every three years will help develop a history of the nutritional status of the soil and provide information that can guide fertilizer recommendations. Soil tests should always be compared to tissue tests to make sure that values correlate and that what is in the soil is getting into the vine in sufficient quantities.

Compaction is always a problem in vineyards with repeated tractor passes from mowing, spraying and other vineyard operations. Compaction reduces the amount of air and water available in the root rhizosphere hampering nutrient uptake and root growth. There are many ways to reduce soil compaction, from using cover crops, especially broadleaves with large taproots, to mechanical means such as ripping on the wheel paths. A penetrometer can help determine if compaction is becoming a problem.

Growers should have a strategy for row middle and vine row maintenance. Row middles in the Eastern US are usually planted to a cover crop. There are many options for cover crops and each can serve a different purpose. It is important to have a clear idea of how the cover crop planted will affect vine performance and the ecology of the vineyard. In organic applications, cover crops often serve to extend biodiversity in the monoculture vineyard, attracting beneficial insects. But broadleaves can also be a host from Tomato Ringspot Virus, a serious problem in two of our most important white wine varieties, Vidal Blanc and Chardonnay. A cover crop can be used to provide competition for resources with the vine so it will moderate vine vigor. A legume cover can be used as a green mulch, adding fertility to the soil.

In the current vineyard aesthetic, a clean vine row is demanded. Usually this means an herbicide strip that keeps the area under the vines weed-free. That aesthetic is slowly changing with more sustainable practices being used in vineyards. Plants can be allowed to grow in the vine row as

long as they do not detract in some way from wine quality, for example, causing too much humidity in the canopy or competition for water and nutrients. There are many mechanical tillage tools that work effectively in a wide range of soil conditions. Some growers are even letting their row middle cover crops grow under the vine and using special articulating mowers to reach under the vine to keep the grass mowed.

No matter what you do to the soil, the grower should always ask, "why am I doing this and what impact will it have on wine quality?" Do I want to push yields to increase profitability? Or do I want to reduce vine vigor to all the fruit to more fully ripen? The goals are as numerous and diverse and the means to achieve them. Soil is still a mysterious realm, one so close and always under foot but so little understood. As wine growers we need to take advantage of every shred of knowledge and tool to better understand and maintain our soil's health. Like the wine, it will be our legacy.

Mark L. Chien
Statewide Viticulture Extension Educator
Penn State Cooperative Extension
February, 2009

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La Gestion des Sols et Fertilisation

Journee Vigne, Quebec

Mars, 2009

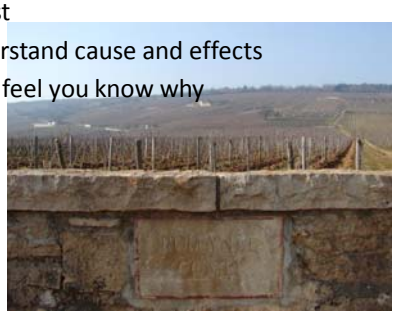
Mark L. Chien
Viticulture Extension Educator
Penn State Cooperative Extension

Assumptions for this Discussion

- We are trying to make the best wine possible from all species and varieties grown in Quebec
- Quality exists at all levels of production, from sweet native wines to expensive vinifera wines
  - Red wines are the most difficult to produce
  - White wines are a challenge but somewhat easier to make
- What is the style and price point of the wines?
- We want to make money growing and selling wines
- Proper management of the soil cannot be done without a clear understanding of it

Understanding Your Terroir: an incredibly complex, integrated, and dynamic system

- Viticulture: our contribution to the wine
- Plant materials: so critical to match variety, clone and rootstock to soil and mesoclimate
- Climate at all levels: macro, meso and micro
- Soil: physical, chemical and biological properties
- And… wine making
- Quantify what you can and intuit the rest
- Collect empirical data over time to understand cause and effects
- Always try to understand why but never feel you know why



Viticultural Goals

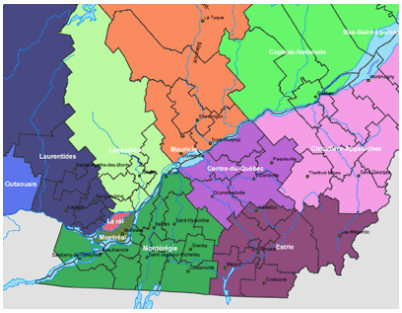
- Optimize fruit maturity every vintage
- Maximum cold hardiness in all varieties
- Produce fruit and vines that are health and free of defects
- The same viticulture principles and practices support all of these objectives!

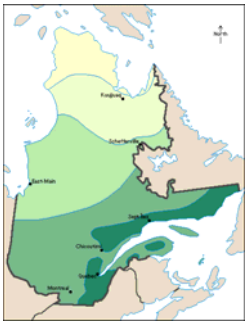
- Kees van Leeuwen at Chateau Cheval Blanc: small berries
  - Limit available nitrogen to the vine
  - Regulate water so to stop shoot growth nearly before veraison

- Grow a vine of small to modest size, ripen a balanced crop as soon as possible to let the vine build up carbohydrates and harden off.

The Importance of Soil and Climate in Quebec

- Continental climate
- Humid soils
- Distribution of rain fall
- The effects of cold temperatures
- The difference between us and them (arid regions)





Site Selection and Evaluation

- Predicting vine size and vigor
- Impact on critical development decisions
  - Vine density and spacing
  - Trellis and training system
- Select for site characteristics that promote early fruit maturity
  - Soils: well to excessively-well drained soils with moderate nutrient values
  - Climate: a warm site in a cool to cold place
  - Try to find some slope, any amount of slope
  - Aspect: southeast to south is probably the best
  - Local elevation: avoid low areas at all costs

Soil Evaluation: limiting vine size

- Chemistry: the concept of viticulture vs. agrono
  - Modesty is the best policy
  - Test at various depths, not just the surface
  - Plant available water
  - Soil pH range 5.5 – 6.5. pH as a tool to limit vigor
  - Organic matter 1-3%, over 5% is asking for trouble
  - Nitrogen should be < 2%, preferable 1.2 – 1.8
  - Interpreting the data: viticulture vs agronomy
- Soil physical properties
  - Dig a hole! 1.5m – 2.0m deep
  - Have skilled and experienced eyes look at the profile
  - Look for physical and chemical impediments to root growth, determine the ERD
  - Measure soil compaction
  - Understand what needs to be amended, why, how and when

Essential Plant Nutrients

Nutrients derived from the soil and/or fertilizer

Macronutrients

Primary
- N - Nitrogen
- P – Phosphorus
- K – Potassium

Secondary
- S – Sulfur
- Mg – Magnesium
- Ca – Calcium

Micronutrients

- Zn – Zinc
- B – Boron
- Fe – Iron
- Mn – Manganese
- Cu – Copper
- Mo – Molybdenum
- Ni – Nickel
- Cl – Chlorine

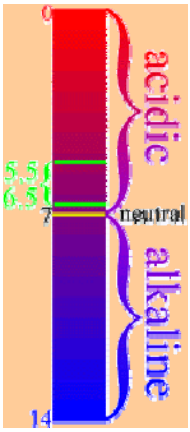
Soil Testing

- Soil test before planting
- Test every 4 to 5 years after planting
  - Or when a problem is suspected
- Supplements petiole testing in established vineyards
  - Use both soil and petiole tests, not one or the other
  - Compare results

Used with permission from Dr. Carl Rosen, Univ of Minnesota

Soil pH

- Nutrient availability
- Soil pH as a management tool: Dr. Terry Bates research in Western NY
  - Variety x Rootstock x pH
  - Very obvious differences in wine quality
- Microbial activity
- Ideal pH range for grapes: 5.5 – 6.5
- Low pH easily modified before planting; high pH is often a problem
- Difficult to change after planting



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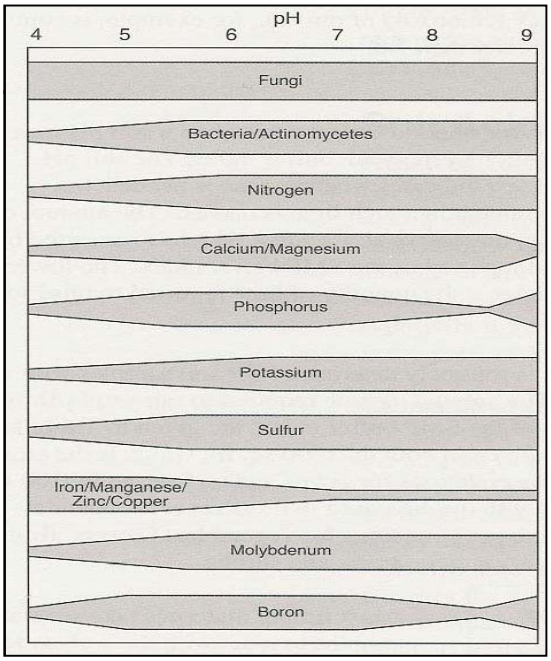
- Microbial activity
- Nutrient availability



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Mineral soils

Modifying Soil pH

- Lime recommended if pH <6.0
  - Rate based on buffer pH
- Lime also adds Ca and Mg
  - Dolomitic lime contains Mg
- Incorporate lime 20 – 25 cm inches
  - Apply one year before planting
- Acidification of high pH soils is generally not economical
- The use of gypsum in vineyard soils

What we can do to help

- Drain tile (see Ontario)
- Drip irrigation (maybe or maybe not)
- Prevent soil erosion
- Proper selection and use of cover crops
- Increase soil tilth and health with thoughtful practices and amendments
- Promote biological diversity above and below the surface



Preparing the Soil for Planting

- Follow recommendations of soil evaluation
- The good and bad of physically manipulating the soil
  - Organic matter
  - Soil structure
- Cultivation: to rip or not to rip and if so, how?
- Plow > disc > harrow > springtooth cultivator > drag
- Fixing what you have messed up: compost


Potential Effects of Soil Manipulation

- Time and fuel inputs
- Harrowing and cultipacking break up surface soil structure
- Multiple passes in the rows aggravate soil compaction
- Organic matter is oxidized and driven off as CO_2
  - Soil organisms are reduced as OM decreases
  - As a result there is less bonding of soil aggregates so structure is lost
  - Soil O_2 and water holding capacity are reduced
- Impermeable crust may form on the soil surface increasing run off and worsening erosion problems

The Benefits of Cover Crops

- Significantly reduce soil erosion
- Feed the soil as a green manure
- Reduce vine vigor
- Increase water penetration into the sub soil
- Provide stable surface for equipment operation
- Adds plant diversity to the vineyard system
- Aesthetic value to the vineyard

Potential disadvantages of a cover crop:

- Expense of establishment and maintenance
- The need to mow and possible compaction problems
- Covers can compete too aggressively with vines for water and nutrients, especially in drought years
- Increases risk of frost damage
- Can be a host for a variety of subsurface pests including virus, bacteria, vertebrates, etc.

Getting the Work Done

- Wheeled tractor vs. crawler
- Implements
  - Tillage: rippers,
  - Covers: seed drill, mower
  - Flotation tires
- Tillage radishes
- Reduce and minimize soil compaction
  - Reduce # of vehicle passes

Vineyard Floor Management: row middles

- Cover crop vs. clean till
- Reducing soil compaction
- Ameliorating soil compaction

Vineyard Floor Management: vine rows

- Herbicide vs. cultivator? Pros and cons of chemicals vs. cultivation
- Let the vines be your guide
- Various mulching materials – straw, geotextiles, black plastic, rocks
- Width of clean strip and cover crop
- Using under vine grass to control vine vigor

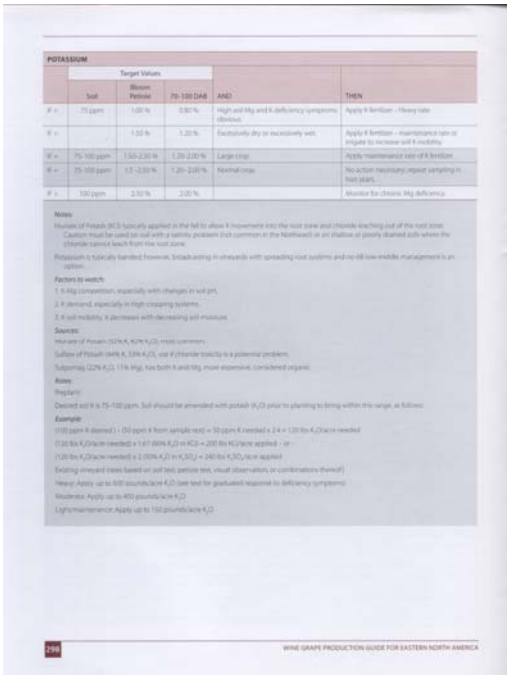
Soil Fertilization: Ask WHY?

- Do not amend unless a vine or test says you need to
- Test: soils every 3 years, tissue every year
- Observe carefully, especially around and after veraison
- Flag problem vines and analyze the problem
- Consider bringing in a consultant or fellow grower for a second opinion
- More is definitely not better
- Maintenance, not luxury levels of nutrients. Watch you vigor!
- Choose the right materials: organic vs. synthetic fertilizers

The Problem Nutrients for Grapevines

- Nitrogen – usually too much but sometimes too little
- Potassium – if in excess wine pH can be too high, often deficient if Mg is too high
- Magnesium – essential to chlorophyll and photosynthesis, can be a late season problem in hybrid varieties
- Phosphorus – often a problem in acid soils and reacts with Al and Fe to become insoluble
- Boron – can be deficient or toxic is minute amounts. Deficiencies will severely affect shoot growth and fruit set
- Zinc – when deficient can affect fruit set
- Iron
- Manganese
- Copper
- Molybdenum – implicated in poor set on Merlot?

Fertilizer recommendations from Dr. Terry Bates, Cornell University



POTASSIUM

	Target Values			AND	THEN
	Soil	Bloom Petiole	70-100 DAB		
If <	75 ppm	1.00 %	0.80 %	High soil Mg and K deficiency symptoms obvious	Apply K fertilizer - Heavy rate
If =	-	1.50 %	1.20 %	Excessively dry or excessively wet	Apply K fertilizer – maintenance rate or irrigate to increase soil K mobility
If =	75-100 ppm	1.50-2.50 %	1.20-2.00 %	Large crop	Apply maintenance rate of K fertilizer
If =	75-100 ppm	1.5 -2.50 %	1.20- 2.00 %	Normal crop	No action necessary; repeat sampling in two years.
If >	100 ppm	2.50 %	2.00 %		Monitor for classic Mg deficiency

Notes:

Factors to watch:

Sources:

Rates:

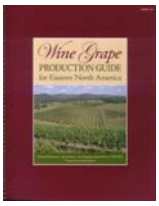
Example:

From the Winegrape Production Guide for Eastern North America 2009

Composts and Compost Teas

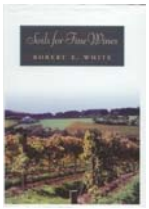
- A little is usually enough
- Types of compost
  - Manure: livestock, poultry, horse
  - Yard residue
- Quality of the compost material
- Proper application
  - Placement and volume
  - When to apply compost
- Costs: transportation to the site

Educational Resources



- Wine Grape Production in Eastern North America
- Soils for Fine Wines
- USDA Soil Primer
- Soil Food Web

  http://www.soilfoodweb.com/
- Your own local resources
  - Extension and research assets in Quebec
  - Ontario! The best wine growing region east of the western states? Perhaps!
  - Fellow growers and wine makers – talk to your neighbors, work together to solve problems!
  - Other tree and horticultural crops



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QUESTIONS?

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Fertilizer Additions

(Before Planting)

- Base P and K needs on a soil test
  - Also Mg, Zn, and B
- Very difficult to correct P and K deficiencies after vines are planted
- Broadcast and incorporate to a depth of 8 to 10 inches

Potassium Stratification

Soil Depth (inches)	K Level (ppm)
0-3	250
3-8	95

Fertilizer Recommendations

(Non-Bearing Vines)

- Main nutrient required is **Nitrogen**
- General N recommendations
  - 30 lb N/ac – high OM soils (>4.6%)
  - 45 lb N/ac – medium OM soils (3.1-4.5%)
  - 60 lb N/ac – low OM soils (<3.1%)
- Account for N from manure, compost, legume cover crops
- Apply inorganic N sources after planting
  - Split applications on sandy soils

Fertilizer Recommendations

(Non-Bearing Vines)

- Goal is to promote vegetative shoot growth for the first 2-3 years

- Nitrogen Fertilizers
  - Urea (46-0-0) – needs to be incorporated
  - Ammonium nitrate (33-0-0)
  - Ammonium sulfate (21-0-0)
  - Calcium nitrate (15.5-0-0)
  - Organic N sources

The New Varieties from the University of Minnesota

Peter Hemstad
Research Viticulturist
University of Minnesota
www.grapes.umn.edu

Minnesota's Terroir

- Extreme continental… hot in the summer, very cold in the winter. From -40°C in January to 38°C in July
- No moderating influence from water, midway between the Atlantic and the Pacific Oceans
- More sunshine than most of the East Coast
- About 700mm of annual rainfall
- Snow persists throughout the winter
- Wide range of soils (clay, sand, gravel)
- River valleys provide good vineyard locations with excellent air and water drainage

Minnesota's wine industry

- Rapid expansion… from 3 wineries in 1992 to 28 today
- Approximately 800 acres of vineyards
- Over 700 members of the MGGA (mngrapes.org)
- Cold Climate Conference in February attracts over 500 people annually
- '3 Rivers Wine Trail' began in 2007
- Wineries are concentrated in southern part of the state near the Twin Cities (Minneapolis/St. Paul)
- Wineries are allowed to bring in up to 49% juice from out of state

Minnesota's wine industry

- Foch and Seyval had been dominant, now Frontenac, Marquette, La Crescent, and Frontenac gris are the top four varieties, Foch is #5 and St. Croix is #6
- Seyval was the #1 white, but has now been almost completely abandoned since it needed winter protection

Extensive new plantings in MN

Trellising

- Minnesota is the home of the “J system” and the “mini-j system” for growing winter tender varieties
- Today, most grapes are grown using an upper cordon system
- Some vines are grown on VSP (vertical shoot positioned) with a fruiting wire height of about 83cms
- None are grown with very low versions of VSP, like those in Quebec

Elmer Swenson

- Father of Minnesota grape growing
- Used MN #78 as the basis for his breeding
- Worked at University of Minnesota's HRC for 9 years
- Developed numerous cultivars: Swenson Red, Edelweiss, St. Croix, St. Pepin, La Crosse, Sabrevois, Prairie Star, Brianna

U of M Grape Breeding Program

has been breeding grapes since 1908!

Current U of M Grape Breeding Goals:

- Extreme cold hardiness
- High wine quality
- Disease resistance
- Productivity
- Growth habit

U of M Grape Breeding Status

- 11+ acres of research vineyards
- 2-4,000 more vines planted each year
- Approximately 35 crosses made each year
- Breeding table grapes and rootstocks in addition to wine grapes
- Approximately 150 wines made/year

Wine evaluation

U of M Varieties

- Bluebell, Blue Jay, Moonbeam, Red Amber (1944)
- Swenson Red (1978)
- Edelweiss (1978)
- Frontenac (1996)
- Frontenac gris (2003)*
- La Crescent (2002)*
- Marquette (2006)*

* now legally available in Canada! (The process took 6 years)

Frontenac

- Cross of (*V. riparia* X Landot 4511)
- Named after small MN town on Mississippi River
- Now the #1 variety in Minnesota, also being planted elsewhere in the Midwest, Northeast, and Quebec

Why is Frontenac gaining popularity in the Upper Midwest?

- Vine is vigorous and easy to establish
- Easy to manage growth habit
- Very cold hardy
- Highly productive
- Very good disease resistance (esp. downy)
- Loose cluster, doesn't split or rot
- Highly desirable wine aromas (strong cherry note)
- Very versatile, can be used for red wine, rose, or port

What are Frontenac's limitations?

- Susceptibility to foliar phylloxera
- Frequently needs cluster thinning, especially on young vines
- High acidity… needs attention both in vineyard and cellar

Foliar Phylloxera

Secrets to success with Frontenac

- Don’t overcrop!
- Maximize fruit exposure through careful training and leaf removal (Consider using GDC)
- Be careful not to over-fertilize or plant too closely on high vigor soils
- Control phylloxera with Danitol or Thiodan
- Don’t pick by brix alone, acid level is more critical
- Let the fruit hang until acid starts to drop
- Watch for signs of raisining

Frontenac at St. Croix Vineyards

Frontenac gris

- White wine version of Frontenac
- Started as a single bud mutation, discovered at the HRC in 1992
- Released in 2003
- Vine is identical to Frontenac…use the same cultural practices, spacing, training, spray program, etc

Frontenac gris Wine

- Characteristic peach aroma
- Lesser amounts of citrus and tropical fruit
- Has the high brix and acidity of Frontenac
- May be suitable for table wine, dessert wine, and ice wine

Second-year vines of
Frontenac gris grown by Chris Granstrom in Vermont

La Crescent

- Excellent quality, cold hardy, white wine variety
- (St. Pepin X [*V. riparia* X Muscat Hamburg])
- Cross made in 1988
- Selected in 1992
- Released (patented) in 2002

La Crescent Vine

- Very cold hardy, trunks have survived -38°C
- Loose clusters not prone to bunch rot or splitting
- Occasional fruit set or berry shelling problems
- Leaves are susceptible to both downy mildew (Plasmopara) and phylloxera
- Early bud break causes spring frost issues on some sites

La Crescent after -32°C

Excessive vigor on La Crescent

Secrets for Success with La Crescent

- Spray for Downy Mildew!
- Consider spraying for foliar phylloxera
- Don’t over-crop, consider thinning pre-bloom
- Optimize nutrition levels to increase set
- Beware of excess vigor and shading, consider using GDC
- Watch for signs of berry shelling at harvest

La Crescent Wine

- Excellent wine quality
- Germanic character, similar to Vignoles or Riesling
- Characteristic powerful apricot aroma, lesser amounts of dried peach, citrus, and pineapple
- High acidity, lends itself well to dessert or late harvest styles

La Crescent “Ice Wine” wines a gold
…in the ‘vinifera ice wine’ category!
(Just across the border in Vermont)

Marquette

- U of M’s newest cultivar
- Cousin of Frontenac, grandson of Pinot noir
- Outstanding in both vineyard and cellar
- Better chemistry and earlier ripening than Frontenac
- Makes a complete red wine

Thus, in theory Marquette is made up of the following…

- *V. vinifera* 60.0%
- *V. riparia* 19.2%
- *V. rupestris* 8.1%
- *V. labrusca* 7.5%
- *V. aestivalis* 2.8%
- *V. berlandieri* 2.0%
- *V. cinerea* 0.2%

Marquette in Vermont

Marquette is being widely propagated

Alain Breault is now licensed to sell them in Quebec

Marquette Vine

- Very good cold hardiness
- Very good disease resistance
- Moderately susceptible to foliar phylloxera
- Manageable open growth habit
- Moderate yields, 2 clusters/shoot thus usually no need to cluster thin

Potential Concerns with Marquette

- Early bud break
- Fruit is attractive to birds
- Splitting?

Secrets to Success with Marquette

- Use proper site selection to avoid spring frost problems
- Have a good bird control program
- Avoid poorly drained soils
- Consider using VSP

Marquette Growth Habit

Marquette on GDC in Vermont

Marquette Growth Habit

Marquette Wine

- Lower acidity than Frontenac
- Excellent red color, not as dark as Frontenac
- Complex aromas of cherry, black pepper, and spice
- More tannin structure than most hybrids

Dr. Bruce Bordelon, Viticulturist, Purdue University, Indiana

"Marquette is far superior to Foch, Millot, Chancellor, etc. that can be grown in colder areas. Not the strong hybrid character, better tannins, pepper flavors, etc. It does ripen a bit early…which can lead to bird problems, but I like its potential for northern [areas]…"

Comparative Vine Characteristics of U of M Varieties

Cultivar	Growth Habit	Bud Break	Vigor Level
Frontenac	Intermediate	Early-mid	High
Frontenac Gris	Intermediate	Early-mid	High
La Crescent	Sprawling	Early	High
Marquette	Intermediate-upright	Early	Moderate-high (variable?)

Comparative Disease Incidence

(n= 4 years)

(1= no disease, 7= severe)

Variety	Phylloxera	Powdery	Downy	Black Rot
Frontenac	4.0	2.8	1.0	1.3
Frontenac gris	3.8	2.5	1.0	1.3
La Crescent	3.9	2.7	3.9	1.6
Marquette	2.8	2.9	1.4	1.2

Comparative Yield Parameters of U of M Varieties

(n=8 years)

Cultivar	Cluster Weight (grams)	Yield (tons/A)
Frontenac	171.1	4.64
Frontenac gris	134.9	5.33
La Crescent	144.7	3.77
Marquette	101.1	3.70

Comparative Harvest Parameters of U of M Varieties

(n=8 years)

Cultivar	**Pick date**	**°Brix**	**T.A. (g/l)**	**pH**
Frontenac	9/27	24.7 (24.3-25.1)	14.3	3.01
Frontenac Gris	9/27	25.6 (23.2-27.7)	13.5	3.01
La Crescent	9/30	25.1 (22.3-27.6)	12.0	3.05
Marquette	9/18	26.1 (23.1-28.6)	11.3	2.99

Primary Bud Survival, 4/08

Cultivar	% Survival
Castel 19637	55.6
Foch	40.0
Frontenac	86.1
Frontenac gris	80.6
La Crescent	94.4
La Crosse	5.6
Marquette	77.8
Michurinitz	2.8
Noiret	0
Prairie Star	80.6
St. Croix	86.1
St. Pepin	52.8

There's more to come…

Descendent of Marquette, Frontenac, and Merlot

Table Grapes

Rootstock Breeding

For more information:

- U of M website: grapes.umn.edu
- Fall Tour annually at the HRC the first Saturday after Labor Day (12 September 2009)
- Cold Climate Conference annually in mid-February in Minneapolis
- Alain Breault

Fall Tour of the U of M's HRC
up to 100 varieties to taste

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- Viticulture Consortium East (VCE)

Rootstock Breeding: Goals

- Extreme cold hardiness of roots
- Phylloxera resistance
- Excellent root growth
- Ease of callusing and grafting
- Good wood production for rootstock cuttings
- Enhanced productivity of grafted vines

- ‘Replant’ resistance
- Drought resistance
- Shortened vegetative period
- Enhanced hardiness of scion
- pH tolerance