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2000 Ohio-Grape Wine Short Course

Edited by Roland Riesen

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PREFACE

More than 150 persons attended the 2000 Ohio Grape-Wine Short Course, which was held at the Radisson Hotel and SeaGate Conference Center, Toledo, Ohio, February 13-15, 2000. Those attending were from 15 states and Canada and represented many areas of the grape and wine industry. This course was sponsored by Horticulture and Crop Science Department, The Ohio State University, Ohio Agricultural Research and Development Center, Ohio State University Extension, Ohio Wine Producers Association and Ohio Grape Industries Committee.

Cover Picture: Courtesy of John Schmid and David Scurlock

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TABLE OF CONTENTS

TABLE OF CONTENTS

AIR, WATER, SUN, AND FIRE
THE COOPER'S FOOTPRINT ON THE BARREL

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INTRODUCTION

When you are making wine, do you think of yourself as an artist? I believe you are.

Now you may think of yourself more as a scientist or technician because you pick the grapes at a certain Brix level, and you carefully add certain chemicals in the correct amounts based on calculations. You have all these expensive machines which you have ordered to exacting specifications in order to master your style of wine, the wine is sanitized and put into specific capacity bottles. So when we talk about winemaking this way it does sound like science and technology.

But there are other aspects of winemaking that fall into the realm of art. Sure you can trellis your vines for maximum yield and even ripening, but ultimately it's in Mother Nature's hands. Each year she deals you a little different palette of tastes, colors and aromas from which you attempt to make a beautiful picture to tempt the eye, nose, and taste buds of the people who will drink your wine.

All this brings me to my topic in an off-handed way, which is to suggest that the cooper is somewhat of an artist as well. We work with wood, which is variable, and attempt to produce a masterpiece, using a rather inexact tool like oak fire, to add taste, color, and texture to your wine.

This talk then is about some of the techniques, scientific and artistic, that we use to produce the barrels.

OUTSIDE THE COOPERAGE

REGIONAL WOOD DIFFERENCES

The first thing we should look at is where the wood comes from. If grapes grown in Virginia taste slightly different than those grown in Missouri, then it stands to reason that trees grown in Virginia will be slightly different than the ones in Missouri. This is due to weather, soil, rainfall, exposure, etc. But for oak wood, by the time the barrel staves and headings are air-dried and the barrel toasted, the original taste differences due to the growing region are very slight. In an on going experiment in California, comparing barrels made from wood from different regions, including France and Oregon, the taste results have consistently shown extremely small differences between all the white oak regions of the east and France, for several varieties of wine. Tastes of wine made in Oregon oak, not being a white oak, showed a significant difference from the other oak regions.

So when we look at the influence of the cooper on the barrel, the source for the white oak plays a minor role.

There are winemakers who insist on tight grain oak – most normally, oak grown in the more northerly regions where the growing season is shorter. They feel that this oak has better taste properties. I know that there are some differences in the extractives between winter wood and spring wood – the rings of the tree. But, my experience is that tight grain or open grain is just a matter of how quick the barrel imparts its oak flavor into the wine – the tighter grain imparting the flavor more slowly, and perhaps allowing the flavor to integrate better. The downside of this is that it is necessary to leave the wine in the barrel longer.

Another aspect of the wood that is sometimes debated is the difference between split and sawn wood. American white oak can be sawn, allowing about a 50% yield per tree, due to cell blockage called tyloses. European oaks must be split, with only 20 to 30 percent yields, due to the lack of tyloses. Either way, the wood is then trimmed to rectangular shapes, exposing some grain. I have seen no evidence that sawing or splitting affects the taste of the wine.

AIR DRYING, OR SEASONING, OF THE WOOD

What does the drying process accomplish? The main reason for drying is to remove the moisture in the cells, which also shrinks the wood. The purpose is to minimize further shrinkage, and possible leaks, while it is in transit to your winery. Extended air-drying in the eastern U.S. and in France will reduce the moisture content to about 15%. This moisture level is fine for many areas, but a little high for California, Australia and Chile. Barrels made for those areas either need extremely long air-drying (at least three years) to really stabilize the moisture in the wood, or mechanical drying in kilns to 12% moisture.

MICROFLORA AND FAUNA

There is some research that suggests that molds and fungi, which grow on the wood in the drying yard, affect the tastes of the wood. Unfortunately, this is about as far as the research has progressed.

PHYSICAL CHARACTERISTICS OF WOOD

When producing quality barrels, every person, from the log buyer to the people in the stave mills to the inspector on the yard to the coopers in the cooperage are involved with culling out defects that affect the porosity, taste, and beauty of the barrels. Sapwood, knots, mineral streaks, porous wood, insect damage, and red oak are only a few of the defects that we are constantly guarding against including in the barrel.

AREA OF SEASONING

The area of seasoning the wood has been shown to influence some of the flavors coming out of the wood. In wetter climates, such as Kentucky and France, rain and snow will leech out the oak lactones. The oak lactones provide coconut flavors, and in high concentrations, in American oak in particular, give the bourbon/whisky flavors.

Vanillin, responsible for the vanilla flavor imparted by barrels, is unaffected by region of origin or seasoning area.

Eugenol gives spicy and clove flavors. It is reduced in wetter climates.

Molds, of course, are more prolific in the warmer, humid climates. But, as I mentioned, their contribution to flavors remains unclear, and since the outer layers of the wood are planed off, the effects of the molds are probably minimal.

Again, unfortunately, the research has show mixed results with few definite conclusions. In "**Monitoring sensory and chemical variables in oak barrels**" (July, 1995), Barry Gump and Steven Glossner, researchers at Cal State Fresno, presented some taste tests and ended up with mixed results.

Effects of time on air-drying

1. butterscotch flavors improve with age
2. vanilla flavors improve with age, but the control was the same as the 3-yr-old barrel
3. toast flavors improve with age, but the six months and control treatments were the same as the 3-yr-old barrel

Effects of toasting

1. butterscotch decreases
2. vanilla no improvement
3. toast flavors mixed results

INSIDE THE COOPERAGE

TOASTING THE BARRELS

The toasting process is the one over which the cooper has the most influence. We can control the amount of fire, the time on the fire, and, to a good degree (no pun intended), the amount of heat.

One recent study indicated that the cooper toasting the barrel has more influence over the taste than the source of the oak (French oak was studied). (Cooper vs. Forests: "Which is More Important", Nick Goldschmidt, International Symposium on Oak in Winemaking, Reno, Nevada, June 1999, page 63)

Dr. Spellman, a researcher in Australia, has developed a heat wheel. It shows which flavors are emphasized as the amount of heat is increased.

Light toast – spicy, clove, sappy, scented, nutmeg, coconut
Medium toast – vanilla, sawdust, toasty, sweet, nutty
Heavy toast – coffee, butterscotch, smoke

Also, toasting has been shown to reduce tannins ("Influence of toasting techniques on color and ellagitannins of oak wood in barrel making", Lucio Matricardi and Andrew L. Waterhouse, International Symposium on Oak in Winemaking, Reno, Nevada, June, 1999, page 47)

More specifically, the toasting process increases guaiacol, from which the wood smoke aroma arises.

Furfural, responsible for the coffee, almond, and toasty aromas, is also increased by toasting, especially in drier woods (12% versus 15%). Vanilla is also increased by toasting. Above, we noted one experiment where vanilla showed little change. Here we say it changes. This shows the lack of definitive knowledge about how the barrels truly affect the wine.

Toasting reduces the lactones. In high concentrations, they produce resin and varnish and bourbon-like flavors. In lower concentrations, they are responsible for coconut flavors.

As we mentioned wood tannins are reduced by toasting

European oaks toast faster, because the American oak is more dense. European oaks and American oak have the same extractives, but differ in the amount each contains.

BARREL SIZE AND SHAPE

Some other factors, over which the cooper has control, can affect the tastes coming from the barrels. The larger the barrel the less the surface to volume ratio, resulting in reduced extraction, i.e. less oak flavors.

Some winemakers think that Bordeaux- and Burgundy-shaped barrels affect the taste of the wine differently, but I have seen no evidence to prove this.

BARREL APPEARANCE

In France, a few years ago, we visited a cellar in Burgundy. The mold growing on the barrels, walls, ceiling and on all the unused equipment was at least ½ inch thick. For some reason it did not seem out of place. That same mold on barrels in a pristine winery in the U.S. would cause one to walk away quickly. I guess our molds have not attained that ageless look of maturity; so we need to keep our barrels clean.

A cleanly crafted and sanded barrel makes the wine coming out of it more appealing. You all know the hypnotic spell that the winery can have on your visitors. I think that barrels, used for decoration in tasting rooms and added for ambiance during winery tours, help create that aura.

INTERIOR SURFACE

The interior surface area of the barrel can be increased by grooving. The wine inside will pick up more oak flavors quicker, but it remains to be seen whether the aging also occurs quickly.

Blisters do not seem to affect tastes. They are no harder to clean than the rest of the porous surface of the interior of the barrel. They are caused when the staves are heated too fast.

WHAT COOPERAGES DON'T DO

Lastly, I want to look at some of the things the cooperages could do more of, if requested by winemakers.

Winemakers don't ask for kiln-dried lumber. Kiln-drying provides control; it is fairly exact, the moisture in the wood can be adjusted closely to a desired percentage. Used in conjunction with air-drying for the precipitation, it allows for more consistency. Each lot is processed more identically, regardless of the time of year. A number of cooperages use kilns for some aspect of the drying process, but few admit it.

Winemakers don't ask for electric, gas, or microwave toasting; they want the traditional oak fire. An experienced cooper can regulate the fires fairly precisely. But not as precisely as your home oven or stove, where, when you set the dial at 350 degrees, you get the same amount of heat every time. Coopering is a beautiful craft and an art form, but it is an inexact science because that is what the winemakers/customers have requested.

But just keep that in mind, what you would gain in consistency, you might lose in artistry.

CONCLUSION

The cooper, like the winemaker and the artist, can control many aspects of his craft. But, coopering barrels, being still much an artistic craft, is subject to some variation.

KEEPING THE BUGS UNHAPPY
SUCCESSFUL BARREL SANITATION AND MAINTENANCE

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General rules

- Keep barrels full
- If you can't keep them full, then keep barrels sulfured and dry on the inside
- Smell, look at, and taste wines in all barrels frequently
- Try to avoid the use of chemicals in barrels, especially chlorine (exceptions are sulfur compounds and citric acid)
- Keep winery clean (story of making vinegar next to wine ended up all vinegar) and keep utensils used to fill, empty, and rack wines clean and sanitary
- Don't put barrels outside (barrel full of toothpicks due to bore bugs)

1. Receiving barrels - look outside for shipping damage and inside for proper toast level and debris
2. Hot water soak for tight barrel – put 5 gallons of hot water in, bung, stand on end for 30 minutes, flip for another 30 minutes, empty, fill with wine, drip dry and sulfur. Soak your new cooperage as soon as you receive it so that you have time to fix problems.
3. If there are signs of leakage, look for reason. If nothing is apparent, soak for 2 days. If it is still leaking, search for leak with flashlight and paper towel and call cooper.
4. Best to put fermenting wine or unfiltered wine in barrel first.
5. Sulfur barrel when not full of wine.
6. Use silicone bungs for wine – wooden bungs for sulfur (or wrap silicone bung)
7. After use – clean well with hot water, drip dry, sulfur, turn upside down with cloth bung, check every few weeks with nose and flashlight
8. Next use – look inside and smell before use, presoak as with new barrel
9. Smell and taste your wines in barrels often and especially before racking and blending – you can set aside a questionable or funky smelling barrel
10. Use your barrels for white wines first for one or two years and then shift to red wines
11. do not use any chlorine-based compounds - can result in 2,4,6,tricholoanisole - use cleaners such as soda ash, citric acid or sodium percarbonate

Summary

Oak is like a spice, don't overuse or underuse

Display barrels prominently - they add magic and romance to your winery

RECOMMENDED METHODS FOR CLEANING AND MAINTAINING OAK COOPERAGE

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INTRODUCTION

This pamphlet is for the use of home winemakers, commercial wineries, and anyone else who uses wooden cooperage, especially oak, for the production and aging of wine. The following methods have been proven effective by commercial use. However, given the nature of wine and oak cooperage, Barrel Builders claims no responsibility (caused by the misuse of information contained in the manual) for leakage or spoilage.

September, 1987

IMPORTANT KEY POINTS

Water quality is perhaps the single most important factor in maintaining sound cooperage. If using heavily chlorinated water (most city water), a charcoal filter or other filtering devices, which remove chlorine, is strongly recommended. If using well water, or water from other sources which is high in iron and sulfur, a Potassium Permanganate filter, or other iron exchange methods which remove these minerals, are strongly recommended (residual iron can cause an "iron haze" in wine; residual sulfur may cause an off-odor like that of rotten eggs - hydrogen sulfide).

Wooden cooperage, such as oak and redwood, is porous and can never be absolutely sterile. The treatments described here are to be used to clean, detartrate, prevent microbial growth, and reduce the population and retard the growth of undesirable microorganisms.

When any chemical is introduced into wooden cooperage, it will penetrate into the wood. The use of hot water will increase penetration. The function of citric acid is to neutralize any residual chemical. The neutralizing step is very important, and is for a longer duration of time than the preceding step to assure deep penetration and neutralization of any chemical residue. If hot water is used initially, use hot water in the neutralizing step. Citric acid is a mild cleaning and bleaching agent and has a "sweetening" effect on the wood.

Plain water can stagnate if left in a barrel for more than two or three days. If a barrel must be filled with water for more than two days, either empty the barrel, rinse, and refill with fresh water every two days, or add citric acid to keep the water sweet. Your nose is the best tool to use in the prevention of problems.

When adding any powder to a barrel, be sure it is completely dissolved in water first. Some chemicals will fall to the bottom and form a deposit as hard as plaster.

When adding both citric acid and some form of sulfur dioxide (SO2) (sodium or potassium metabisulfite) to a barrel, mix these solutions separately. Citric acid is used to keep the water sweet and to lower the pH of the water to make SO2 more active. When a form of SO2 and citric acid are mixed together, SO2 gas will be released which will irritate eyes, nose, throat and lungs.

We recommend the use of potassium metabisulfite over sodium metabisulfite (or sodium bisulfite), as excess sodium has been shown to be harmful to one's health. However, sodium metabisulfite is generally less expensive.

Finally, we do not recommend the use of chlorine to disinfect barrels. Chlorine has been shown to cause TCA (Trichloroanisol) that produces off-smells and tastes in wine. It is best to use an off-smelling wine barrel as a planter. But if it is not too far gone, the use of sodium percarbonate is a much better choice.

METHOD I: TO SOAK UP OR SWELL A NEW BARREL

As water is inexpensive and plentiful and wine is not, it is recommended that a barrel be "tight" before the introduction of wine. Before following the procedures below, be sure that the hoops are snug. As a barrel swells, the hoops may be tightened a little at a time. If the hoops are too tight, the swelling wood may burst a hoop. If the barrel is very dry a water mist inside and outside the barrel will conserve water and hasten the tightening.

PROCEDURE I for Tight Barrels:

1. Look inside barrel for contamination and smell for off-odors.
2. Fill barrel with 5 gallons of hot water.
3. Slosh the water in barrel and turn barrel on end to let stand for 30 minutes.
4. Turn barrel on other end for 30 minutes.
5. Drain water, fill with wine or, dry further and gas with sulfur.

PROCEDURE II for Dried-Out Barrels:

1. Rinse the barrel to be sure it is free of dust and debris.
2. Mist, if extremely dry.
3. Fill the barrel half way with cold water.
4. Add citric acid and potassium metabisulfite solution (see table p.12). In this case 100-ppm SO2 is sufficient. Mix by rolling the barrel.
5. Fill the barrel completely with water.

It usually takes from 2 to 3 days to completely soak up a barrel, however, it may take longer. The barrel should be topped up daily with water. When the barrel is completely soaked up, empty the barrel and rinse well several times before introducing wine.

Although a barrel is tight with water, it may seep with wine. Wine has a lower specific gravity than water and may find a channel to the outside. It is best to introduce a fermenting must or a non-filtered wine to the newly soaked barrel as the high solid content will seal the pores of the wood.

If the barrel does seep a little, keep the barrel topped with wine and wash off the outside to prevent mold from forming. If the leak continues, refer to your barrel repair manual for specific procedures to pinpoint and repair the problem or call your cooper.

METHOD II: SODA ASH TREATMENT

Soda ash is a caustic chemical (caustic soda) and is considered a harsh treatment for barrels. Its use in a barrel is to clean and leach out undesirable odors and flavors caused by microbial problems. Soda ash is also used in an attempt to sterilize a barrel that has turned sour. The main function of soda ash is to dissolve tartrate deposits. Soda ash has been used to bleach red wine color out of a barrel, but this is next to impossible and is not recommended. Soda ash will also leach out the oak flavor of a barrel and is not recommended for use on a new barrel for that reason. Soda ash should be dissolved in hot (140 - 180°F) water and mixed with hot water. Protective clothing should be worn when using soda ash.

Warning: Soda ash, when used in strength over ¼ oz. per gallon water has burned oak staves. Therefore, we highly recommend that soda ash not be used in concentrations over ¼ oz. per gallon of water, and that ¼ oz. per gallon water be used only for the most severe cases.

PROCEDURE:

1. Rinse barrel so that it is clean (of loose material) and empty (barrel must be tight, see Method I).
2. Fill the barrel half way with hot water (140 - 180°F)
3. Add soda ash solution (see table) , mix by rolling barrel.
4. Fill barrel completely with hot water. Bung may be placed in bunghole loosely.
5. Allow to stand for 24 hours, then empty and rinse several times with cold water.
6. The barrel should be neutralized with citric acid.
7. Immediately fill the empty barrel with wine or sulfur.

METHOD III: CITRIC ACID BATH

The citric acid bath is used to neutralize any residual chemicals in the barrel and is essential to the maintenance of sound cooperage.

PROCEDURE:

1. Rinse barrel several times to remove as much of the preceding chemicals as possible.

2. Fill the barrel half way with water --- use hot water if hot water was used initially, use cold water if cold water was used initially.
3. Add citric acid solution (see table, p.12), mix by rolling the barrel.
4. Fill the barrel completely.
5. Allow to stand 24 hours if using hot water, 48 hours if using cold water.
6. Empty and rinse several times with fresh water.
7. Immediately fill the barrel with wine or sulfur.

METHOD IV: MAINTENANCE OF EMPTY BARREL, SULPHUR STICK OR SO2 GAS

If a barrel is left empty after wine or water has been introduced, molds and bacteria will begin to grow, eventually destroying the barrel for wine use. However, there are times when a barrel must remain empty for a period of time. Therefore, it is important to replace the atmosphere of air inside the barrel with one of sulfur dioxide so that microbes cannot grow. Sulfur gas is recommended when possible, as few sulfur wicks are truly dripless.

PROCEDURE:

1. After wine use or cleaning of the barrel, rinse well several times with hot water followed by a cold water rinse. Drain well (any residual water standing in the barrel will combine with SO2 gas to form Sulfurous acid which will soak into the wood).
2. Hang sulfur stick from sulfur bung (one with cup to catch drips) and burn from the top to bottom (to prevent drips) inside barrel. Sulfur bung should be placed in bunghole loosely.

   1/2 stick for 50-60 gallon barrels.
   1/4 stick for 20-30 gallon barrels.
   1/8 stick for 5-15 gallon barrels.

   Or inject gas (3 to 5 seconds for 50-60 gallon barrels) from a pressurized canister.
3. Allow to burn at least three to five minutes. When completely burned, remove sulfur wick and replace regular bung tightly.
4. Store in a cool, dark, dry place. Repeat treatment every 3 to 4 weeks to keep fresh.
5. If barrel is to remain empty for a long period of time, it should be soaked overnight with fresh water prior to burning a sulfur stick to keep it tight. If a barrel begins to dry and the staves shrink, air will enter the barrel, displacing the sulfur, creating an environment for harmful microbial activity.
6. When preparing the barrel for wine use, be sure the barrel is tight (refer to Method I, p.3) and rinse well with fresh water. Fill with wine immediately.

TABLE OF SOLUTIONS (in grams)

	5 Gallons	10 Gallons	30 Gallons	60 Gallons
Potassium Metabisulfite				
100 ppm	3.75	7.5	22.5	45
200 ppm	7.5	15	45	90
Sodium Metabisulfite				
100 ppm	3.25	6.5	19.5	39
200 ppm	6.5	13	39	78
Citric Acid	15	30	90	180
Soda Ash				
light to medium cleaning	1/8 ounce per gallon of water			
heavy duty cleaning	1/4 ounce per gallon of water			
Chlorine				
AntiBac-B Chlorine 100 ppm	12	23	69	138
AntiBac-B Chlorine 200 ppm	24	46	138	276
Chlorinated TSP 100 ppm	63	126	378	756
Chlorinated TSP 200 ppm	126	252	756	1512

USEFUL CONVERSIONS

Volumes	Weights
1 ounce = 29.3 milliliter	1 ounce = 28.3 grams
1 gallon = 3.785 liters	1 pound = 454 grams
1 60-gallon barrel = 227 liters	

CHIP ME, STAVE ME, OAK ME !
THE ROMANCE, DOLLARS AND SENSE OF BARREL ALTERNATIVES

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As some of you know, I sell oak products that complement and enhance the flavors of wine. Most of you probably do not know how great a wine enthusiast I am! In the title of this talk the word "romance" is included. In my mind, the romance begins with wine and its traditions, no matter where it is produced.

Some of the products I and others sell, manipulate the flavor profiles of wine in some non-traditional ways. These non-traditional ways are warranted because of market conditions and the desire to make a profit. I would like to think that the market conditions are a segment of wine drinkers that enjoy a $6.00 bottle wine because they feel it is affordable. While the desire to make a profit stems from producing a $6.00 bottle wine using a quality, low cost method. Thus BARREL ALTERNATIVES!

As you will see later, they are cheaper than barrels, from a cost and maintenance standpoint; quicker to use, and sometimes more available. Five years ago there were four most commonly used and marketed barrel alternatives. Now there are eleven, that I know.

Five years ago, the most common barrel alternatives you could choose were oak chips, powdered oak, tobacco-like shavings, and barrel interior stave frames. Entering the year 2000, you have the same four, plus liquid extract, oak cubes, oak stix, oak beans, oak balls, snake-like barrel staves and chips, and tank staves. All of these alternatives claim to manipulate the flavor of your wines in different ways. Only you by experimenting, testing, and tasting can determine which one is best for you.

Choice of toast levels are not unlike those available for barrels: light, medium, heavy. The number of types of oak seem to be increasing: American, French, Hungarian, chestnut, and European. Shelve life is long, assuming dirt and water, and any other harmful substances are avoided. Reusing a barrel alternative is not recommended. The best results and strongest oak flavor are produced when used the first time.

Having all of these alternatives in front of you, you may ask "What varieties can I use with barrel alternatives?" The answer is --- just about anything that you think oak would enhance. I have listed vinifera, French hybrids, native Americans, and other fruit varieties that I know wineries are using. This list is not comprehensive or exclusive by any means.

You may also ask "How are they used in the process, and contained so they do not burn my pump out?" Three of the four stages listed are probably of no surprise --- crush, fermentation, and aging. The fourth stage is one I developed through discussions with my customers – fortification. The wine is usually finished, but still needs that little something to round it out. The production factor to consider here is oak flavor control. Using barrel alternatives at aging or fortification, gives the winemaker greater control throughout the process because of the ability to add and taste. The ability to add and taste becomes more difficult during the crush and fermentation stages. But the benefits of mastering the use of barrel alternatives at fermentation outweigh the lack of control. Because of the reactions that occur, barrel alternatives used during crush and fermentation produce more richness and complexity in the wines.

I have listed the several ways barrel alternatives are contained. The most effective means for tank usage is oak chip bags (flow through and strength) and stainless infusion tubes for barrels. Some bags are open for self-filling, while others are already filled and sewn shut. Naturally, any stave alternatives will most likely be self-contained and not require any bag or enclosure.

Now that your enthusiasm has heightened, you ask "How long do the barrel alternatives stay in contact with the wine?" In my opinion, the next statement is the most important of this talk. "THE ONLY RECIPE IS THE ONE YOU CREATE!" Your wine style and taste contributes to your recipe. You must taste frequently. When the wine tastes the way you want it, oak the wine longer. Just like a barrel, the oak flavor will settle back or lessen with time. When the wine settles back, you are trying to get it back to the taste profile you liked!

After all these great winemaking questions, you finally get to the profit question: "How much do these barrel alternatives cost?" Compare the costs for American oak and French oak barrel alternatives with oak barrels. Each alternative by oak type is calculated on a per barrel (225l), per gallon (60gal), and per bottle (750ml) basis. The analysis excludes shipping, maintenance, and stainless tank purchases. I would like to stress that this table was developed to introduce you to the numerous barrel alternatives available in the market place, and was not intended to show preference for any one product.

There are three factors that I think will be helpful when determining which alternative to use: bottle price, flavor impact versus wine style, and degree of difference between alternatives. Looking under the American, $6.00 bottle row, an oak barrel is 15.5% or $.93 of the selling price; compared to oak staves at 2.0% and $.12, and oak chips at .1% and $.007, respectively. A French oak barrel is 28.8% or $2.02 of the $7.00 selling price; compared to oak staves at 2.1% or $.14, and oak chips at .2% or $.014. Considering per bottle cost differences, by using oak staves instead of an oak barrel, your winery would save $.81($.93 - $.12) per bottle (American) and $1.88($2.02 - $.14) per bottle(French); pretty significant. Now let us compare using oak chips instead of oak staves; $.11($.12 - $.007) per bottle (American) and $.13($.14 - $.014) per bottle (French); much less. Even though the difference is much less between the two alternatives, it still requires a judgment as to which barrel alternative makes sense to use.

The judgement should not only consider the differences in cost, but also flavor and wine style. I stated earlier in the talk that each alternative claims to impact your wine different, and better. This stage is where experimenting, testing, and tasting are be helpful. Try to gather as much information as possible --- do you need the alternative at the beginning of the process (crunch or fermentation), or do you need to oak closer to the end(aging or fortification)? Some barrel alternatives produce a stronger impact than others. Experimentation and taste tests between barrel alternatives will help you match the alternative with the wine style.

The third factor to consider is the degree of difference between the alternatives. Combining the information you gathered about the bottle price, flavor, and style of your wine, you can now decide if the difference in flavor between the barrel alternatives is worth the cost. We have already determined that using a new oak barrel to make a $6.00 or $7.00 bottle wine has a big profit impact. What you are trying to decide is if the flavor I derive using one barrel alternative over another is worth the difference in cost. Looking at the American price per barrel portion it costs $15.50 more per barrel to use oak staves than oak stix; $6.75 more using oak stix than oak beans; and $13.70($15.75 - $2.05) more to use oak beans than oak chips. You have to decide whether the flavor is that much better!

Now that your excitement has probably gotten the better part of you with all this low cost, high quality barrel alternative information, you start thinking about long range strategies for your winery. You ask " Why not turn all of my barrels into planters and parking barriers, and use strictly barrel alternatives in my production?"

WHAT A GREAT IDEA! YOU CAN, IF YOU PLAN ON MAKING WINES WITH THE COMPLEXITY OF A $6.00 A BOTTLE WINE FOR ALL YOUR CUSTOMERS!

BARREL ALTERNATIVES HAVE A HARD TIME DUPLICATING THE SLOW, BREATHING, OXIDIZING, OAK INFUSION EFFECTS OF A BARREL. THIS HOLDS TRUE EVEN WITH ALTERNATIVES USED IN BARRELS. THUS, LESS COMPLEX WINES VERSUS BARREL WINES!

My conclusions may sound personal. That is because they are coming from me, the wine enthusiast, a customer of your winery. Barrel alternatives are fantastic! They seem easy enough to use, maintain, and buy. But it still requires not only you, the winemaker, to experiment, test, and taste to determine what is best for your business, but also your customers' desire of wine experience.

Barrel alternatives provide a low cost method for producing a wine that satisfies a market segment wanting what they feel is an affordable bottle of wine. That customer is happy, and you as a producer and business are happy! But maybe the customer looking for more complexity in your wine will not be happy!

OAK EXPERIMENTS

Roland Riesen

Tasting 1: <u>**Chardonnay, Firelands Winery**</u>

Objectives:
1. Evaluate the effect of oak origin on wine quality and style
2. Evaluate the effect of the cooper on barrel quality and style
3. Evaluate the effect of toast level on wine quality and style

Tasting 2: <u>**Chardonnay, Ferrante Winery**</u>

Objective: Evaluate the effect of oak origin on wine quality and style

Tasting 3: <u>**Chardonnay, Ferrante Winery**</u>

Objectives:
1. Evaluate the effect of oak chips on wine quality and style
2. Evaluate the difference between chips and barrels
3. Evaluate the source of oak chips on wine quality and style

Tasting 4: <u>**Pinot Gris, Chalet Debonné Vineyards**</u>

Objectives:
1. Evaluate the effect of the cooper on barrel quality and style
2. Evaluate the effect of lees stirring on wine quality and style

Tasting 5: <u>**Pinot Gris, Chalet Debonné Vineyards**</u>

Objectives:
1. Evaluate the effect of oak chips on wine quality and style
2. Evaluate the difference between chips and barrels

February 13, 2000

Tasting I : Firelands Winery

Objectives:
1. Evaluate the effect of oak origin on wine quality and style
2. Evaluate the effect of the cooper on barrel quality and style
3. Evaluate the effect of toast level on wine quality and style

Grape Variety: Chardonnay
Source: North Bass Island
Clone: 15 (Innerstave: clone 4)
Harvest: 10/4/99 (Innerstave: 9/28/99)
Must analysis: ss = 21.8 Brix (Innerstave: 23.0 Brix)
TA = 0.59% (Innerstave: 0.78%)
pH = 3.59 (Innerstave: 3.42)
Wine analysis: pH = 3.62 (Innerstave: 3.55)
TA = 0.55% (Innerstave: 0.71%)
alcohol = 12.7% (Innerstave: 13.8%)
RS = 0.3% (Innerstave: 0.3%)

Fermentation: SO_2: 3-5 g/hl (18-30 ppm) after pressing
Skin contact: 3-4 hrs
Clarification: centrifugation
Pectic enzyme: Pec5L
Nutrient addition: 20 g/hl (1.8 lbs/1000gal) Fermaid K
Yeast: 3079 (15 g/hl = 1.3 lbs/1000gal)
Fermentation in ss tank to 2-3% alcohol, then transfer to barrels.
Completion of fermentation: 10/23/99 (Innerstave: 10/18/99)

Cooperage: 2 barrels, Canton Cooperage, American oak, new, medium toast, 2 yrs air-dried
2 barrels, Canton Cooperage, American oak, new, medium$^+$ toast, 2 yrs air-dried
1 barrel, Canton Cooperage, American oak, new, heavy toast, 2 yrs air-dried
13 barrels, World Cooperage, American oak, new, medium toast, 2 yrs air-dried
12 barrels, World Cooperage, American oak, new, heavy toast, 2 yrs air-dried
4 barrels, World Cooperage, French oak, new, medium toast, 2 yrs air-dried
All barrels: toasted head

Treatments: All lots: barrel fermentation, MLF (OSU) in barrels, aging and lees stirring in barrels until sampling
Stirring regime: - first 5 weeks: once weekly
- afterwards once every 2 weeks

MLF: All lots: OSU, in barrels, at 1-1.5% RS

2000 Ohio Grape-Wine Short Course

February 13, 2000, Columbus, Ohio

<u>Tasting 1</u>

_____ Canton Cooperage, American oak, new, medium toast

_____ Canton Cooperage, American oak, new, medium^{+} toast

_____ Canton Cooperage, American oak, new, heavy toast

_____ World Cooperage, American oak, new, medium toast

_____ World Cooperage, American oak, new, heavy toast

_____ World Cooperage, French oak, new, medium toast

_____ Innerstave, French oak, new, medium toast

2000 Ohio Grape-Wine Short Course

February 13, 2000, Columbus, Ohio

Tasting 2

_____ control: stainless steel fermentation, no MLF

_____ Canton Cooperage, Hungarian oak, new, heavy toast

_____ Canton Cooperage, American oak, 1-year old, heavy toast

_____ Demptos, French oak - Alliers, new, heavy toast

_____ Demptos, French oak - Nevers, new, heavy toast

_____ Demptos, French oak - Tronçais, new, heavy toast

_____ Demptos, French oak - Vosges, new, heavy toast

2000 Ohio Grape-Wine Short Course

February 13, 2000, Columbus, Ohio

Tasting 3

_____ control: stainless steel fermentation, no MLF

_____ Canton Cooperage, Hungarian oak, new, medium toast

_____ Canton Cooperage, American oak, 1-year old, medium toast

_____ Barrels, Chips, etc., chips, Hungarian oak, medium toast

_____ Barrels, Chips, etc., chips, American oak, medium toast

_____ Barrels, Chips, etc., chips, French oak, medium toast

_____ World Cooperage, chips, French oak, medium toast

_____ World Cooperage, chips, French oak, heavy toast

February 13, 2000

Tasting IV: Chalet Debonné Vineyards

Objectives:
1. Evaluate the effect of oak origin on wine quality and style
2. Evaluate the effect of oak age on wine quality and style
3. Evaluate the effect of less stirring on wine quality and style

Grape Variety: Pinot Gris
Source: Debonné Vineyards
Harvest: 9/26/99
Must analysis: ss = 22°Brix
TA = 0.83
pH = 3.38

Fermentation: SO_2: 25 ppm after pressing
Pectic Enzyme: Cinn-Free
Nutrient Addition: 6 lbs/1000 gal DAP
Yeast: Epernay II
ML strain used: EQ54
Fermentation started in ss tank on 9/27/99, then transferred to barrels on 10/1/99
Completion of fermentation: 10/15/99

Cooperage:
Lot 1: control, stainless steel fermentation, no MLF
Lot 2-5: barrel fermentation, no lees stirring
- Lot 2: Demptos
- Lot 3: Seguin-Moreau
- Lot 4: AK Cooperage, new
- Lot 5: AK Cooperage, 1 year old w/French oak chips

Lots 6-9: barrel fermentation, with lees stirring
- Lot 6: Demptos
- Lot 7: Seguin-Moreau
- Lot 8: AK Cooperage, new

Stirring regime: first 5 weeks: once weekly
afterwards, once every 2 weeks
Bentonite addition to all for protein stability: 12/29/99 @ 1lb/1000gal

Tasting V: Chalet Debonné Vineyards

Objectives:
1. Evaluate the effect of oak chips on wine quality and style
2. Evaluate the difference between chips and barrels

Wine: Pinot Gris wine from Lot 1 treated with different oak chips

Treatment: Lots 10-12: Oak chips, all medium toast
Source: Barrels, Chips, etc.
- Lots 10a-c: American Oak, 3 reps
- Lots 11a-c: Hungarian Oak, 3 reps
- Lots 12a-c: French Oak, 3 reps

2000 Ohio Grape-Wine Short Course

February 13, 2000, Columbus, Ohio

Tasting 4

_____ control: stainless steel fermentation, no MLF

_____ Demptos, American oak, new, medium toast, no lees stirring

_____ Seguin-Moreau, American oak, new, medium^{+} toast, no lees stirring

_____ AK Cooperage, American oak, new, medium toast, no lees stirring

_____ Demptos, American oak, new, medium toast, with lees stirring

_____ Seguin-Moreau, American oak, new, med^{+} toast, with lees stirring

_____ AK Cooperage, American oak, new, medium toast, with lees stirring

2000 Ohio Grape-Wine Short Course

February 13, 2000, Columbus, Ohio

Tasting 5

_____ control: stainless steel fermentation, no MLF

_____ Demptos, American oak, new, medium toast, no lees stirring

_____ Seguin-Moreau, American oak, new, medium^{+} toast, no lees stirring

_____ AK Cooperage, American oak, new, medium toast, no lees stirring

_____ Barrels, Chips, etc., chips, Hungarian oak, medium toast

_____ Barrels, Chips, etc., chips, American oak, medium toast

_____ Barrels, Chips, etc., chips, French oak, medium toast

28th OHIO GRAPE-WINE SHORT COURSE

Tastings I - III

PLEASE RECORD YOUR FAVORITE AND LEAST FAVORITE WINE !

Tasting I: Firelands Winery

Favorite: ______

Least Favorite: ______

Tasting II: Ferrante Winery

Favorite: ______

Least Favorite: ______

Tasting III: Ferrante Winery

Favorite: ______

Least Favorite: ______

28th OHIO GRAPE-WINE SHORT COURSE

Tastings IV - V

PLEASE RECORD YOUR FAVORITE AND LEAST FAVORITE WINE !

Tasting IV: Chalet Debonné Vineyards

Favorite: ______

Least Favorite: ______

Tasting V: Chalet Debonné Vineyards

Favorite: ______

Least Favorite: ______

Tasting Notes

BARREL EXPERIMENT

Nick Ferrante, Winemaker & General Manager
Ferrante Winery, Geneva, OH

Tasting II: Ferrante Winery
Tasting III: Ferrante Winery

Objectives:

1. Evaluate the effect of oak origin on wine quality and style.
2. Evaluate the effect of oak age on wine quality and style.
3. Evaluate the effect of oak chips, the difference between chips and barrels and the source of oak chips on wine quality.
4. Evaluate the effect of barrel fermentation on wine quality and style.
5. Evaluate the effect of aging and lees stirring on wine quality and style.

Grape Variety: Chardonnay
Source: Glenora Farms, Seneca Lake, Finger Lakes, New York
Harvest: 9/16/99, machine harvested
Must analysis: ss = 19.0°Brix
TA = .60%
pH = 3.6
Wine analysis: TA = .75
pH = 3.4
Must was chaptalized to 22° Brix
RS = .2%

Fermentation: SO_2 : None
Skin contact: 5-6 Hours
Clarification: 48 Hours settling @ 45° F
Pectic enzyme: Cinn-Free (15-30 ml/ton)
Nutrient addition: 5 lbs/1,000 gal DAP, 2 lbs/1,000 gal Fermaid K
Yeast: D254 (2 lbs/1,000 gal)
Tartaric acid: .25g/100 ml in juice before fermentation.
Fermentation: 2 days in SS tank (-2.5° Brix), then transfer to barrels.

Cooperage: 2 barrels, Canton Cooperage, Hungarian oak, new, medium toast.
2 barrels, Canton Cooperage, Hungarian oak, new, heavy toast.
2 barrels, Canton Cooperage, Hungarian oak, 1 year old, medium toast.
2 barrels, Canton Cooperage, Hungarian oak, 1 year old, heavy toast.
2 barrels, Canton Cooperage, American oak, 1 year old, medium toast.
2 barrels, Canton Cooperage, American oak, 1 year old, heavy toast.

Cooperage Cont'd:

1 barrel each Demptos, Allier, Nevers, Troncais, Vosges, new, medium toast.
1 barrel each Demptos, Allier, Nevers, Troncais, Vosges, new, heavy toast.
Oak Chips: Barrel, Chips, Etc.: American, French, Hungarian, medium toast.
World Cooperage: French, medium and heavy toast.

Treatments: Barrel lots: Barrel fermentation, aging and lees stirring in barrels until sampling (Feb. 1st).
Barrel time: 3 months
Oak chips: 3 gal carboys @ 2 reps per treatment.
10g of oak chips per gal of wine (30 g/3 gal carboy)
Carboys filled with stainless steel fermented Chardonnay.
Oak chips in contact with wine for 2 months.
Stirring regime: First 5 weeks: Once weekly
Afterwards once every 2 weeks.
MLF: All lots: (barrels and SS fermentation), OSU strain.

EXPLORING THE VERSATILITY AND POTENTIAL OF VIDAL

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The objective of the Open House is to focus on a specific variety which has proven to be a reliable and well accepted veteran in our industry or a promising newcomer whose potential has not been fully exploited yet.

Vidal or Vidal Blanc or Vidal 256 is one of the so-called "hybrids" or "French hybrids". Or is it "French-American hybrids" or even "American hybrids"? There is a lot of confusion and uncertainty about the correct term. By the simplest definition "French hybrids" are a group of grape selections that originated in France from crossing *Vitis vinifera* with certain North American species such as *Vitis rupestris*, but not *Vitis labrusca*. There were efforts as early as 1874 in Montpellier in southern France to produce cultivars resistant to phylloxera, diseases and eventually calcarious soils which are capable of producing acceptable fruit for wine on their own roots. Collectively they became known as "hybrid direct producers", or HPD's. Among the first of those coming to the US were Clinton, Isabelle, Othello and Noah. Since they have *labrusca* in their parentage they don't fall under the definition given earlier. By the time World War II came a new group of French hybridizers made its impact. They were among others Seyve, Seyve-Villard, Ravat, Landot and of course Jean-Louis Vidal. They used *viniferas* as major parent and crossed them primarily with *rupestris*, but not *labrusca*. These new hybrids acquired good acceptance by French growers, even though none of them were granted "appellation d'origine" status, and thus could only be used in "vin ordinaire" (table wine) or as table grapes. Hybrids had been forbidden in AOC (Appellation d'Origine Contrôlée) VQDS (Vin de Qualité Supérieur) since 1927. By the late 50's 1 million acres or 31% of the total acreage were planted to these hybrids. This was the peak, and since then the acreage declined steadily to about 180,000 in 1979.

In the US Philip Wagner from Boordy Vineyards in Maryland was among the first to introduce the hybrids on a larger and systematic scale in the late 30's. In the Finger Lakes, one of the earliest commercial French hybrid vineyards was planted in 1944 by Gold Seal. They used Seibel 1000, which was named "Rosette" in 1972. The vines were described later as having "trunks as big as oak trees".

The first French hybrids introduced in Ohio were 1.38 acres of Seibel 1000 in 1941 and an additional 1.3 acres of Baco in 1955 at Mantey, now Firelands Winery, in Sandusky. As far as I know both plantings still exist. OARDC planted Seibel 1000 in their vineyards at Wooster in 1956.

Growers and wineries were not very comfortable with numbered varieties, some named, often with several names, some not at all. So over the 60's and 70's efforts were directed towards finding acceptable names which was a difficult and lengthy process considering all the interests and power struggles involved. All this is behind us now and we have become familiar with cultivars such as Seyval, Vidal, Vignoles, Baco, Foch, DeChaunac, Chancellor and Chambourcin, to name the most popular.

Tonight we will explore the versatility and potential of one of those hybrids, Vidal Blanc. Eleven award winning wines from Ohio, Indiana, Michigan, New York, Missouri and Illinois have been selected. Some are blends, some are varietals; some are barrel fermented, others were crafted in stainless steel tanks; some are drier than others; some harvested early, others late. It's the purpose of this event to offer you the opportunity to decide which style suits your palate, needs, and customers the best.

28th OHIO GRAPE-WINE SHORT COURSE
Open House - Vidal Reception

Roland Riesen

1.	___	1997	Vidal, Grand River Valley, Chalet Debonné Vyds, Madison, OH
2.	___	1999	Vidal, late harvest, Ferrante Winery, Geneva, Ohio
3.	___	NV	Vidal Blanc, Heineman Winery, Lake Erie, Put-in-Bay, Ohio
4.	___	1997	Vidal Blanc, Henke Wine, Ohio River Valley, Cincinnati, Ohio
5.	___	1998	Vidal Blanc, Huber Winery, Starlight, Indiana (Stainless steel fermented)
6.	___	1998	White Blossom, Huber Winery, Starlight, Indiana (Barrel fermented)
7.	___	1998	Red Newt White, Red Newt Winery, Finger Lakes, Hector, NY (65% Vidal, 35% Cayuga)
8.	___	1999	Vidal Blanc, Missouri Weinland, Blumenhof Vyds, Dutzov, MO (5% Muscat)
9.	___	1998	Michigan Vidal Blanc, Lynfred Winery, Roselle, Illinois
10.	___	1998	Vidal Blanc, semi-dry, Alto Vineyards, Alto Pass, Illinois
11.	___	1998	Vidal Blanc, Sweet Reserve, semi-sweet, St. Julian Winery, MI

! Match wines 1 - 11 with wines A - K !

28th OHIO GRAPE-WINE SHORT COURSE
Open House - Vidal Reception

Roland Riesen

1.	_G_	1997	Vidal, Grand River Valley, Chalet Debonné Vyds, Madison, OH
2.	_C_	1999	Vidal, late harvest, Ferrante Winery, Geneva, Ohio
3.	_K_	NV	Vidal Blanc, Heineman Winery, Lake Erie, Put-in-Bay, Ohio
4.	_D_	1997	Vidal Blanc, Henke Wine, Ohio River Valley, Cincinnati, Ohio
5.	_J_	1998	Vidal Blanc, Huber Winery, Starlight, Indiana (Stainless steel fermented)
6.	_H_	1998	White Blossom, Huber Winery, Starlight, Indiana (Barrel fermented)
7.	_E_	1998	Red Newt White, Red Newt Winery, Finger Lakes, Hector, NY (65% Vidal, 35% Cayuga)
8.	_A_	1999	Vidal Blanc, Missouri Weinland, Blumenhof Vyds, Dutzov, MO (5% Muscat)
9.	_I_	1998	Michigan Vidal Blanc, Lynfred Winery, Roselle, Illinois
10.	_F_	1998	Vidal Blanc, semi-dry, Alto Vineyards, Alto Pass, Illinois
11.	_B_	1998	Vidal Blanc, Sweet Reserve, semi-sweet, St. Julian Winery, MI

28th OHIO GRAPE-WINE SHORT COURSE
Open House - Vidal Reception

! PLEASE RECORD YOUR FAVORITE AND LEAST FAVORITE WINES !

Favorite 1: ______

Favorite 2: ______

Least favorite 1: ______

Least favorite 2: ______

28th OHIO GRAPE-WINE SHORT COURSE
Lunch Wines

Roland Riesen

1. 1998 OARDC Pinot Gris, blend I
2. 1998 OARDC Pinot Gris, blend II
3. 1999 OARDC Traminette
4. 1999 Swedish Hill, red hybrid blend (tank sample)
5. 1997 OARDC Lemberger
6. 1997 OARDC Dornfelder

28th OHIO GRAPE-WINE SHORT COURSE

Lunch Wines

Wine Analysis

		pH	TA	alcohol	MLF
1.	1998 OARDC Pinot Gris, blend I	3.32	.69	13.5%	partial
2.	1998 OARDC Pinot Gris, blend II	3.27	.70	13.3%	partial
3.	1999 OARDC Traminette (RS: 4%)	3.15	1.10	12.9%	no
4.	1999 Swedish Hill, red hybrid blend (tank sample)				
5.	1997 OARDC Lemberger	3.72	.59	12.7%	yes
6.	1997 OARDC Dornfelder	3.74	.57	12.3%	yes

Must Analysis

		pH	TA	ss	date
1.	1998 OARDC Pinot Gris (Wooster)	3.58	.52	19.7	9/18
2.	1998 OARDC Pinot Gris (Kingsville)	3.53	.56	20.7	10/5
3.	1999 OARDC Traminette (RS: 4%)	3.39	.69	26.5	10/18
4.	1999 Swedish Hill, red hybrid blend (tank sample)				
5.	1997 OARDC Lemberger	3.12	1.01	19.2	10/28
6.	1997 OARDC Dornfelder	3.55	.85	20.8	10/28

FERRANTE - 1999 VINEYARD PLANTING

Nick Ferrante, Winemaker & General Manager
Ferrante Winery, Geneva, Ohio

Ferrante Winery planted its first commercial vineyard since the 1970's using the latest technology available. Lloyd Schmidt from International Viticultural Services acts as our consultant. The vineyard was designed using Canadian (Ontario) viticultural techniques. A six acre field was laser leveled by earthmovers. The top soil was stripped, field leveled and evenly distributed over the field. Extensive drainage tile was installed in our heavy clay soil. The vineyard has 8.5 foot row spacing. A three inch drain tile is located in the center of every row at 30 inches in depth. Extensive tiling provides for quick water removal, oxygenation of the soil and quicker cane dormancy in the fall months. The field has over eight (8) miles of tile installed.

The following field operations were completed before planting. Ripped at 18 inch depth, deep plowed, disced, limed and fertilized. A V-shaped plow was used to make a trench for hand planting of the vines. This time consuming method was used to provide loose soil to around the roots. Tightly hand planted vines, without air pockets around the roots, provided for quick vine growth. The vines were obtained from Mori Nursery, Niagara Falls, Ontario. Two acres of Riesling, clone 239, were planted on rootstocks 3309 and S04, 2 acres of Cabernet Franc, clone 1, on rootstocks 3309 and S04 and 2 acres of Vidal on rootstock S04. The vines were planted 5 feet apart. Planting was done in the first week of May. No irrigation was used, but will be installed for future use.

Trellis construction started soon after planting to provide a full growing season, without vines on the ground. Metal nine (9) foot line posts were installed by a post pounder at twenty (20) foot intervals. End posts are eight (8) foot cedar angled at 60 degrees with 36 inch metal anchors and a 20 gauge brace wire. Vertical shoot position (VSP) was chosen as trellis system for the vinifera plantings. The VSP has a 32 inch fruiting wire and 3 sets of catch wires (stationary) at 40 inch, 60 inch and 80 inch. The Vidal is trained to a top wire cordon system with a 36 inch bottom wire and a 84 inch top wire. Metal staking rods were installed by each vine to provide straight trunks. Good first year growth was obtained because the vines had no weed competition. Two fungicide sprays were applied during August to further cane and leaf growth.

This type of narrow row grape farming requires specialized equipment. Two new tractors were purchased. A John Deere 5400N (narrow tractor - 48 inches overall width) and a New Holland 90 HP cab tractor. A Microliner 400 gallon S/S sprayer and a Braun grape hoe were also purchased. We built a 6 foot row ripper and a hill-up plow.

The spring 2000 planting consists of 2 acres of Riesling, 2 acres of Vidal Blanc, 1 acre of Cabernet Sauvignon and 1 acre of Chardonnay.

BREEDING ROOTSTOCKS FOR CURRENT AND IMPENDING VITICULTURAL PROBLEMS

Andrew Walker
Department of Viticulture and Enology
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HISTORY OF ROOTSTOCK BREEDING

Viticulturists in California and Europe first experienced the ravages of phylloxera at about the same time in the 1860's. The Europeans developed an intensive breeding program which produced hundreds of phylloxera resistant rootstocks adaptable to a broad range of sites and viticultural practices, which they were using by the turn of the century. Californians first used cuttings of *Vitis riparia* and *V. rupestris* harvested from the wild in the Midwest, and grafted directly on them. As European rootstocks were released, Californian viticulturists and growers began screening them to see which were best suited to our climates and soils. Rootstock breeding did not begin in California until much later, when the potential danger of root knot nematodes on the sandy soils of the Central Valley was recognized.

When Europeans first bred rootstocks, they were mostly concerned with combining the ability to root with durable phylloxera resistance. They used the easily rooted *V. riparia* and *V. rupestris*. However, vines grafted on these species showed lime-induced chlorosis when planted on typical European chalky soils. This led to the hybridization of *V. berlandieri* with either of these species to produce rootstocks with phylloxera resistance, rooting ease, and lime tolerance. In the cooler parts of Europe, which experience summer rainfall, the most common rootstocks were *V. berlandieri* x *V. riparia*. In warmer Mediterranean areas that experienced summer drought, *V. berlandieri* x *V. rupestris* hybrids predominated.

Breeders in the United States were producing fruiting varieties in the mid and late 1800's with the objectives of combining good fruit quality with disease and cold resistance. Near the turn of the century T.V. Munson, in Texas, produced Dog Ridge and Ramsey for use in his breeding program to produce fruiting varieties. They were later discovered to have excellent root knot nematode resistance and were used as rootstocks.

Rootstock breeding in the United States began with Snyder and Harmon at the USDA station near Fresno, when they selected seedlings of 1613C and Dog Ridge in 1935. The best of these seedlings were later crossed to produce Harmony and Freedom. Their program was focused on resistance to root knot nematodes and adaptation to the sandy soils of the San Joaquin Valley.

Lloyd Lider of U.C. Davis also bred rootstocks to resist root knot nematode. Two of his selections K51-32 and K51-40 (*riparia* x *champinii*) are used in Australia and South Africa to a limited degree. He also produced hybrids with *V. arizonica*, *V. candicans*, *V. longii* and *V. rufotomentosa* that tested resistant to the dagger nematode (*Xiphinema index*). None of these are used as rootstocks, but they are being used as parents in the current breeding program.

H.P. Olmo of U.C. Davis produced *V. vinifera* x *Muscadinia rotundifolia* hybrids in the 1940s. His purpose was to examine genetic differences between these species, and to begin a long term breeding project designed to incorporate the excellent disease and pest resistances of *M. rotundifolia* with the fruit quality of *V. vinifera*. Two of these hybrids, O39-16 and O43-43, were tested in trials initiated by Lider and Goheen and later released as rootstocks to combat fanleaf degeneration.

FANLEAF RESISTANCE

Perhaps the most serious pest problem facing viticulture is fanleaf degeneration, a disease complex caused by grapevine fanleaf virus (GFLV) vectored by the dagger nematode, *Xiphinema index*, when it feeds on grape roots. GFLV prevents normal berry set and thus reduces yields by as much as 80%. *X. index* not only transmits GFLV from root to root, but can cause vine decline because of its severe root feeding. Fanleaf degeneration is common throughout California and is particularly severe in Lodi, Livermore and portions of Napa and Sonoma counties. When the VR hybrid O39-16 was released, scions grafted to it yielded well and were free of GFLV. Since its release, we have detected high levels of GFLV in scions grafted on O39-16, but yields to date appear unaffected, suggesting that O39-16 induces fanleaf tolerance in scions grafted on to it. We cannot be sure how long this tolerance will last and this causes concern about the long term use of this rootstock. In addition, as mentioned in an earlier article in this series, O39-16 is half *V. vinifera* which compromises our confidence in its long-term phylloxera resistance.

The rootstock breeding program at UC Davis is attempting to find better sources of resistance to *X. index* feeding in *Vitis* and *Muscadinia* species, with the goal of incorporating non-*vinifera* GFLV resistance with dagger nematode resistance. Thus far, the only sources of GFLV resistance known are within *V. vinifera*, a species without phylloxera resistance. The French have successfully genetically engineered the coat protein gene of GFLV into 3 rootstocks (41B, SO4 and 110R) and into Chardonnay. This means that these plants carry the gene which controls the production of the protein shell of fanleaf virus. The expectation is that grapevine cells with this gene will be preoccupied producing empty virus shells, and will not produce enough infectious virus particles to cause disease. This strategy has been reported to work in some annual crops, but has failed in others. The French have invested millions of dollars from private and public agencies into this program to produce fanleaf resistant plants.

Given adequate resource, these sorts of strategies would also be possible at U.C. Davis. However, a more stable and long-term answer to this disease complex will require identifying the GFLV resistance genes and combining them with sources of resistance to *X. index*.

NEMATODE RESISTANCE

The need for resistance to nematodes in the Central Valley of California is both a current and impending problem. Most Central Valley vineyards are still own-rooted. Nematodes are controlled with nematicides during the growing season and fumigation between plantings. Environmental and political pressure is limiting the application of these pesticides and it is possible that their use will eventually be banned. Another nematode strategy that is becoming less useful is vineyard abandonment and replanting on a new site. Economics and urbanization will soon force the reuse of unproductive sites, and require use of nematode resistant rootstocks.

A number of nematodes attack grapevines including root knot (*Meloidogyne* species), dagger (*Xiphinema americanum* and *X. index*), ring nematodes (*Criconemella xenoplax*), lesion (*Pratylenchus vulnus*), and citrus (*Tylenchulus semipenetrans*). Rootstocks with resistance to all of these nematodes are unavailable, and more aggressive strains of root knot have been found which are capable of overcoming current used rootstocks such as Harmony. These factors point to the need for new rootstocks with broad and durable nematode resistance. Recent resistance screens against root knot nematodes at U.C. Davis found promising sources of resistance in *V. aestivalis*, *V. berlandieri*, *V. champinii*, *V. cinerea* and *M. rotundifolia*. These sources are being used in the production of new nematode resistant rootstocks.

Another factor limiting the wider use of rootstocks in the Central Valley is the lack of rootstocks tailored to raisin and table grape production. Once soil pesticides become limited, only rootstocks will allow viticulture in some areas. Current nematode resistant rootstocks tend to be overly vigorous leading to delayed maturity, decreased bud fertility and reduced berry color. Some of these cultural problems can be dealt with by changing trellis design or cultural practices such as leaf pulling. New rootstocks are needed that are bred to address table and raisin grape culture problems, including the ability to control fruit ripening, control canopy size, increase bud fertility, improve berry color, and at the same time possess durable and broad pest resistance.

FUNGAL RESISTANCE

Rootstocks are also needed to control a number of fungal diseases. Some of these now limit viticulture, such as oak root fungus (*Armillaria mellea*) and Phytophthora root rot (*Phytophthora cinnamomi*), while others, like Texas root rot (*Phymatotrichum omnivorum*), are potential future threats. Phytophthora root rot is usually associated with sites having poor drainage due to very heavy soil texture or high water tables. This association is so strong that it is difficult to determine whether the fungus is the causal agent in vine death, or whether it acts opportunistically and attacks the vine only after it is weakened. *Vitis palmata* is one of the few *Vitis* species that grows in swamps and ponds, although it is often a weak-growing vine it may have value in breeding a rootstock capable of tolerating a wet root crown and resisting Phytophthora.

Vineyards have expanded into areas once occupied by oak woodlands or orchards and oak root fungus has been encountered. This fungus feeds slowly on the decaying wood of oak and fruit trees. It attacks grapevines when their roots grow into contact with the fungus. Fumigation, advised for spot control of this problem, does not penetrate deeply enough to affect the fungus on deeply buried roots. When grapes are replanted their roots eventually grow down to the fungus again and the new vines become diseased. There are reports that resistance may exist in *V. riparia*, but studies are incomplete and need to be confirmed. *Vitis californica* grows in areas where oak root fungus is present and may possess some resistance. The rootstock O39-16 seems to survive, at least in the short term, in some oak root fungus areas, but there has been no research to prove whether this stock is resistant or whether its high vigor only postpones the disease. One of the impediments to progress in breeding resistance to oak root fungus is its slow acting nature. Past resistance screens took place over a two-year period in containers. A more rapid method of assessing resistance will enhance progress.

Texas root rot is a fungus that prefers the hot climates and alkali soils of the southwest and northern Mexico. It is able to persist in fallow soils for many years, is difficult to control with fumigants, and readily attacks and kills grapevines. The *V. champinii* rootstock Dog Ridge has shown resistance, but it has cultural flaws such as high vigor and poor rooting that limit its use. Other southwestern species such as *acerifolia, arizonica, berlandieri, candicans, and doaniana* should be screened for resistance and then crossed to produce resistant rootstocks with good viticultural characters.

ADAPTATION TO SOILS AND VITICULTURAL USE

As people and wildlife garner a larger share of California's agricultural water, viticulturists in most areas of the state will have to depend on rootstocks with greater drought tolerance. Lack of sufficient water will also mean that many of the state's soils will become more saline. High quality (low salt) and plentiful water from the California Water Project is responsible for much of the San Joaquin Valley's agricultural success, particularly along the west side of the valley. As urban and environmental pressures decrease the availability of this water the soils will become increasingly droughty and saline. New rootstocks are needed to address these problems. The mechanism of drought and salinity tolerance must be better understood so that appropriate decisions for rootstock breeding can be made. The sources of drought and salinity tolerance now available are also very vigorous; we must understand these tolerances so that we can modify the vigor of new drought and salinity tolerant rootstocks.

Rootstocks with differential nutrient uptake efficiency should also be bred. Rootstocks are needed to exclude chloride, magnesium, sodium, and potassium and nitrogen in some soils, while others are needed to increase uptake of phosphorus, zinc, and nitrogen and potassium in other soils. Australian research has shown that rootstocks transport different levels of potassium and sodium to their scions. Grape species grow in a wide range of habitats and soils ranging from forested areas with rich relatively high nitrogen soils to the eroded, high salt soils of the southwest. It should be possible to exploit species from these areas to produce rootstocks that are very thrifty in their nitrogen demands, and others capable of growing in high nitrogen areas which avoid nitrogen-induced problems with fruit set and ripening. Rootstocks with tolerance to high salts could also be bred from species growing on similar soils.

It may also be possible to breed rootstocks with adaptation to serpentine soils. Serpentine soils are relatively common in the North Coast and Sierra Nevada foothills, and as vineyard plantings continue to expand more of these soils are utilized. Serpentine soils have an unusual, plant limiting, mineral composition with low calcium, phosphorus and nitrogen, and excessive magnesium and toxic minerals such as copper and mercury. There is some interest in using the rootstock 44-53 Mgt for serpentine sites due to reports that it grows poorly on sites deficient in Mg. It has yet to be tested on serpentine to see if it will tolerate the high Mg, low Ca, N and P levels.

Rootstock texts report that *V. vinifera* vines grafted on *V. riparia* ripen fruit earlier, and that some hybrids with *V. riparia* also hasten maturity. It is presumed that the *V. riparia* root system stops growth early and therefore hastens fruit maturity. Conversely, some species grow late into the fall and may help delay harvest. These characteristics can be exploited to breed rootstocks capable of delaying or hastening harvest, benefitting raisin, table and wine grape growers.

In apple production, the Malling series rootstocks are available to control the size of scions grafted to them, allowing a given apple variety to be grown as a small dwarf or a full sized tree. Some grape rootstocks are thought to be devigorating, but this area of vine control needs further research. In the past, rootstock breeders selected the most vigorous seedlings with the resistance characters they wanted because they were the easiest to grow. We must select the best seedlings in different seedling vigor classes as a possible means of producing resistant rootstocks with vigor control. Thus far it is clear that weak seedlings make weak plants, but studies of this effect on grafted vines are not complete.

PHYLLOXERA RESISTANCE

Rootstocks were first bred to combat phylloxera, and that resistance is no less important today, as the collapse of AXR#1 illustrates. Fortunately, rootstocks hybrids of *V. berlandieri, V. riparia*, and *V. rupestris* seem to possess broad and durable resistance to phylloxera, as evidenced by their use in many climates and against many populations of phylloxera over the last 120 years. However, rootstocks with *V. vinifera* in their parentage are at risk.

The most important phylloxera-related problem for rootstock breeders is the poor understanding of phylloxera resistance. We know some species possess broad and durable resistance, but we don't know why. More importantly, we don't know if other *Vitis* species that are needed for such characters as nematode resistance and drought tolerance also have broad and durable phylloxera resistance.

Type B phylloxera was first considered to be a mutation from a standard A type phylloxera. Recent research on phylloxera DNA shows that there are strains of A type phylloxera (those that do poorly on AXR#1) and strains of B type phylloxera (those that reproduce rapidly on AXR#1 and are associated with its decline). In other words, there are genetically distinct phylloxera populations that act as A types and genetically distinct phylloxera populations that act as B types. Their genetic differences do not classify them as As or Bs, and seem unrelated to their ability to feed on AXR#1. This suggests that a B type did not evolve from a standard A type, and that B types are not spreading, but rather developing independently at different sites. Why phylloxera are diverse in California is not known, but it could be due to multiple initial introductions, a functioning but unobserved sexual cycle which would promote variability, or a means of realigning its DNA without sexual recombination. At any rate, it seems likely that wherever AXR#1 is used B type phylloxera will eventually appear.

Why is phylloxera diversity important? Why must we understand the phylloxera-*Vitis* interaction? These questions seem unimportant to vineyard re-establishment, as long as we are confident that available rootstocks will resist phylloxera. Because phylloxera have a sexual cycle in Europe, they should be quite diverse, and rootstocks bred with only *V. berlandieri, V. riparia,* or *V. rupestris* have not collapsed in over a hundred years of use against this diversity. But what will happen to rootstocks bred with *V. champinii*, a species with reportedly low to moderate phylloxera resistance, broad resistance to nematodes, and drought and salinity tolerance? Will such rootstocks withstand phylloxera pressure for years on soils conducive to phylloxera damage? Are phylloxera capable of evolving new strains with the ability to destroy rootstocks based on species other than *berlandieri, riparia* and *rupestris*?

The overall answer to these questions is that a thorough understanding of phylloxera diversity and the various phylloxera/*Vitis* interactions is essential for rootstock breeding. Such discoveries may not have an impact on today's replanting decisions, but they will definitely impact how freely we use the *Vitis* species in producing rootstocks for tomorrow's vineyards.

CONCLUSION

California growers are still angry and confused over the collapse of AXR#1 to more aggressive strains of phylloxera. Fortunately, there are solutions to this problem. A large number of broadly adaptable rootstocks are available which resist biotype B phylloxera and do well in California. The viticultural dilemma stems from lack of current information about which rootstocks are best suited to specific Californian conditions. However, there are still serious soil-borne pest problems for which no rootstock answers exist. Some of these problems are specific to California, while others are international problems.

California growers face a variety of nematode problems ranging from complexes to new more aggressive strains of root knot. Perhaps the most important problem facing grape growers on nematode conducive soils is the possibility that all soil applied pesticides may be banned or be very tightly regulated in the near future. New rootstocks are needed with broad and durable nematode resistance. O39-16 seems to be tolerant of fanleaf virus, but its long-term virus tolerance is in doubt, as is its phylloxera resistance. Soil-borne fungi are a more limited problem, but where they occur grapes will not grow. Sources of resistance to these fungi may exist, but rapid screening methods are needed before rootstock breeding for fungal resistance can progress.

The rootstocks currently used in California were bred for soils, climates, and viticultural practices that are not encountered here. Many are broadly adaptable, but do not adequately address problems such as salinity and drought tolerance, excessive vigor, serpentine soils, and raisin and table grape culture. Rootstocks bred and selected for use in California with these problems in mind will be better tailored to our soils, climates and viticultural practices.

Rootstock breeding must be done in conjunction with investigations into the mechanisms of traits being utilized. Phylloxera resistance is a classic case. We know that *V. berlandieri, V. riparia* and *V. rupestris* rootstock hybrids have resisted phylloxera for over 100 years. However, we don't know why. We also don't know if rootstocks bred from *V. champinii*, a species with a variety of potentially useful traits, will adequately resist phylloxera. If we understood how species resist pests and tolerate soil conditions we could breed rootstocks much more rapidly and be assured that the rootstocks we produced would be long-lived.

Rootstock breeding at U.C. Davis is well underway. *Vitis rupestris* x *M. rotundifolia* hybrids have been selected that resist dagger and root-knot nematodes, and are in field trials in fanleaf and nematode sites across the state. Genetic markers are also being identified to accelerate the selection process, and genetic mapping is ongoing with the eventual goal of identifying nematode resistance genes.

The need for the rootstocks discussed in this article is real. The goals and objectives can be accomplished; time and money are the limitations. Rootstock breeding is a slow and expensive process. It requires extensive collections of species with various traits, vineyard space on which to grow seedling populations, and qualified assistance to evaluate seedling resistance and field performance. It also requires a vision of what will be needed in the future. Answers to the future's problems must be considered now so that the rootstock breeding can produce results.

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GRAPE EXPECTATIONS
LOOKING TOWARD TRADITIONAL AND NON-TRADITIONAL SPONSORS TO ENHANCE YOUR EVENT

Doniella Winchell, Executive Director
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Definitions:

***Contributor*:** someone who makes a free will donation - seldom expects any return on investment

Sponsor: someone who gives cash or services with an eye to exposure, consumer contacts, image development, etc.

Partner: someone who truly looks to a joint effort for mutual benefit

Strategies for identifying appropriate sponsors: look to existing relationships, for someone with needs you can fulfill, for someone whose interest parallels your target audience, someone who has an affinity for your operation or service

Traditional sponsors: fine foods, magazines, simple brainstorming - who has similar interests

Non-traditional sponsors: bank, jewelry store, soup company --who has $, who wants access to your credibility

Contract development: detail, detail -- call ahead to identify the correct person and then call the person at another time -- don t call wine buyer when you need the sponsorship development/promotions person

Completing the arrangements: detail/detail again -- no unfulfilled expectations -- formal contract

Building mutual goals: look for more support than you originally promised toward THEIR goals -- make sure you over do -- see below

Satisfying needs: be realistic on both sides

Before the event: follow-up regularly

At the event: meet EVERY need -- make them feel special

Following the event: get ready for next year -- remember them at the holidays, etc.

Building for the future: brainstorm for fresh ideas -- cut through the clutter -- be more creative than others who look to the same people for $

Expanding the circle of relationships: if your relationship is good, as satisfied sponsors for leads/endorsements

Examples:

Event marketing: Vintage festivals

Cause marketing: charity tie-ins are good

Co-op advertising: get in-house $ (and partner $) to leverage buys with more and/or freebee space

Cross promotions: look at other businesses who benefit during your event -- ask them to mention you if you mention them

Consumer promotions: look at your weekend mall promotions, other big events, other related events for additional exposure

Mailing Lists: direct mail, mailing lists, direct mail -- need repetition

Media promotions: on air - call in - expert guests - free tickets for mentions -- look to smaller markets -- easier to get the time

ASSESSING GRAPE MATURITY BY TASTE AND BY NUMBERS

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Obviously flavor ripeness is the key. We must have grape varieties which are fit into the ripening conditions of our winegrowing area. And we must have a typical year which allows full flavor maturity.

The flavor composition of the grapes should decide when the grapes are harvested. If necessary we can add sugar and acid and we can remove acid – we can not add flavor (unless we are making non-standard wine, wine or wine based beverages). Ideally we harvest the grapes at the time they contain the flavor profile desired for the type of wine we like to make. Of course in cool climate winegrowing regions we have to deal with unpredictable weather conditions which at times do not allow fruit to ripen to the desired degree. The weather might become too cool, the leaves might be frozen off, or bunch rot might set in and the fruit must be harvested earlier than planned. In this case we have to adjust our winemaking techniques and perhaps also change the wine style to optimize the quality of the fruit. Flavor ripeness can be difficult in cool climate winegrowing areas but when it works it is worth the gamble - we can make wines of intense flavor and very fine structure.

Fruit of all grape cultivars go through a series sequence of flavor changes at it matures. Winemakers must be familiar with the flavor characteristics of a given grape variety and the flavor profile of this variety in a given area. The flavor profile over different degrees of grape maturity determines what types / styles of wine can be / should be made.

Flavor profiles during fruit maturation

Typically white grapes start with flavors of green vegetable, fresh cut grass, progressing into green apple and citrus flavors, then into floral, and spice tree fruit aromas. Each grape variety has its own distinct flavors at various stages of maturity. Red grapes also start with green vegetable, herb, and green apple flavors, progressing into red berries or red tree fruits, then dark berries (black currants, blackberries, blueberries) and black cherries, then peppery and other spicy aromatic wood aromas. Maturity of tannins typically comes late when the fruit aromas are already full of ripe berries, spice, dark fruit. Tannin maturity is assessed by chewing on the skins. When the tannins taste like very good black tea or rich black espresso coffee then the tannins are mature. If they still taste sharp, bitter, hard, a bit green then they are green and these green tannins will stay green as long as the wine ages!

We also have to be cautious of overmature fruit. Especially some interspecific hybrid grapes can mature quickly. When overmature they loose very desirable fruity, floral and spicy aromas. In the case of Cayuga White, the nice fruit aromas are lost and the grape acquire foxy labrusca flavors. Not only Cayuga White can be overripe in our climate. All early maturing grapes such as Chasselas, Siegerrebe, Silvaner, Müller-Thurgau can easily become overripe. If we wait to long we miss the preferred flavor profile. In early maturing varieties, spicy and floral aromas can be lost within one week (and less). We even have some years in which we can have Chardonnay and Riesling become overripe. Not only will the have lost their desired intense fruit aromas, white wines also become phenolic bitter, and the alcohol content can be too high, leaving an burning alcoholic aftertaste or even sticking out in the first smell aroma impression.

Winemaking by numbers

Sugar and acid content and pH are important in winemaking. The sugar content determines how much alcohol will be in the finished wine. A finished wine must be balanced with the alcohol content. Also the acidity must suit the wine style. Of course, we can remove acidity and we can acidity. The pH should be as low as possible during winemaking because it protect the wine against spoilage. In the finished wine of course it has to be balanced to give the wine a long aftertaste and to list the fruit characteristics. It would be nice if we could say that a given variety is ripe at 15, 18, 20 or 24 Brix and a certain acidity. A big mistake that sometimes is (was) made is to use sugar contents which are typical for ripeness in California and expect fruit grown in cool climates to have obtain the same sugar content and same flavor profile at a given sugar content. This does not happen here. Fruit in cool climate conditions develops ripe fruit flavors at lower sugars. For example, Riesling in Upstate NY can be ripe between 16 and 20 Brix, Chardonnay (depending on clone) is ripe at 19 to 23 Brix, Cayuga White is ripe at 14 to 18 Brix, Pinot Noir is ripe between 19 and 24 Brix. Unfortunately, in different years we can have very different flavors at a given sugar content. In cool years Riesling is ripe at 16 Brix. In a hot, dry year like 1999 Riesling was ripe at 20-22 Brix. In a moderately warm year like 1990 Cayuga White was ripe with intense flavors at 15 Brix, in a hot, dry year like 1999 it was ripe (with less intense flavors) at 18 Brix. The point I am trying to make is, in cool climate growing areas we have to look for flavor maturity at lower sugar content **and** from year to year we can **not** expect the same flavor profile at the same sugar and acid content. We need to taste the grapes, watch sugar and acid content and be ready to make sugar adjustments to achieve the desired alcohol content and make acid adjustment for the desired acid balance.

Sugar, Acid, and pH

As already said, sugar content at flavor maturity is typically low in our grapes. Yet, it is easy and not at all harmful to the quality of the wine to add more sugar to increase the alcohol content. It is not possible to remove sugar from ripe grapes to lower the potential alcohol content. When wine is dealcoholized technically it's flavor quality always suffers to some degree. We can also remove acidity without harming the flavor profile and of course we can add acid. Adding acid should be done to control the pH within reasonable limits and to balance the final flavors. In the Finger Lakes and in most or all other places grapes are not flavor ripe when the fruit pH is still below 3.0 (Riesling might be 2.9 in some years). For most white wines we find a pH between 3.0 and 3.3 typical at harvest. In some reds in some whites the pH might be

3.4-3.6. Luckily this is rare. Ideally for flavor quality and to protect against microbial spoilage the pH should always be no higher than 3.4. If the pH in the fruit at harvest is lower than 3.0 a winemaker should consider must deacidification (depending on grape variety and wine style). If it is higher than 3.4 the must should be acidified. If it is high at harvest the wine almost always needs acid additions to bring it into balance. It is best to make (large) acid corrections in the must. The sugar content does not have to be over 20 Brix. Depending on grape variety, the desired flavors can be present at lower sugar content. And not all wine needs an alcohol content of 12 or 13%. Some light white wines are beautifully balanced at 8% alcohol. Chardonnay, Pinot Noir and most reds though have their most desired flavor balance at alcohol contents of 12 to 13%. Titratable acidity (TA) at harvest can be in a wide range, again depending on grape variety and desired wine style. And acidity can be adjusted over a wide range. Again, the winemaker should not harvest by acidity but by flavor. But he/she should of course measure the acidity to be able to correct it if necessary. Ideally, for the least amount of interference required most whites should have a harvest TA of 6 to 10 g/L in the juice (Rieslings 8-10 g/L, Chardonnay 6-8 g/L), malic acid content should be no higher than 3 g/L (otherwise expect a big pH shift and high malic acid content indicates low ripeness). TA in reds is typically lower, 5-8 g/L. Again, sugar, acid and pH can be adjusted within limits without damaging the wine quality. Sugar content of course can only be adjusted up (too bad for the winegrowing areas where flavor ripeness only comes at 25 and more Brix).

Conclusion

Check pH, acidity, and sugar content as the grapes ripen and **taste, taste, taste!** Wait for flavors to develop away from green grassy, herbaceous, vegetative, apple citrus flavors into ripe tree fruit, berry, floral, and spicy flavors, more intense flavors. Wait for tannins to mature in reds. Do not wait too long in early maturing white varieties and in interspecific hybrid grapes. Don't let white grapes get overripe, loose fruit flavor and become bitter (phenolic). Different areas will find somewhat different sugar and acid content at flavor maturity. And different grape varieties are flavor ripe at different sugar and acid contents. Use experience in other wine growing areas as guideline and taste the progression of flavors in your own fruit.

INFLUENCE OF FRUIT CONDITION ON WINE QUALITY*

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The first prerequisite in making a high quality wine is the selection of the correct grape variety. Throughout the many famous wine regions of the world, a single variety is often the critical factor in producing exceptional wines. For this reason, the evaluation of grape varieties for wines has been emphasized in the enology program at OSU/OARDC. The results from these studies have indicated that several varieties are desirable for making wines in Ohio. These include: Vidal blanc, Seyval, and Chambourcin.

Although wine quality is greatly influenced by the variety, considerable attention should also be given to fruit condition. It is very rare that unsound fruit yield high quality wines. This is only true for *Botrytis* infected grapes from a few wine areas in certain years. When the temperature and relative humidity conditions are favorable, wines from *Botrytis cinerea* infected grapes are extremely high quality. However, more often than not, *Botrytis* infection is a serious spoilage problem of grapes in most wine regions. This rot produces an enzyme called laccase which is a powerful browning enzyme. It also makes filtration very difficult by increasing the level of the polysaccharide glucan. In addition to the problems of high sulfur dioxide and poor filterability, fruit damage by *Botrytis* infection causes the invasion of other spoilage organisms. In many instances, this secondary spoilage leads to off-odors and undesirable tastes in wines, especially from the growth of acetic acid bacteria. Studies concerning the effect of *Botrytis* rot on wine quality have shown the importance of using sound fruit for wines. Wagener (4) reported that grapes containing 10% *Botrytis* rot should be processed within 1 hour after harvesting. For grapes held over 1 hour, he recommended that the percentage of rot must not exceed 5% to obtain the highest wine quality. Results from Loinger *et al.* (1) also indicated that wine quality decreased with higher levels of *Botrytis* rot. At a range between 5 to 10% rot, wine quality was significantly reduced as judged by a taste panel. Other fruit spoilage organisms, such as powdery mildew, also have a significant effect on wine quality. A study by Ough and Berg (2) showed that wines made from powdery mildew grapes were lower in quality.

In addition to the degree of spoilage, fruit condition may also refer to harvesting temperature and holding time between harvest and vinification. Most winemakers agree that low fruit temperature are necessary for making high quality wines. This is especially important for vinifying white wines which are considered more delicate in aroma and taste than red wines. For this reason, some wineries require that their grapes be harvested at night or early in the morning. In a direct study, Wagener (3) reported that harvesting temperature had a significant negative

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effect on wine quality for a short holding time, 1 hour. Grapes held over 1 hour at 80°F yielded wines with lower quality. At a holding time of 18 hours, grapes at harvesting temperatures of 62°F and 80°F produced wines which were judged as poor quality.

After selecting the correct grape variety with good fruit condition, the next important factor to consider in making high quality wines is harvesting the fruit at peak maturity. In cool regions, such as Ohio, the usual criterion for picking grapes is measuring the sugar content (°Brix) of the grapes. Although the general concept is that the best wines are made from the highest °Brix grapes, studies in Ohio have found that this is not necessarily true. On several occasions, when good quality wines are expected from high °Brix grapes, wine quality has only been acceptable. For our studies in Ohio, several varieties were used to determine the effect of fruit maturity (°Brix) on table wine quality. These varieties included: Catawba, Delaware, Vidal blanc, and Niagara. Grapes from each variety were harvested at three maturity levels (°Brix) from commercial vineyards in northern Ohio. After the grapes were harvested at early, mid, and late stages of maturity, they were transported to the Research Center in Wooster, Ohio for vinification. The fruit were destemmed, crushed, treated with sulfur dioxide and pressed. From the °Brix readings, those juices below 21°Brix were ameliorated with sucrose to bring °Brix content to 21°. After amelioration, the juices were inoculated with Montrachet #522 and fermented at 18°C. When the wines reached dryness, they were racked and treated with an additional amount of sulfur dioxide. Then, during a 6-month period, the wines were cold stabilized, bottled, and analyzed for composition and quality.

The results of the sensory evaluation indicated that most varietal wines were preferred from grapes at the mid-maturity stage. Wines from Vidal blanc, Catawba, and Niagara were rated best in overall quality at °Brix readings of 19.0°, 19.9°, and 15.0°, respectively. Delaware was the only variety which produced wines of better quality at the late stage of maturity, 23.7° Brix.

In conclusion, variety selection, sound fruit, and cool fruit temperatures are significant factors in producing high quality wines. Another important factor in making the best quality wines is harvesting the fruit at the correct stage of maturity, °Brix. Only the highest quality fruit should be used in vinifying wines.

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INFLUENCE OF POST BOTTLING STORAGE TEMPERATURE AND SO_2 ON WINE QUALITY

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Wine behaves like a typical preserved food or beverage. Thus, a wine's shelf life is affected by time and temperature during storage. Many wines are improved by moderate, controlled storage temperatures. The same storage conditions that can turn a fine wine into a great wine in a period of five to ten years can make that same wine poor in a period of one year (1). No winemaker wants to sell a browning white wine, an orange blush wine or a dull brownish purple red wine. This would not look or sell well. This would reflect poorly on the winery as well as the wine industry as a whole. If we do not control our bottle storage temperatures and sulfur dioxide levels we will greatly increase our odds of producing one of these flawed wines.

To show the importance of bottle storage temperature and sulfur dioxide (SO_2) on wine quality we can look at a significant study by C.S. Ough in 1985, (2). In this study, a white wine blend and a red wine blend were stored at temperatures of: 80°F, 90°F, 100°F, 110°F and 120°F for a period of twenty-one days. Each wine blend was divided into two lots. These lots consisted of a high SO_2 concentration and a low SO_2 concentration. The white wine blend with a high SO_2 had a concentration of 110 mg/l total and 40 mg/l free SO_2. The low SO_2 white wine consisted of 40 mg/l total and 4 mg/l free SO_2. The red wine blend with high SO_2 had a concentration of 103 mg/l total and 13 mg/l free SO_2. The low SO_2 concentration wine consisted of 7.8 mg/l total and near zero mg/l free SO_2.

Ough showed that as days of storage increase in relation to increasing temperature there was a dramatic increase in absorbency. Increasing absorbency is directly related to color deterioration in this case. This was shown for both the red and white wine blends.

When we look at the effects of SO_2 concentration on color deterioration in the white wine blend, we see that the higher SO_2 concentration had a significant effect on the control of color deterioration. In the red wine blend, there was a similar trend. As days in storage increase in relation to increasing temperature the low SO_2 sample showed a considerably greater increase in brown color than the high SO_2 samples, even though the final index ratio was not that different. However, for both the white and red wine blends the 120°F storage samples continued to increase in color deterioration over time with both high and low SO_2 concentrations.

This study also shows the effect of temperature on isoamyl acetate. Isoamyl acetate is one of the major fermentation esters responsible for the fruity aroma in wine. As we increase storage temperature over time, we see a significant decrease in isoamyl acetate concentration. Therefore, if we are producing a fruity style French American hybrid or labrusca wine, we can see the effects of higher storage temperatures as detrimental to the fruity aromas. It is noteworthy that the SO_2 concentration seemed to have little effect on changes in the isoamyl acetate ester concentration. Therefore the decrease in isoamyl acetate is due directly to increased temperature in relation to time of storage.

When looking at the sensory results of this study, we can see similar trends in both white and red wine blends. For aroma, color, taste and general quality there was a definite pattern of decreased acceptance or score as temperature increased.

When looking at the effects of SO_2 concentration in the sensory results, we see that for both blends the high SO_2 concentration scored better in aroma, color, taste and general quality than did the low SO_2 concentration. The only exception was the color evaluation in the red wine blend. The low SO_2 concentration scored higher than the high SO_2 concentration which is due to the bleaching effects of SO_2.

The main conclusions that we can derive from this study are: 1) To maintain wine quality during shipping and storage the use of SO_2 is necessary in both red and white table wines; 2) Color in wines unprotected by SO_2 will dramatically change with higher temperature for even short periods of time.

What important factors can we directly relate to the Ohio wine industry? The first suggestion is the need to adjust the SO_2 levels based on pH, to a molecular level of .8 mg/l just before bottling. This will help ensure better overall wine quality and shelf life. Secondly, we need to keep bottle storage temperatures as low as possible. The ideal would be below 68°F. The third point we need to consider is to keep bottle storage temperatures as constant as possible. This will help prevent wine leakage through corks due to the shrinking and expanding from temperature changes. Temperature fluctuation can also cause convection currents stirring up any hazes or sediment in the bottle. The fourth factor is to keep bottle head space to a minimum. This is simply due to the fact that oxygen can readily attack the wine and cause deterioration. The last suggestion would be to have a well insulated bottle storage room. The bottle storage area will need to be well insulated or underground so that the Ohio winters and summers will not have such a significant effect on wine quality.

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WHAT WE DO AT HARVEST TO HELP WINE QUALITY

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At Chalet Debonne Vineyards the quality of our raw fruit is of utmost importance in the production of our finished wine. However, equally important is our constant concern of maintaining a good sanitary environment in our processing area. All phases of our operation from harvest to bottling are monitored to maintain acceptable sanitary conditions. Chlorine, citric acid, sulfur dioxide, iodophores and water are the primary cleaning agents we have used for years. The only time we use detergents is when the equipment has been contaminated with grease/oil-based substances or when equipment is new to our facility. Once cleaned of any grease or oils, the equipment is simply cleaned with a chlorine wash, rinsed with cold water, washed again with a water/citric acid/potassium metabisulfite solution to remove any chlorine residue, and cold water rinsed again. After each day's usage, the equipment is hot water rinsed to remove any solid residual matter, knowing that our standard sanitation solutions will be applied again prior to juice or wine contact.

Even though our harvesting equipment is pre-cleaned with the same solutions used in the winery, sanitation under field conditions is more difficult. We repeat the sanitation of the equipment depending on field and temperature conditions. A thorough daily cleaning with water to remove grape particles is essential. Good viticulture trellis practices to control insects, mildew, fungus and birds are very important when hand-harvesting or using mechanical harvesters. A clean trellis, free of old pruning wood, animal nests, weeds or other debris greatly helps to maintain wine quality. During mechanical harvesting operations, our bin tender can be our best sanitation inspector by removing any unwanted materials prior to reaching the crushing pad. The temperature at the time of harvest and pressing is also critical, especially to our white wine production. We prefer 35-50° F, with the colder temperatures being ideal for premium quality Riesling or Vidal Blanc.

All of our white juices are cold settled with enzymes and fined prior to fermentation. The tank bottoms are lees filtered to reduce losses and to remove any foreign contaminates from the juices. Fruit fly control is also important to prevent the spread of bacteria and other contaminates during the processing season. We can never completely eliminate fruit flies, but we can control the concentration of their population early in the season. Our red fermenters are kept covered at all times, and any equipment used around the crushing and press house facility are cleaned with water immediately after each usage. All floors and outside concrete pads are washed to remove grape residues and other particles. The pomace is religiously removed each day to a remote farm location and spread on an open field to promote quick drying. The fruit fly population can quickly get out of hand especially later in the season as the cool fall weather arrives. Once the population becomes established within the winery environment, it is increasingly difficult to control. When everything else fails, we resort to food grade insecticides to reduce the numbers.

There are many facets to producing quality wine, but sanitation during the process of converting grapes to a finished bottle of wine is one of the most critical.

DELIVERING WINE QUALITY

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Ferrante Winery purchases wine grapes from the same contract grower each year. Cheaper priced fruit can always be purchased on the open market, but at what quality level? Communication with your grower will yield high wine/grape quality. Visit your grower more than once during a growing season. Visiting the grower during harvest is very helpful because you taste the fruit, visually inspect the vineyard, plan when to harvest the vineyard and tell your grower what you expect from him at this busy time. Communication by phone, fax and e-mail can be done. Review your growers spray records. This might help you if a problem occurs during fermentation or later in the wine's life.

Use a reliable transportation company. Ferrante has used the same transportation company for over 17 years. We have developed a long term relationship with our shipper. This person is an extension of our business for many reasons. Our shipper informs me of changing weather conditions, uses clean bins, maintains a flexible schedule, and delivers on time. All these factors help deliver wine quality.

Quality control measures consist of using sulfur dioxide on the fruit at 60 - 80 ppm, using covered bins that help contain the sulfur dioxide and keep out rain, snow and truck exhaust. Quality enhancing pectic enzymes are dispersed in the fruit during harvesting. Cinn-Free from Scott Laboratories is used for greater extraction of monoterpenes that improve aroma and varietal character. Quick transportation of the fruit to the winery helps to deliver wine quality.

Quality control measures at the winery include initial inspection of all grape bins, use of sulfur dioxide after crushing, quick refrigeration of the juice and use of pectic enzymes to help facilitate settling. Overall good sanitation is very important to deliver wine quality.

In summary, working together as a team helps everybody be happy and provides for the highest juice and wine quality possible.

CRITERIA FOR SELECTING ROOTSTOCKS

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Grape rootstocks were bred about 100 years ago to combat phylloxera. This pest was inadvertently imported from the central or eastern United States and devastated the susceptible vinifera vineyards. The best of many attempted control measures was the development of resistant rootstock upon which desired vinifera cultivars could be grafted. Phylloxera were also imported into California at about the same time and destroyed many of the vinifera vineyards there. Rootstock trials were initiated to determine which of the newly bred European rootstocks were best suited for Californian vineyards. A wide variety of rootstocks were tested and after 60 years growers were advised to use AXR#1 as a rootstock widely adapted to many wine-producing vineyard sites.

AXR#1 was known to have limited phylloxera resistance, but seemed to have coped with Californian strains of this insect for many years. However, by the 1980s phylloxera had adapted to AXR#1 and aggressive strains, named type B, were found at many locations. As growers struggled to replant their vineyards they were faced with the dilemma of which rootstock to use. Rootstock testing had been discontinued after the 1960s and growers did not have rootstock information adapted to their current vineyard practices. European, South African and Australian rootstock evaluation data were available, but the conditions and evaluation criteria applied in these cases were often inappropriate for California. Confronted with this scenario, growers had to rely on outside information and educated guesses.

There has been a renewed rootstock evaluation effort underway in California since the mid 1980s and growers are beginning to utilize new data when making replant decisions. Specific comments from Dr. J.A. Wolpert summarizing these trials are included below. Alternatively, growers can select rootstocks from within parentage groups, having similar performance characteristics, to avoid making bad decisions. Characteristics of these rootstock groupings and their species parents are also presented below.

Although rootstock alternatives for many of California's vineyard sites exist, there are soil-borne problems for which few or no rootstocks exist. Problems such as fanleaf degeneration, nematode complexes, drought and salinity tolerance, and fungal problems such as oak root fungus and cotton root rot. Most of these problems are destined to become much more severe in the coming years.

Rootstock breeding is a long-range endeavor. Breeders are given the opportunity to consider what future problems might occur and attempt to produce the crosses needed to solve these problems. Rootstock evaluation is also a long term process and goals or viticultural objectives often change during the course of these evaluations. Rootstock breeding and evaluation must continue so that growers have the materials and information needed for future decisions.

CHARACTERISTICS OF VITIS SPECIES USED IN ROOTSTOCKS

RIPARIA — **Habitat** — moist sites near streams/rivers, high humidity, variable soils but high in organic matter and fertile, not well-adapted to limestone soils. Found form the Rocky Mountains to the Atlantic, from Canada to TX. **Propagation** — roots and grafts well. **Pest resistance** — highly resistant to phylloxera feeding on roots, but leaves are heavily galled. Some selections have nematode resistance. **Phenology** —goes dormant earlier than the other species and appears to induce/hasten maturity in scions. **Roots** — very thin, tough, fibrous, well-branched, shallow meandering.

RUPESTRIS — **Habitat** — now found mostly in northern Arkansas, Missouri and Tennessee in rocky stream beds. Relatively poor fertility due to excessive leaching and open rocky soil. Does poorly on limestone soils. **Propagation** — roots and grafts well. **Pest resistance** — resists phylloxera although perhaps at lesser levels than riparia. Selections vary in nematode resistance, many susceptible though. **Phenology** — early bud break, early maturity, no dramatic effect on scions. **Roots** — tough, deep penetrating, branching and thicker than riparia with greater presence of larger roots. Able to hold plants in highly erosive creek beds.

BERLANDIERI (now called *cinerea* var. *helleri*)— **Habitat** — on limestone bluffs with broad-leaved trees in central TX, relatively dry areas. Trees in these areas appear stunted, likely due to the lime content of the soil and the availability of nutrients. Also grows well in non-lime soils. **Propagation** — roots and grafts poorly. **Pest resistance** — good phylloxera resistance, perhaps repellent; some selections have resistance to root knot nematodes. **Phenology** — late budbreak and late maturity, not used as a rootstock. **Roots** — strong thick deeply penetrating, little or no branching.

CHAMPINII— **Habitat** — wooded limestone areas in central TX, and sandy creek beds. Soil appears well leached, without abundant organic matter. Cyclical moisture patterns, but hot and dry for much of the year. **Propagation** — varies but cultivated rootstocks root relatively poorly, but graft if rooted. **Pest resistance** — disputable to unknown phylloxera resistance may not be durable; good resistance to root knot, variable for dagger nematodes. **Phenology** — average budbreak and dormancy. **Roots** — wiry, deep, very penetrating.

LONGII (now called *acerifolia,* once called *solonis*)— **Habitat** — dry gullies and ravines in west TX into NM. Associated plants are juniper and mesquite. Not necessarily associated with limestone but grows in limestone areas. Dry areas except for infrequent, but abundant rainfall. Sandy soil leached and dry with little organic matter. **Propagation** — roots and grafts well. **Pest resistance** — good resistance to root knot nematodes, some to dagger. Phylloxera resistance judged to be moderate, not known if durable. **Phenology** — early budbreak, average leaf fall. **Roots** — slender branching, very wiry and deeply penetrating.

ROTUNDIFOLIA — **Habitat** — wooded areas of south east. Acidic soils, relatively high organic matter. Not found in overly wet or dry areas. **Propagation** — will not root or graft from dormant cuttings, roots and grafts from green cuttings, but long term compatibility is unknown. **Pest resistance** — seems to resist all soil pests of *vinifera*. **Phenology** — almost evergreen in the south, late budbreak and leaf fall in Davis. **Roots** — thick, little branching, intensely pungent taste.

VINIFERA — **Habitat** — varies from wooded areas and streamside locales of western and central Europe to dry hillsides of the Middle East and central Asia. Excellent tolerance to drought, salinity and calcareous soils. **Propagation** — roots and grafts very well. **Pest resistance** — some resistance to root knot nematodes, and some tolerance to fanleaf. Susceptible to phylloxera leads to decline to rootstocks with *vinifera* in parentage (AXR#1, 1202C, 41B, O43-43, Jacquez (Lenoir), French hybrids, Harmony, 1613C, Freedom(?), O39-16 (?) **Phenology** — varies but average in comparison with the species. **Roots** — branching, medium thickness, penetrating.

ROOTSTOCK PARENTAGE GROUPS

Riparia —

Riparia Gloire de Montpellier— much like the species. Induces low vigor in scions, and early maturity. Needs ample moisture and not adapted to dry soils or water-stressed sites. Shallow fibrous root system. Poor nematode resistance, very high phylloxera resistance, good rooting, lime susceptible, suited for deep moist fertile loams with good drainage. Provides early ripening and a tendency to overbear has been observed.

Rupestris —

St. George — much like the species, has apparent drought tolerance due to massive root system, but does not do well in shallow soils under drought stress. Phylloxera resistance is not as strong as *riparia*, seems to support a relatively high population on the roots. Phylloxera resistance studies using potted plants in some countries have concluded that resistance may not be great enough (Whiting found substantial numbers of nodosities on St. George) but no case of field failure exists.

Moderate to high vigor, poor nematode resistance, high phylloxera resistance, excellent rooting, on well-drained non-restricting soils provides drought tolerance. Has problems with bearing on vigorous sites and small clustered varieties. Moderate to poor yields, high K juices with high pH.

Riparia x Rupestris —

Schwarzmann (once called Teleki in West Australia)— moderate vigor, good nematode resistance (root knot and dagger), high phylloxera resistance, moderate lime tolerance, good rooting, should not be used where summer drought is common. Easy to propagate can have high K uptake, recommended where drought and high juice pH are not a problem.

101-14 Mgt— low to moderate vigor, moderate nematode resistance, high phylloxera resistance, moderate lime tolerance and good rooting, similar to riparia with shallow, well branched root system needs deep moist soil. Tolerates wet spring conditions in France, but susceptible to water-logging in Australia. Promotes early maturity.

3309C — moderate vigor, low root knot resistance, good resistance to phylloxera, moderate lime tolerance, good rooting, does not tolerate saline or dry soils. Recommended for replanting on well-drained shallow soils with low fertility. Said to have deep rooting with well-branched roots.

Berlandieri x Riparia —

Teleki 5C — moderate vigor, moderate nematode resistance, strong phylloxera resistance, excellent rooting, moderate lime tolerance, cool region rootstock used in Germany. Not suited to hot dry areas, yields well where cooler except where drought is a problem, moderate vigor and low pH juice, recommended for most areas except where drought is a problem (Whiting). Shallow well-branched root system. French find **SO4** confers higher vigor to the scion; other problems include later maturity, susceptible to Mg deficiency and waterberry, not for use in fertile soil.

5BB — low to moderate vigor, moderate nematode resistance, very high phylloxera resistance, excellent rooting, well suited to moist compact soils, used in Europe as dual purpose nematode/phylloxera stock and warrants further testing here on that basis. Whiting found a few nodosities in his potted vine studies. Relatively high vigor and yielded well in some dry sites (confirmed by preliminary Wolpert data). Shallow well-branched root system.

420A — low vigor, low to moderate nematode resistance, high phylloxera resistance, poor to moderate rooting, shallow well-branched root system, well suited to poor heavy textured soils, tolerates dry conditions but not water logging, may over crop in early years. Whiting found it survived in water-logged soils, but not recommended in Australia (too weak and low yields).

Berlandieri x Rupestris —

110R — moderate to high vigor, low to moderate nematode resistance, high phylloxera resistance, moderate rooting, drought tolerant. Scions develop slowly then bear large crops of excellent quality, wet poorly drained soils should be avoided. More roots and thicker roots, not quite as deep as St. George. Whiting found a few nodosities in his potted vine studies. Vigor has ranged from low to high in different trials (as have yields). Australian 110R has vein necrosis and may effect experiences with low vigor and low pH juice.

140Ru — high vigor, high phylloxera resistance, low nematode resistance, moderate to fair rooting, but have been problems with grafting, excellent drought tolerance. Root system is like St. George. Late maturity and susceptible to wet feet, not advised for fertile sites. Very deep growing roots, and well-branched.

1103P — moderate to high vigor, moderate nematode resistance, high phylloxera resistance, moderate rooting, good drought tolerance but not susceptible to water logging, moderately tolerant of salt. Roots deeply like St. George. Late maturity not for use in fertile sites.

Champinii —

Ramsey — low dagger and high root knot and phylloxera resistance, moderate lime tolerance, poor rooting, well suited to coarse textured low fertility soils, susceptible to Zn deficiency. Recommended for sandy soils. Problems with high vigor and K in some varieties, but not as problematic or as vigorous in cooler areas. Phylloxera resistance may not be durable and has been rated differently.

Dog Ridge — very high vigor, same characters as Ramsey, suited to very coarse textured and infertile soils, Ramsey easier to manage.

(Longii x Othello ((labrusca x riparia) x vinifera)) x Dog Ridge —

Freedom — moderate to high vigor, questionable phylloxera resistance (nodosities have been found in pot studies), high root knot and moderate dagger nematode resistance. Can have high pH and K problems in high vigor areas, but grows with only moderate vigor in cooler sites.

Harmony — moderate to high vigor, questionable phylloxera resistance, good nematode resistance, lower yields and vigor than Freedom. Both stocks were designed for sandy soils in the Central Valley.

Longii x Riparia —

1616C — low to moderate vigor, but Davis 1616C is different from French selections. Shallow well-branched rooting, and sensitive to drought, seems to tolerate high water tables in Sonoma. Early maturing, resists phylloxera. Should act much like a more vigorous Riparia Gloire.

Vinifera x Rotundifolia —

O39-16 — high vigor, high resistance to dagger nematode, does not prevent transmission of fanleaf virus, scions on this rootstock seem to prevent the decreased set effects of fanleaf degeneration. Good phylloxera resistance in lab and field, durability unknown. Susceptible to root knot nematodes. **O43-43** is showing effects of phylloxera decline in some areas.

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Parentage and breeder of grape rootstocks available to some degree in California. Compiled by M.A. Walker, for the Proceedings of the Rootstock Seminar: an International Perspective. Reno, NV, June 24, 1992.

Roostocks	Parentage	Breeder
Riparia Gloire	riparia	Viala, Portalis/Montpellier, 1860's
St. George	rupestris	Sijas of Montpellier, 1860's
187G	rupestris	Neustdat (1297)
Salt Creek (Ramsey)	champinii	Species selection (Munson?) ~1900
Dog Ridge	champinii	Munson selection ~1900
3306 C	riparia x ruprestris	Couderc 1881
3309 C	riparia x ruprestris	Couderc 1881
101-14 Mgt	riparia x ruprestris	Millardet 1882
Schwarzmann	riparia x ruprestris	Schwarzmann, 1891
44-53 Malègue	riparia x (cordifolia x rupestris)	Malègue
106-8 Mgt	riparia x (cordifolia x rupestris)	Millardet 1882
44R	berlandieri x rupestris	Richter ?
57R	berlandieri x rupestris	Richter
99R	berlandieri x rupestris	Richter 1889
110R	berlandieri x rupestris	Richter 1889
140 Ruggeri	berlandieri x rupestris	Ruggeri, 1897
775 Paulsen	berlandieri x rupestris	Paulsen, 1894
779 Paulsen	berlandieri x rupestris	Paulsen, 1894
1103 Paulsen	berlandieri x rupestris	Paulsen, 1895
1447 Paulsen	berlandieri x rupestris	Paulsen, 1896
Vivet 15	rupestris x berlandieri	? from Neustadt
SO4	berlandieri x riparia	Teleki group 4A, 1896
8B	berlandieri x riparia	Teleki, 1896
5A	berlandieri x riparia	Teleki, 1896
5BB	berlandieri x riparia	Kober from Teleki 5A
5C	berlandieri x riparia	A. Teleki, from 5A, 1922
125AA	berlandieri x riparia	Kober from Teleki 5A?
161-49C	berlandieri x riparia	Couderc 1888
157-11C	berlandieri x riparia	Couderc 1889

Rootstock	Parentage	Breeder
33 EM	berlandieri x riparia	Foex 1899
*34 EM	berlandieri x riparia	Foex 1899
420 A Mgt	berlandieri x riparia	Millardet, 1887
22 Ru	berlandieri x riparia	Ruggeri, 1897
Cosmo 2	berlandieri x riparia	Cosmo from 8B, 1931
Cosmo 10	berlandieri x riparia	Cosmo from 8B, 1931
*Boerner	riperia x cinerea	Boerner released by Becker 1988
41 B	vinifera x berlandieri	Millardet 1882
333 EM	vinifera x berlandieri	Foex 1883
Vidal 1	vinifera x berlandieri?	Vidal 1??
Evex 13-5	Probable vin x berland	Fernandez de Bobadilla, 1943
AXR#1	vinifera x rupestris	Ganzin, 1879
Fercal	(berl x vin) x 333 EM	Pouget/Ottenwaelter, 1983
*Gravesac	161-49C x 3309 C	Pouget/Ottenwaelter, 1985
196-17 Castel	1202 x RipariaGloire	Castel, late 1800's
216-3 Castel	solonis x rup (1616 x St. Geo)	Castel, 1880's
1616C	solonis x riparia	Couderc 1881
1613 C	solonis x Othello (labxripxvin)	Couderc 1881
Lenoir (Jacquez)	Bourquiana (aest x cin x vin)	?
Harmony	1613 C x champinii	Weinberger/Harmon, 1966
Freedom	1613 C x champinii	Weinberger/Harmon, 1967
VR 039-16	vinifera x routundifolia	Olmo, 1984, patent 1988
VR 043-43	vinifera x rotundifolia	Olmo, 1948, patent 1988
171-6	rufotomentosa x vinifera	Lider, 1966

A COMPARISON OF PINOT NOIR PRODUCTION IN NEW YORK AND BURGUNDY

Pascal Durand, ENESAD, Dijon France
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Introduction

New York State has long been recognized for its leading edge in the production of Concord and Niagara grapes for juice products. More recently, New York has experienced great growth in its wine related industry. With 33,00 acres of grapes under production, New York ranks second to only California in wine production. The number of wineries has increased rapidly in the past 20 years, from approximately 20 to over 125 today. In 1976, the Farm Winery Act was first passed, resulting in explosive growth of the wine and grape industry and the development of numerous farm wineries.

The moderate climates of the Finger Lakes area, the Lake Erie escarpment, the Hudson River Valley and Long Island simulate some of the best grape production regions in France and Germany. Pioneers of the grape growing industry in New York worked diligently to introduce classic Old World style grape cultivars such as Riesling, Chardonnay and most recently Pinot Noir. The microclimates encountered in this diverse state have supported the production of high quality *Vitis vinifera* cultivars and today winemakers on Long Island, in the Hudson Valley, the Finger Lakes and along Lake Erie are winning international wine competitions and gaining some market share. New York is starting to show that it can produce excellent wines in various regions around the state.

New York State has a variable climate in each of these regions and in fact, this microclimate, its soil, and viticulture, or terroir, is thought to impart very specific and characteristic qualities to the wine products produced in each of these regions. The climate, mineral soils, sunlight and water availability of the Finger Lakes region are in fact, reminiscent of the conditions observed in Burgundy France, the home of the popular and complex grape, the Pinot Noir. The rare Burgundy Pinot Noir wines are often described as opulent and complex, with each exhibiting the specific attributes of the vineyard site of production. Currently, the demand for Pinot Noir and other vinifera varieties has continued to increase in New York. There is a general idea that sites suitable for production, i.e. along the lakes and in other protected locations, are limited, especially in the Finger Lakes and Hudson Valley. However, there is much plantable land available in the Finger Lakes for current production and our recent advances in viticultural production techniques for *V. vinifera* in New York may allow expansion into sites formerly considered less suitable.

The Pinot Noir grape is often considered by the world's wine experts to be the most difficult to produce and vinify because of its susceptibility to *Botrytis cinerea*, gray mold, and other pathogens, its sensitivity to heat during the growing season, its sensitivity to frost and cold damage during winter, and its complex and fruity nature which can be easily lost with inappropriate fermentation and vinification practices. Therefore, a good Pinot Noir wine fetches high prices and is in considerable demand because of its interesting characteristics and rarity. The Burgundy Pinot Noirs bring among the world's highest prices for red wines and are considered to be perhaps the world's most desirable reds in a good vintage year. Because of the great interest in Pinot Noir wines, producers in California and Oregon have converted acreage to Pinot Noir and are starting to produce some interesting wines. These wines typically exhibit great fruity characteristics, and may or may not possess more complex aromas and very fine texture exhibited by Burgundy Pinot Noirs.

Pinot Noir production: a challenge for the Finger Lakes

Pinot Noir is one of the rarest and most difficult grapes to cultivate throughout the world, in comparison to Cabernet, Merlot, Syrah or Chardonnay grapes. This difficult cultivar is grown mainly in the septentrional (cool-climate) regions of the two hemispheres.

I. ***Why is Pinot Noir so difficult to produce and vinify ?***

It is a complicated grape to produce

- grapes are sensitive to high temperatures and sunlight as well as disease, particularly botrytis
- requires a long maturation period for good tannin production
- vinification and aging processes are delicate and critical for high quality

Risks involved in production and marketing

- sensitivity to climatic conditions leading to variable quality and vintages

Expensive to produce

- greater investments in vineyard management for disease and quality control
- greater investment in winemaking skills for vinification and quality control

II. ***Pinot Noir can be considered as a challenging wine for New York wine industry***

One of the rare and most appreciated wines in the word
Well adapted to cool climate countries
A most fashionable and distinguished wine with an increasing market share
Successfully produced now in California and Oregon
The King of the Burgundy wines

III. ***Pinot Noir: a new product niche for NY wineries***

NY State is a cool climate region, with climatic stresses
NY has many new wineries with an opportunity for specialization
Applied research on adapted clones is being performed at the local experimental vineyard at the Geneva Ag Experiment Station
A high quality reputation can be built for New York wines, in comparison with California wines

PINOT NOIR PRODUCTION IS A HIGHLY DEMANDING PROCESS, WHERE THE GRAPE GROWER AND THE WINEMAKER HAVE TO BE PARTICULARLY CAUTIOUS AND WATCHFUL THROUGHOUT THE YEAR. THEY MUST BE WELL EDUCATED AND TRAINED TO GROW AND VINIFY SUCH A SENSITIVE VARIETY, WHERE THE WORST CAN OFTEN HAPPEN IF APPROPRIATE PRECAUTIONS ARE NOT TAKEN.

Pinot Noir in Burgundy: Concept of quality and origin related to wine marketing potential

I. ***A vineyard sculpted by history.*** Burgundy has a long and well documented history in wine production. For 20 centuries, the wine industry has been an essential part of the social and economic environment of this region. Burgundy is located at the crossroads of some main highways of communication between the North and South of Western Europe. Christian Abbeys in the Middle Age and the Dukes of Burgundy in the 16 and 17th centuries contributed to the development of a large market for local wines, consumed at the tables of rich, educated and influential persons who traveled and maintained contacts with other prestigious vineyards in the Loire Valley, Bordeaux or even Hungary's Tokay region.

   Three elements can explain the long term development of Burgundy wines: the existence of a large regional market, a market essentially composed of rich and "connaisseur" group of consumers, able to improve, with feed back to the producers, the general quality of the wine they sipped.

   A remarkable adaptation of Pinot Noir to the calcareous soils of the rising slopes of the River Saone. As an example, the Duke of Burgundy, decided, in a famous law in 1538, that the grape growers of Burgundy were forbidden to grow Gamay à jus noir grapes and, of course, to mix this juice with the noble Pinot Noir grape. The Duke considered that a 100% pure Pinot Noir would have better structure and finesse than a blend with the common Gamay, less adapted to the limestone soils of Burgundy.

II. ***Phylloxera vastatrix and the industrial revolution.*** At the end of the 19th century, demand for wines increased dramatically due to the industrialization of Northern France. Wines rich in alcohol were considered as an energetic beverage for hard laborers in mines or steel plants. In the same time, phylloxera, powdery mildew and some other diseases invaded France, destroying most of the vineyards.

   After considerable efforts in searching for adapted cultivars, and also scientific controversies between breeders of French-American hybrids and grafters of American rootstocks, new, large and modern vineyards were planted at the beginning of the 20th century, mainly in the plains of Languedoc in Southern France. These wines were produced generating large yields and quantities of wine, as basic quality table wines for blue collar workers. With the tremendous development of a new domestic market and to add more market shares, some new producers introduced misleading labeling practices (as for example : a false Bordeaux or Burgundy label for a wine produced in Languedoc) to confuse new consumers of fine wine, without respect for origin and traditions.

III. ***A regulation system in order to protect the producers.*** In 1935, the producers of fine wines convinced the French legislature to organize, by law, the respect of appellation of geographic origin. Two main classes of wines have been defined: the table wines, classified by color and percent of final alcohol, the wines of geographical origin (AOC) as Bordeaux , Burgundy, Champagne, Alsace, Cotes du Rhone...classified by provenance.

To justify this classification, the law organized, in agreement with producers, a regulation system for grape growing and vinification, adapted to each local tradition (differences between Burgundy and Bordeaux for example).

Producers must abide by a certain number of regulations if they want to get benefits of an AOC in a restricted viticulture area. These are the requirements for production:
varieties : Aligoté, Chardonnay, Gamay, Pinot Noir in Burgundy
vine density per acre: 4,000 per acre in Burgundy
yield: 1.8 tons/acre for 1er Cru to 2.8 tons/acre for Regional Burgundy
minimum potential alcohol: 10% for Regional to 11.5% for 1er Cru
vinification practices
annual official tasting for definitive commercial agreement of the finished wine

IV. Question : Is quality (and reputation) related to a particular wine industry structure in Burgundy ?

Dramatic diversity in production, with a large number of brands produced by more than 2,000 farm wineries and 120 larger wine merchants (negociants), based on 96 different geographic Burgundy appellations, divided between white and red wines and vintages.

Influence on the small business sector, with 4,300 producers (1,300 grape growers and 3,000 farm wineries) for a total acreage of 60,000 acres (40% Pinot Noir). The average size is 14 acres.

The role of the farm wineries on the market. The farm wineries which own 67% of the total acreage of Burgundy wine market just 25% of the total of Burgundy wines. They sell a large part of their production, mostly wines in bulk, to the negociants who market 65% of the total. The negociants own only 8% of the vineyards.

Points to consider in Pinot Noir strategy in Burgundy

A small vineyard (3% of total French wines, 6% of total AOC wines) with a large number of small grape growers generally equipped for vinifying, able to sell grapes or wine in bulk (or even stock and market in bottles), depending on the vintage and the price trends.

Focus on natural factors. Producers must use the same production technology : varieties, density and yields, vinification process.

An appellation system based on typicity. When produced in a particular location, wines have similar characteristics; this is signaled by a geographic denomination.

A hierarchical system of appellation of origin. All the producers agree on causes and consequences of typicity, deciding together on the level of regulation to apply for each appellation at the vineyard (area, density, yield) and in terms of final wine quality (tasting of finished wines before permission of using the Burgundy Appellation vintage label).

The consumer of Burgundy wines understands the guarantees offered by the hierarchical appellation system, based on three levels of pyramidal quality : Regional Burgundy, Village Burgundy and Premier Cru Burgundy for each vintage.

The producers and negociants of Burgundy have developed a common philosophy of quality wines, where the origin of grapes is the key of a strict AOC regulation. They invest together a part of their profits for research and promotion, controlled by a common association, managed by their representatives.

Points to consider for a future Pinot Noir strategy in the Finger Lakes region

Greater recognition of Pinot Noir standards for producer and consumer in terms of quality perception and marketing

Level of collective interest in production in terms of leadership and strategy to obtain quality grapes consistently

Ability and competence to produce quality wines consistently in terms of worker education, training and involvement

Investments in production chain in terms of volume and quality control

Public and industry support for funding for research and extension

Past precedents for the Finger Lakes

If one looks at certain developments in successful vineyards across the US, we can see that the main keys to success have involved the following :

- A group of leading grape producers, investors or winemakers who have decided to work together to promote their region
- The support of the state or region, through the development of a long-term program with incentives for planting, promotion, research and development

University support through extension and research programs in viticulture and enology

Examples of successful programs exist in Indiana, Ohio, or Virginia. Another interesting example are the vineyards of the Ontario Peninsula region, where a mix of incentives and regulation exist for establishment of plantings and winemaking practices, through an alliance between Ontario producers and the Ontario Liquor Board, to redevelop a successful industry to market fine Ontario wines. This example is particularly interesting given the fact that a minimum regulation has been developed for the types of grapes planted (they must be vinifera) and the use of a VQA label (Vintner's Quality Alliance) to promote quality wines of the region after undergoing an official taste evaluation. All these elements have contributed to the new concept of Ontario's quality wines now exported successfully in the US, across Canada and in Europe.

Proposal for future efforts

I. Focus on viticulture: the main objective is to achieve a long term strategy for high quality wines. There is no other secret for super premium Pinot Noir wines than the use of the highest quality Pinot Noir grapes.

Materials and techniques:
- Development of a collection of suitable clones adapted to New York State conditions
- Use of an effective trellis management system for density plantation
- Data and models for control of grape maturation in the vineyard

Soil management: For each site available, the vines response to related microclimate and soil type has to be calculated considering the opportunity to establish different families of Vinifera grapes (Chardonnay, Pinot, Cabernet...). In comparison to Chardonnay which is produced successfully across many soil types , the relations between soil, subsoil, rootstock and clone have to be discussed case by case for Pinot Noir production. This specialization in planting sites also depends on the general wine style expected by the winery in terms of aromas and structure.

II. Improve Enological Practices: The art of winemaking is to consider each grape produced as a specific object. Vineyard location, age of vines, clones used, sanitary quality, vintage weather events and maturity at the harvest are all critical to the winemaking process. There is no recipe or automatic management style for production of high quality wines! A winery managing many different wine styles and qualities can have difficulties with the introduction of the special management style required (and equipment) for super premium wines such as Pinot Noir.

III. Adoption of a market strategy: This will be the focus of future work to be supported by industry and external grant funds. The development of a successful marketing strategy for Pinot Noir products in the Finger Lakes is the key to profitability, once a high quality product is generated with some consistency. This will be the focus of our future research efforts at Cornell University.

Burgundy: the greatest % exporter of French Appellation Wine

	% French AOC production	*% Exported*
Burgundy	**6%**	**56%**
Beaujolais	6%	45%
Champagne	10%	42%
Bordeaux	22%	35%
Alsace	4%	28%

Comparing Geneva, NY and Dijon, Burgundy

	Geneva	Dijon
Minimum Temperature	17°F	29°F
Average Temperature		
January	22°F	35°F
March	32°F	50°F
June	70°F	70°F
Day degree accum.	2,500	2,080
Growing season	190 days	235 days
Average precipitation	32.6 inches	29 inches
Rain/year	180 days	164 days
First winter freeze	Oct. 27	Nov. 15
Latitude	43°	47°15'

Vineyard Management for Pinot noir in Burgundy

Limited Density
— 2,800 minimum vines/acre
— 56 inches maximum between rows
— 32 inches minimum between vines

Pruning
— Guyot: 1 cane x 7 spurs
— Cordon de Royal: short canes x 2 spurs
— Cane 1/2: 1 can x 4 spurs + 2 or 3 short canes x 2 spurs

Trellis Height
— 56 x 0.6 above the bottom wire

Yield
— 2.4 to 2.9 T/acre

Alcohol Potential at the Harvest
— Potential final degree: 10.5 degree minimum, 13.5 degree maximum

A UNIQUE APPROACH TO HARVEST LABOR

Fran Massaro
The Winery at Wolf Creek
Norton, OH

The Winery at Wolf Creek in Norton, OH has approximately ten acres of grapes. Two years ago we discussed ways to improve the harvest season. We needed to decrease the number of days spent picking which meant increasing the number of pickers picking. Our harvest staff consisted of the vineyard manager, the winemaker (when he was not busy processing the grapes and cleaning tanks), myself (administrative manager) and the winemaker's 84 year-old father. Not a very impressive labor force! We had already tried the Tom Sawyer approach with our tasting room staff telling them how much fun picking grapes could be. One or two of them would show up on their day off and very quickly realize that a) the vineyard is not air-conditioned and b) they could make better tips inside. We would never see them picking again. Given this dismal failure, we decided that charitable organizations would provide the best solution to our dilemma. They would help us pick grapes and we would pay money towards their cause. A win-win situation for all of us. Working with organizations has the benefit of providing a large number of pickers with only one contact person. Based on this decision we developed the following program:

Guidelines:

Picking begins at 10:00 am. Lunch break 1:00 - 1:45 pm. Finish at 6:00 pm.
Workers should commit to a minimum of three hours.
Workers must be 16 years or older to participate.
This is not a suitable activity for individuals allergic to bee stings.
We provide workers with clippers, sun screen, bug spray, and soft drinks.

Compensation:

Compensation is based on the grape variety being picked. Are the clusters small (Leon Millot) or large (Seyval)? Are they extremely easy to pick (Chambourcin) or a nightmare (low-wire Vignoles)? We determine a dollar amount per full lug based on grape variety.

Scheduling and Recruiting:

Picking dates are determined in advance by the vineyard manager and winemaker. Promotional fliers listing the picking dates, compensation, and guidelines are displayed at the sales counter in the tasting room. We also mail fliers to those organizations which provided volunteers the previous year. The organizations register for the dates that best fit their schedules. We often have more than one group picking on the same day.

The picking day begins with a general lesson about rules of the vineyard. This includes safety, what to pick and what not to pick. From there it is on-the-job training. The winery personnel work alongside the volunteers, checking that they are following safety procedures, picking everything that should be picked, and answering questions. If more than one organization is picking, each picker is given a magic marker to label their lugs.

It is important to make the day fun. If the volunteers have a good time they are much more likely to come back next year. Talk to them about the wine that will be made from the grapes they are picking. Fill them in on the history of the winery. Ask your volunteers about their organization and their role within it. End on a positive note. If you do a good job you will not only have repeat volunteers, you will also gain repeat customers in the tasting room. If the day is hot and you see that your volunteers are becoming exhausted, encourage them to rest or go home. Thank them for their effort when they leave and send them a letter of thanks with their compensation check.

This approach to harvest has been a tremendous benefit for us. We have significantly reduced the number of picking days, built goodwill with area organizations and gained new customers.

NEW FUNGICIDE REGISTRATIONS FOR GRAPES IN THE YEAR 2000

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Several new fungicides have recently been registered in the U.S. for use on grapes. Much of this new chemistry is highly effective for control of many of our major grape diseases, and should prove to be valuable tools in our grape disease management program. The following information provides a brief description of these new fungicides.

Strobilurin fungicides

The strobilurin fungicides represent a new class of fungicide chemistry that is highly effective controlling many of the major fungal diseases of grapes in the midwest. The strobilurin fungicides were first discovered or isolated from wood-decaying mushrooms, such as *Strobilurus tenacellus.* This new class of chemistry is a valuable addition to our current arsenal of fungicides for grape disease management. Perhaps one of the most exciting characteristics about the strobilurins is their spectrum of activity. Most of them are registered for control of black rot, downy mildew, powdery mildew, and Phomopsis cane and leaf spot. Some recent research suggests that they have fair to good activity for control of botrytis. Until now, we have never had a fungicide that would provide simultaneous control of all these diseases. Prior to the development of the strobilurins we had to rely on tank-mixes of fungicides to control all these diseases. For example, the sterol-inhibiting fungicides such as Nova provide excellent control of black rot and powdery mildew, but are not effective against downy mildew or Phomopsis. Thus, we have recommended a tank-mix of Nova plus mancozeb to control all these diseases simultaneously. The Nova for black rot and powdery mildew and the mancozeb for downy mildew and Phomopsis.

The strobilurins are very good protectant fungicides. They have good residual activity and have provided good control in 10-14 day spray schedules. They are also locally systemic and provide some level of curative or after-infection activity. One problem with the strobilurins is that they are at high risk for fungicide resistance development. Fungicide resistance development is a serious problem we are facing with these new fungicides, as well as our previously registered materials such as the sterol-inhibitors (Bayleton, Nova, Rubigan, Procure, and Elite). When Bayleton was first registered in the U.S., it could be used at 2oz per acre on a 21-day schedule and provide excellent powdery mildew control. After years of continual use, the powdery mildew fungus has developed a high level of resistance to Bayleton. Although Bayleton is still highly effective for control of black rot, we no longer recommend its use for powdery mildew control in Ohio.

The remaining sterol-inhibiting fungicides are also facing the threat of fungicide resistance developed by the powdery mildew fungus. This is another reason why the introduction of the strobilurin fungicides is extremely timely. Strobilurin chemistry is very different from chemistry of the sterol-inhibiting fungicides. In short, they attack the fungus in a very different way. One of the main recommendations for preventing or slowing down the development of fungicide resistance is to alternate the use of different fungicide chemistries in the spray program. The introduction of the strobilurins allows us to do that. Alternating strobilurin fungicides with a sterol-inhibiting fungicide combined with a good protectant fungicide will probably become a standard recommendation in fungicide programs for wine grapes in the midwest. Further information on fungicide resistance management will be provided as we discuss each of these new strobilurin fungicides individually. There are three strobilurin fungicides currently registered for use on grapes. They are: Abound (azoxystrobin); Sovran (kresoxim-methyl); and Flint (trifloxystrobin). Although Abound, Sovran and Flint are all closely related and are all excellent fungicides, they do differ to some extent in their effectiveness against specific diseases. In addition, some of them have specific or "special" problems that grape growers need to be aware of.

Abound (azoxystrobin)

Abound flowable (2.08F) was first registered in the U.S. in 1997. Thus, most growers in Ohio have some degree of experience with Abound, and all the grower comments I have heard have been quite positive. Abound is registered for control of black rot, powdery mildew, downy mildew, and Phomopsis cane and leaf spot. It provides good to excellent control of all these diseases except Phomopsis, for which it provides fair control. The following information was taken from the label.

> ABOUND Flowable should be applied in an alternating block spray program. Begin ABOUND flowable applications at bud break and continue applications throughout the season every 10 to 14 days, alternating between blocks of no more than two (2) ABOUND Flowable sprays and other fungicides which have a different mode of action. Do not alternate or tank mix with fungicides to which resistance has developed in the pathogen population. Do not apply more than two (2) sequential sprays of ABOUND Flowable. Do not make more than six (6) applications per acre per year. Do not apply within 14 days of harvest.
> NOTE: ABOUND Flowable is very phytotoxic to apples of the variety McIntosh or varieties related to McIntosh. Do not use the same sprayer to apply ABOUND to grapes that will be used to apply other materials to apples. Do not allow spray to drift from grapes to apples.
> **Please note that label information is subject to change. Always read the most recent label.**

The problem with phytotoxicity to apples can be very serious. In Ohio, this is not much of a problem because most grape growers do not produce apples. This could change to some extent in the future. In states like New York, Michigan and Pennsylvania, where several grape growers also grow apples or where vineyards are situated next to apple orchards, the phytotoxicity is a serious concern and significant losses have occurred in a few orchards. Abound is registered for use at 11 to 15.4 fluid oz/A. In the last couple of years, Ohio growers have used Abound at the rate of 11 to 12 fluid oz/A on a 10 to 14 day schedule with good results. Abound is a product of Zeneca Corp.

Sovran (kresoxim-methyl)

Sovran 50WG fungicide was recently registered (1999) for use on grapes for control of Phomopsis cane and leaf spot, black rot, powdery mildew, and downy mildew. Sovran is a product of BASF Corp. and was the second fungicide in this new class of chemistry (strobilurin) to be registered for use on grapes in the U.S. Sovran is similar to Abound in that it provides good to excellent control for most of our major grape diseases. Unlike Abound, Sovran is not phytotoxic (damaging) to McIntosh apples and other related apple varieties. Although Sovran and Abound are closely related and both are excellent fungicides, they do differ in their effectiveness against certain diseases. Both Abound and Sovran provide very good control of black rot with about equal efficacy. Both fungicides are also very effective against powdery mildew. The biggest difference is with downy mildew. Abound is more effective for control of downy mildew than Sovran. Sovran will provide good control of downy mildew if the highest label rate is used (6.4 oz/A). Sovran is registered for use at 3.2 to 4.8 oz/A for black rot, 3.2 to 4.8 oz/A for powdery mildew, and 4.0 to 6.4 oz/A for downy mildew. The 4 oz/A rate has provided good control of black rot and powdery mildew in fungicide trials. Obviously, using the higher rate of 6.4 oz/A for control of downy mildew will greatly increase cost. Both Sovran and Abound will provide only fair control of Phomopsis.

The following information was taken from the label.

> Use **Sovran* fungicide** as a protective spray at 3.2-6.4 ounces per acre. Make applications of **Sovran* fungicide** in sufficient spray volume to ensure thorough coverage. Do not use less than 10 gallons of water per acre. Black rot and *Phomopsis* cane and leaf spot control should begin at bud break and continue on a 14-day schedule through 1/4-inch berry. Use 4.8 ounces of **Sovran** per acre during periods of heavy infection pressure.
>
> For powdery mildew control, begin sprays at bud break and continue on a 14-day schedule. Form more susceptible grape varieties or under conditions that favor rapid powdery mildew development, use 4.8 ounces of **Sovran** per acre. When disease pressure is low, the spray interval can be extended up to 21 days.
>
> For downy mildew control, begin sprays at bud break and continue on a 7-10 day schedule. Under conditions that favor severe downy mildew development, use 6.4 ounces of **Sovran** per acre.
>
> **Crop-Specific Restrictions and Limitations**
>
> To limit the potential for development of resistance:
>
> *On wine and table grapes, do not make more than four (4) applications of **Sovran** or other strobilurin fungicides per season. On grapes for other uses, do not make more than three (3) applications per season.
>
> *Do not make more than 3 sequential applications of Sovran.

*Apply **Sovran** in alternation with non-strobilurin fungicides with a different mode of action.
Sovran cannot be applied within 14 days of harvest.
Please note that label information is subject to change. Always read the most recent label.

Flint (trifloxystrobin)

Flint 50WG fungicide was also registered for use on grapes late in 1999. Like Abound and Sovran, Flint is also a strobilurin fungicide. Flint is registered for control of black rot and powdery mildew. It is registered for "suppression" of downy mildew and is not registered for control of Phomopsis. Of all the strobilurins, it has the best efficacy for control of powdery mildew. The use of Flint for grape disease control in Ohio may be limited due to the following factors:

3. Flint cannot be used on Concord grapes. The label states **"Do Not Apply Flint to Concord Grapes or Crop Injury May Occur"**; and

4. Flint is not highly effective for control of downy mildew. In fact the label states that it provides "Disease Suppression" not control of downy mildew.

For these reasons, Ohio growers will probably select Abound or Sovran as the strobilurin fungicide of choice for use on grapes. In growing regions such as California where downy mildew is not a problem and Concord grapes are seldom produced, the use of Flint is more practical. If Concord grapes are not a problem and the main diseases of concern are black rot and powdery mildew, Flint will do an excellent job in the midwest.

The following information was taken from the label.
Grapes: Do not apply Flint to Concord grapes or crop injury may occur.
Flint is registered for use at 1.5 to 2 oz/A for powdery mildew control, 2 oz/A for black rot control and 4 oz/A for suppression of downy mildew.
Restrictions: Do not apply more than 8 oz. of Flint per acre per season. Do not apply Flint within 14 days of harvest. Do not apply more than 4 applications of Flint or other strobilurin fungicides to table or wine grapes per season. On grapes for all other uses, do not apply more than 3 applications of Flint or other strobilurin fungicides per season. To limit the potential for resistance to develop, do not apply more than 3 sequential applications of Flint or other strobilurin fungicides before alternating to a non-strobilurin fungicide.
Note that both Sovran and Flint cannot be applied more than 4 times per season on wine and table grapes, and 3 times per season on grapes for all other uses. The label also states do not make more than 3 sequential applications without alternating with a non-strobilurin fungicide with a different mode of action.

The reason for these restrictions is to prevent the development of **fungicide resistance.**

In summary, the strobilurins are excellent fungicides; however, each has certain distinct characteristics. Cost and the various "special" characteristics of each fungicide will help to determine which one should be used. The important thing to note is that these are excellent fungicides and should be incorporated into our fungicide spray program for grapes in the midwest.

Fungicides For Control of Botrytis Bunch Rot

Vangard Fungicide (Cyprodonil) and Elevate fungicide (Fenhexamid) were both recently registered for control of botrytis bunch rot. These are welcome newcomers to our arsenal. At present, Rovral, Benlate, Vangard, and Elevate are the fungicides recommended for bunch rot control. Many growers no longer use Benlate due to the development of fungicide resistance. Rovral has been the "Cadillac" fungicide for botrytis control, but concerns over fungicide resistance development also exist with Rovral. This makes the registration of these new fungicide chemistries (Vangard and Elevate) especially important. Where resistance is not a problem, Rovral is still an excellent choice. The efficacy of Vangard and Elevate is similar to that of Rovral. Vangard and Elevate are both good for botrytis control. However, in several fungicide trials, Vangard appears to be slightly more efficacious than Elevate.

Vangard is registered for use at 10 oz/A when used alone or 5 to 10 oz/A when used in a tank mix. More than 20 oz. of Vangard cannot be applied per acre per crop season, and Vangard can not be applied within 7 days of harvest. Vangard fungicide is a product of Novartis Crop Protection, Inc. (previously Ciba Giegy). The price quotes I have seen for Vangard are about $60/lb. This equates to $3.78/oz. When used alone at the 10 oz/A this is $37.80 per acre. For Rovral 50% Wettable Powder, I received a quote of $22.95 per lb. At 1 ½ lbs. per acre this is $34.43 per acre. Although Vangard is more expensive per pound of product than Rovral, the cost difference per acre per application using each material alone is not great. To prevent fungicide resistance development to these fungicides (Rovral, Elevate, and Vangard), they should be tank-mixed or alternated with each other in the spray program for botrytis bunch rot control. Some research in New York suggests that there may be an additive effect from tank-mixing Rovral at 1 lb/A with Vangard at 5 oz/A. When used in combination with 1 lb. of Rovral plus 5 oz. of Vangard, the cost per acre is approximately $41.85.

Elevate 50WDG fungicide was registered for control of botrytis bunch rot on grapes in 1999. Elevate is a product of Tomen Agro, Inc. and has good activity against botrytis. Elevate has different chemistry than Vangard, Rovral, and Benlate.

The label states that for control of botrytis bunch rot (gray mold) apply 1 lb/acre. The final application may be made up to and including the day of harvest (PHI=0 days). Do not apply more than 3 lbs/acre per season. Thus, you can not make more than 3 applications per season. I have a price quote for Elevate of $29.50/lb.

In summary, all these materials are costly and should be used correctly and only on the tight-clustered "more valuable" wine grapes that are highly susceptible to botrytis. Especially where Rovral has been used for many years, or where the efficacy of Rovral for botrytis control appears to be reduced, these new materials (Vangard and Elevate) should be introduced into the fungicide program for botrytis control.

STUDIES TO DETERMINE TIME OF SUSCEPTIBILITY OF GRAPE BERRY AND RACHIS TISSUES TO INFECTION BY *PHOMOPSIS VITICOLA*

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Introduction

The incidence of Phomopsis cane and leaf spot, caused by *Phomopsis viticola*, has been increasing in Ohio vineyards, and the disease is becoming an important problem in the northeastern U.S. The cane and leaf spot phase of the disease can result in considerable damage to the vine; however, it is rachis and berry infection that results in the greatest economic loss. In 1997, yield losses due to Phomopsis were estimated up to 30% in several commercial vineyards in southern Ohio. Symptoms (lesions) on canes and leaves may appear very early in the growing season (prebloom or shortly after bloom); however, fruit rot symptoms first appear close to harvest after berries begin to mature and are rare on immature (green) fruit. Pscheidt and Pearson (2) reported that berry infections on 'Concord' grapes occur primarily during bloom or shortly after, with little or no berry infection occurring later in the growing season. These early season infections remain latent in green fruit until close to harvest, when they become active and rot fruit. Based largely on this report, fungicide applications for control of berry infection are currently timed during bloom or shortly after bloom. Several growers have obtained poor control of berry infection even after applying fungicide at this time. Based on field observations and grower experience, we feel that the period of grape berry and rachis infection needs to be more clearly defined. The objective of this study is to determine the period of rachis and berry susceptibility to infection of *P. viticola*.

MATERIALS AND METHODS

Greenhouse studies

'Seyval' plants were grown in 8-inch pots during the growing season in 1997, allowed to go dormant, then placed in refrigerated storage for the winter. In March 1998, dormant plants were placed in the greenhouse and trained to two shoots per plant with one cluster per shoot. Intact clusters were inoculated with a conidial suspension of $1x10^7$ *Phomopsis* alpha spores at Eichorn-Lorenz growth stages 12, 17, 23, 27, 29, 33 and 35 (1). Clusters were sprayed to runoff with the conidial suspension then placed in the green in a moist chamber at 20 C for 24 hr. Plants with attached clusters were then placed in the greenhouse. There were five plants (ten clusters) for each of three replications per growth stage. Plants were observed daily and the presence of rachis lesions recorded. The experiment was terminated and all clusters harvested when berries reached a mean of 21 % sugars. Disease severity on rachises was recorded at harvest using the Horsfall-Barratt scale for assessment. Fruit rot incidence was recorded daily as symptoms began to develop near harvest through harvest.

All experiments were repeated in 1999 as previously described. In addition, intact clusters of the cultivar 'Chambourcin' were also inoculated in the greenhouse as previously described at growth stages, 17, 23, 31 and 35.

Field Studies

Field studies were conducted in a 4-year-old Catawba vineyard at the OARDC, Wooster. Ten to twenty randomly selected clusters were inoculated as previously described at each growth stage. In addition to the eight growth stages inoculated in the greenhouse, growth stage 31 (pea-sized berries) was also tested in the field. There were three replications per growth stage. In order to maintain wetness on plant surfaces, plants were overhead irrigated by a misting system for 24 hrs after inoculation. Disease incidence on berries and disease severity on rachises was assessed as previously described. Field experiments were also repeated in 1999 as previously described. Data were analyzed with analysis of variance. The arcsine square root transformation of the proportion of fruit rot incidence and disease severity on rachises were used for GLM procedure.

RESULTS

In the greenhouse inoculations at all growth stages tested on both Seyval and Chambourcin vines resulted in some level of fruit rot and significantly more fruit rot than the uninoculated control (Tables 1, 2 and 3). Although the level of fruit rot increased from bloom (stage 23) through berry touch (stage 33), there were no significant differences between these growth stages in fruit rot incidence. In 1998, fruit rot incidence at growth stage 12 (prebloom) was not significantly different from at all other growth stages. At growth stage 35 (véraison), incidence of berry infection reduced and was significantly lower than at growth stage 33 (berry touch). In 1999, results on both Seyval and Chambourcin were very similar to those obtained in 1998.

In 1998, cluster inoculations also resulted in some level of rachis infection at all growth stages and was significantly higher than uninoculated control (Tables 1, 2 and 3). Growth stages 12 and 33 had significantly higher disease severity on rachises than any other growth stages. There were no significant differences in rachis disease severity between growth stages 17 through 29. Growth stage 35 (véraison) had significantly less disease severity than all other growth stages. Results for rachis infections in 1999 were very similar to those from 1998 (Tables 1, 2 and 3).

Results from 1998 field studies were similar to those obtained in the greenhouse. However, due to high levels of natural inoculum in the vineyard, there were no significant differences in berry or rachis infection between growth stages 12 through 29 and growth stage 35 and the uninoculated control (Table 4). Although the level of infection appeared to increase with increasing maturity, differences were not significant until growth stage 31. There was significantly more fruit infection and rachis disease severity at growth stages 31 and 33 than all other stages. Results from 1999 field studies were more similar to those obtained in the greenhouse. With the exception of growth stage 27, all growth stages starting at stage 23 had significantly more berry infection than stages 12, 17 and the non-treated control. There was a tendency for the level of berry infection to increase with increased maturity level; however; differences were generally not significant. It is interesting to note that the uninoculated check in 1999 had 23% fruit infection. These infections came from natural inoculum in the field. This level of natural infection further demonstrates the economic significance of this disease.

DISCUSSION

Our results indicate that berry and rachis infection by *P. viticola* on Seyval, Chambourcin and Catawba grape vines can occur throughout the growing season with an apparent increase in susceptibility from bloom through berry touch. This is a significant finding and disagrees with earlier reports that berry infections occur primarily during bloom and shortly after bloom with decreasing susceptibility as fruit matures. These results should allow us to make adjustments in timing fungicide application in order to provide more effective control of Phomopsis fruit rot and rachis infection.

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1. Eichorn, K. W., and Lorenz, D. H. 1977. Phänologishche Enwicklungsstadien der Rebe. Nachrichtenbl. Dtsch. Pflanzenschutzdienstes (Braunschweig) 29:119-120.

2. Pscheidt, J. W., and Pearson, R. C. 1989. Time of infection and control of Phomopsis fruit rot of grape. Plant Dis. 73:829-833.

Table 1: Phomopsis fruit rot incidence and disease severity on rachises from intact 'Seyval' clusters inoculated at various growth stages in greenhouse studies (1998)

Growth[1)]	Mean of % fruit rot[2)]	Mean of % disease[3)]
Control	0.0 d[4)]	0.0 d
12	53.8 abc	74.6 a
17	46.2 c	50.0 b
23	67.4 abc	54.7 b
27	68.9 ab	61.7 b
29	65.7 abc	57.9 b
33	74.5 a	73.9 a
35	49.5 bc	29.8 c

1. Growth stages were selected based on the Eichhorn-Lorenz growth stage scale.
2. Mean percentage of Phomopsis fruit rot based on the number of rotted fruit from ten clusters per each of three replications for each growth stage.
3. Mean disease severity on rachises based on ratings from ten clusters per each of three replications, for each growth stage.
4. Means followed by different letters within a column are significantly different (P=0.05) based on Fisher's least significant difference (LSD), calculated on arcsine-transformed percentage data.

Table 2: Phomopsis fruit rot incidence and disease severity on rachises from intact 'Seyval' clusters inoculated at various growth stages in greenhouse studies (1999)

Growth[1)]	Mean of % fruit rot[2)]	Mean of % disease[3)]
Control	0.0 e[4)]	0.0 d
12	64.4 d	30.5 bc
17	81.4 bc	57.4 a
23	88.7 ab	58.6 a
27	83.9 b	60.5 a
29	86.4 ab	43.1 ab
33	91.9 a	57.2 a
35	72.7 cd	23.8 c

1. Growth stages were selected based on the Eichhorn-Lorenz growth stage scale.
2. Mean percentage of Phomopsis fruit rot based on the number of rotted fruit from ten clusters per each of three replications for each growth stage.
3. Mean disease severity on rachises based on ratings from ten clusters per each of three replications, for each growth stage.
4. Means followed by different letters within a column are significantly different (P=0.05) based on Fisher's least significant difference (LSD), calculated on arcsine-transformed percentage data.

Table 3: Phomopsis fruit rot incidence and disease severity on rachises from intact 'Chambourcin' clusters inoculated at various growth stages in greenhouse studies (1999)

Growth[1)]	Mean of % fruit rot[2)]	Mean of % disease[3)]
Control	0.0 c[4)]	0.0 d
17	76.0 ab	57.6 b
23	86.7 a	62.9 ab
31	85.9 a	72.4 a
35	69.1 b	22.6 c

1. Growth stages were selected based on the Eichhorn-Lorenz growth stage scale.
2. Mean percentage of Phomopsis fruit rot based on the number of rotted fruit from ten clusters per each of three replications for each growth stage.
3. Mean disease severity on rachises based on ratings from ten clusters per each of three replications, for each growth stage.
4. Means followed by different letters within a column are significantly different (P=0.05) based on Fisher's least significant difference (LSD), calculated on arcsine-transformed percentage data.

Table 4: Phomopsis fruit rot incidence and disease severity on rachises from intact 'Catawba' clusters inoculated at various growth stages in the field (1998)

Growth[1)]	Mean of % fruit[2)]	Mean of %[3)]
Control	10.2 b	4.7 c
12	18.1 b	6.5 c
17	14.3 b	5.6 c
23	31.8 ab	17.4 c
27	25.7 b	14.6 c
29	29.9 b	18.8 bc
31	62.9 a	34.8 ab
33	58.2 a	47.3 a
35	22.4 b	8.7 c

1. Growth stage was selected based on the Eichhorn-Lorenz growth scale.
2. Mean percentage of Phomopsis fruit rot based on the number of rotted fruit from ten to twenty clusters per each of three replications, for each growth stage.
3. Mean percentage disease severity on rachises based on ratings from ten to twenty clusters per each of three replications and for each growth stage.
4. Means followed by different letters within a column are significantly different (P=0.05) based on Fisher's least significant difference (LSD), calculated on arcsine-transformed percentage data.

Table 5: Phomopsis fruit rot incidence and disease severity on rachises from intact 'Catawba' clusters inoculated at various growth stages in the field (1999)

Growth[1)]	Mean of % fruit[2)]	Mean of %[3)]
Control	22.8 d[4)]	4.6 f
12	56.1 c	23.8 de
17	60.3 c	14.6 e
23	83.8 a	31.1 cd
27	59.6 c	14.2 e
29	74.4 b	33.4 c
31	88.7 a	66.7 a
33	85.5 a	54.9 b
35	69.2 bc	16.4 e

1. Growth stages were selected based on the Eichhorn-Lorenz growth stage scale.
2. Mean percentage of Phomopsis fruit rot based on the number of rotted fruit from ten to twenty clusters per each of three replications, for each growth stage.
3. Mean percentage disease severity on rachises based on ratings from ten to twenty clusters per each of three replications and for each growth stage.
4. Means followed by different letters within a column are significantly different (P=0.05) based on Fisher's least significant difference (LSD), calculated on arcsine-transformed percentage data.

ROOTSTOCK PERFORMANCE IN OHIO

Arnie Esterer
Markko Vineyard

Markko Chardonnay

I. Introduction
   A. Twelve (12) rootstocks
   B. Vintages 1995 to 1999
   C. Five different vineyard blocks
   D. All three factors above affect pruning practices

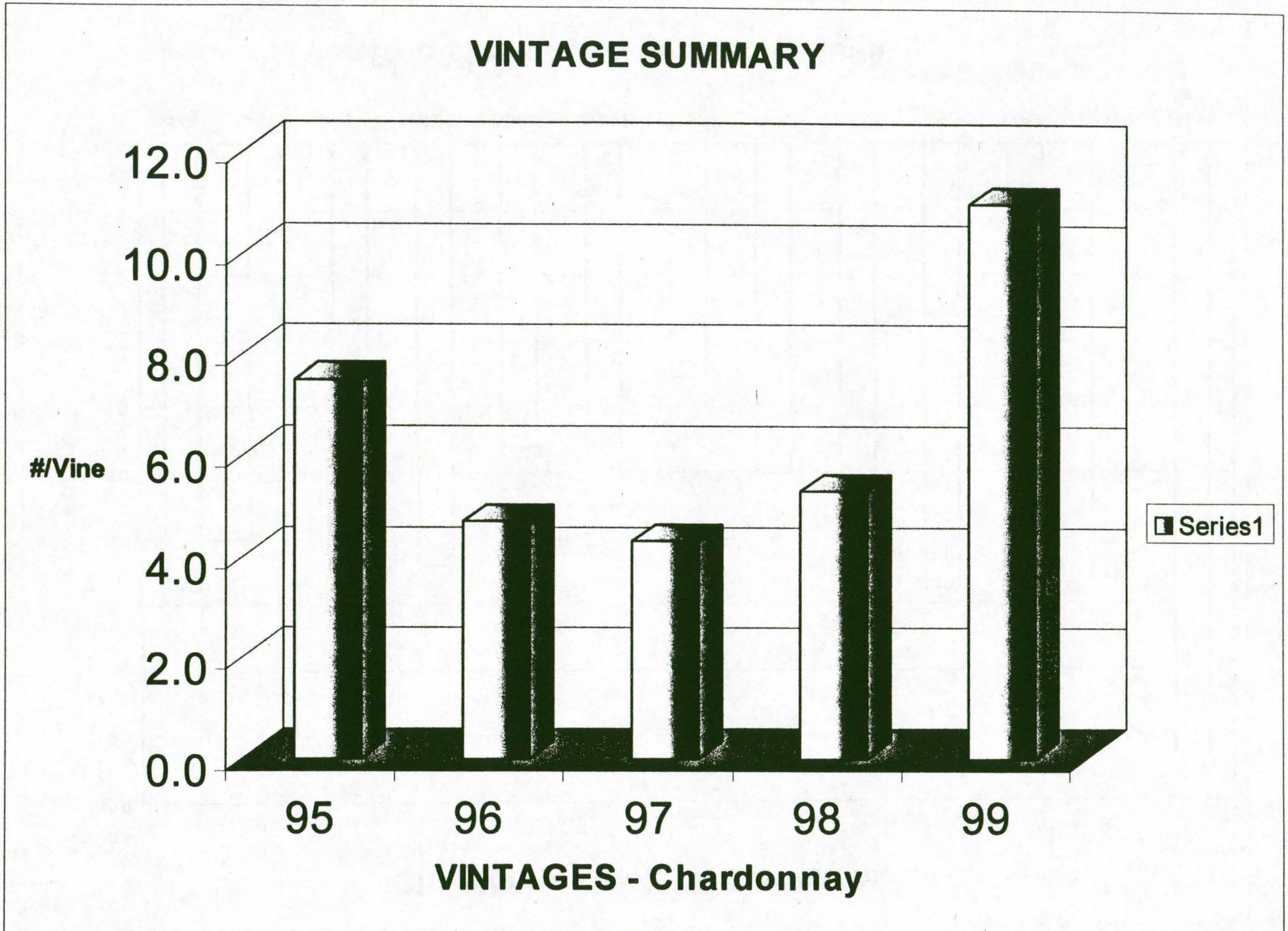
II. Vintages
   A. Growing season and crop
      1. 1994: winter killed vines to snow level (temperatures -22.3°F to -25°F)
      2. 1995: Great season good maturity with 23.1°Brix
         a. warm and dry weather - early harvest
         b. no 1994 crop due to winter kill
         c. easy winter - no damage
         d. wines - big, round, fruity, elegant
      3. 1996: Poor season - low maturity with 19.5°Brix
         a. cool summer
         b. wet fall - late harvest
         c. wines - lean, earthy, mineral, light bodied
      4. 1997: Okay season - small crop with 22.9°Brix
         a. from 1996 low bud fruitfulness
         b. late harvest
         c. wines - good, moderate body and fruit
      5. 1998: Great season - good maturity with 23.3°Brix
         a. warm, dry, early harvest, samples low
         b. started picking a little late.
         c. wines - big, fruity, full bodied
      6. 1999: Very good season - large crop (65 T)
         a. buds very fruitful from 1998
         b. pruned too lightly, then did not thin
         c. wines - moderate flavor and body

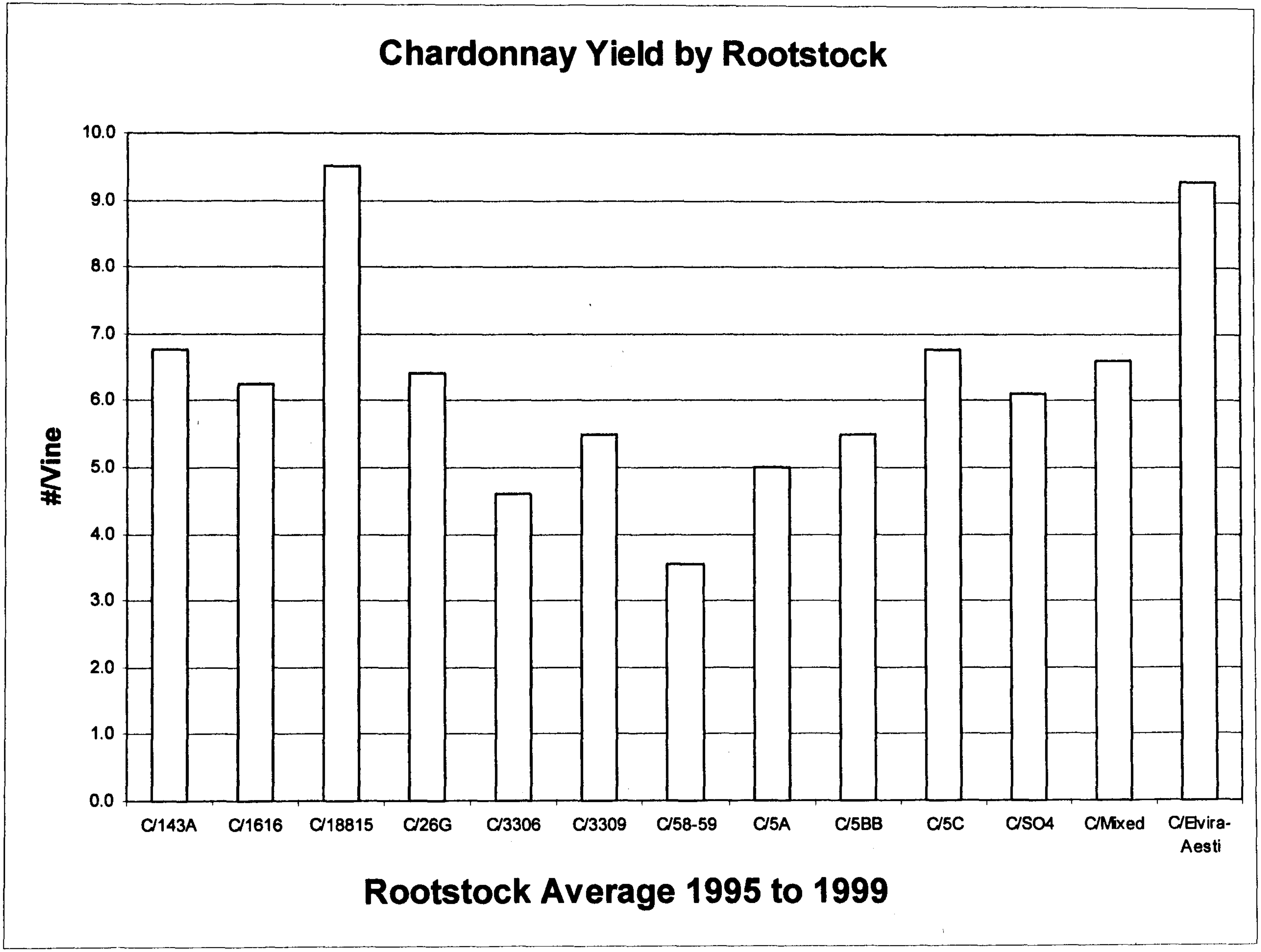
   B. Chardonnay/rootstock survival 1994
      1. Almost 100% primary kill
      2. Major secondary bud kill
      3. Major trunk and arm damage
      4. Best practice trial - cut trunks to snow line
      5. Carefully train vigorous new growh

III. Rootstock performance - 3095 vines on 12 rootstocks

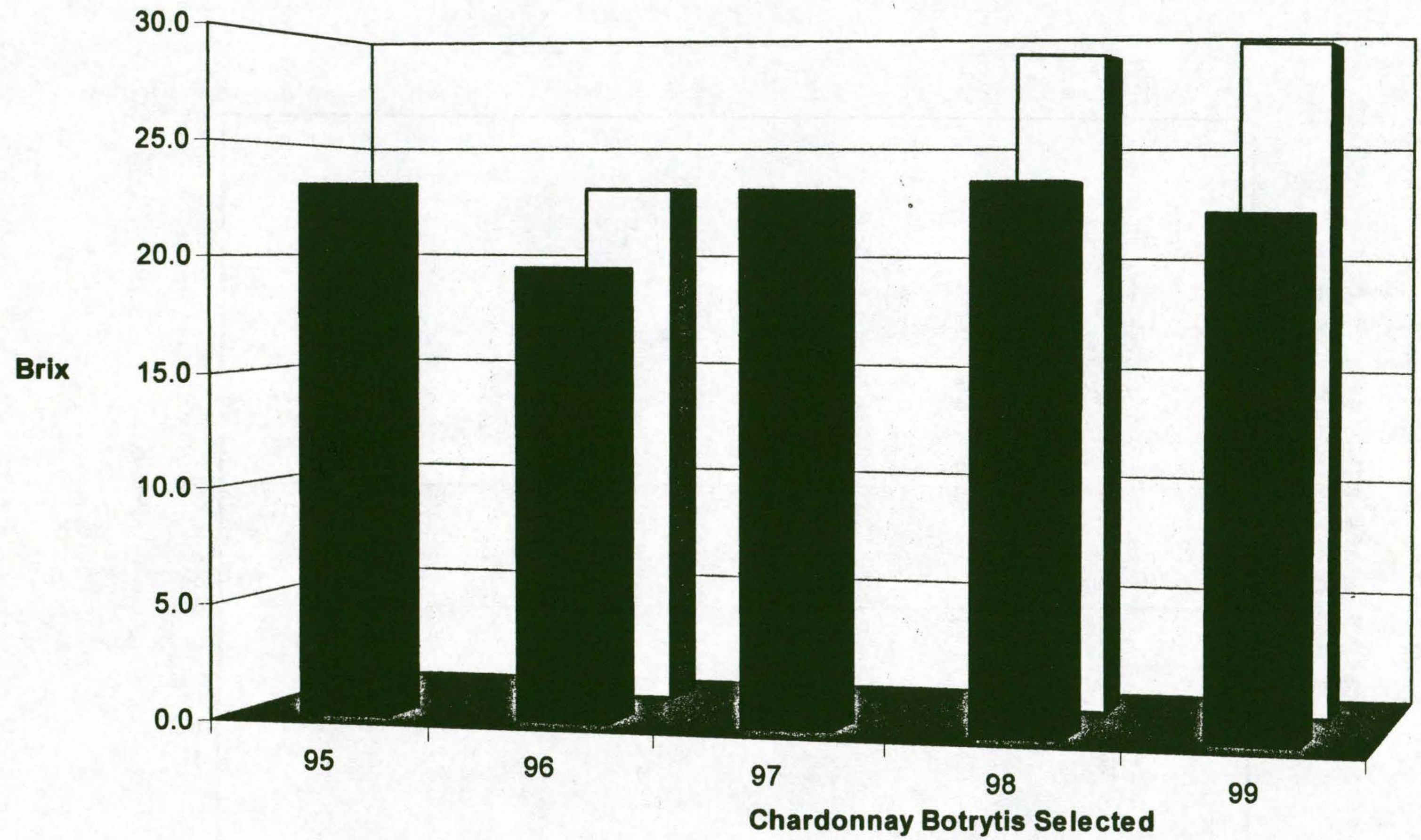
A. Chardonnay yield by rootstock 1995 - 1999
   1. varies with each vintage - goal 12 lbs/vine
   2. pruned to 40-45 buds per vine normal wood
   3. 4 canes with 8 buds plus 6 x 2-bud spurs
   4. trellis: bilateral cordon, 54" high
   5. double trunks - spacing 7' x 9' (rows)
   6. may change varietal character (Gallo study)

B. Rootstock yield by vineyard - same sample
   1. yields vary by vineyard site and soils
   2. vineyard 1: steep hillside, well drained
   3. vineyard 2: lies low, damp
   4. vineyard 3: planted in 1971
   5. vineyard 4: very good site, high and dry
   6. vineyard 5: 1 acre deep plowed, damp, tiled
   7. vineyard 5: 1 acre good, no deep plow
   8. vineyard 6: very vigorous, deep plowed, tiled


VINTAGE SUMMARY
#/Vine
12.0
10.0
8.0
6.0
4.0
2.0
0.0
95
96
97
98
99
VINTAGES - Chardonnay
Series1


Chardonnay Yield by Rootstock
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
#/Vine
C/143A
C/1616
C/18815
C/26G
C/3306
C/3309
C/58-59
C/5A
C/5BB
C/5C
C/SO4
C/Mixed
C/Elvira-Aesti
Rootstock Average 1995 to 1999

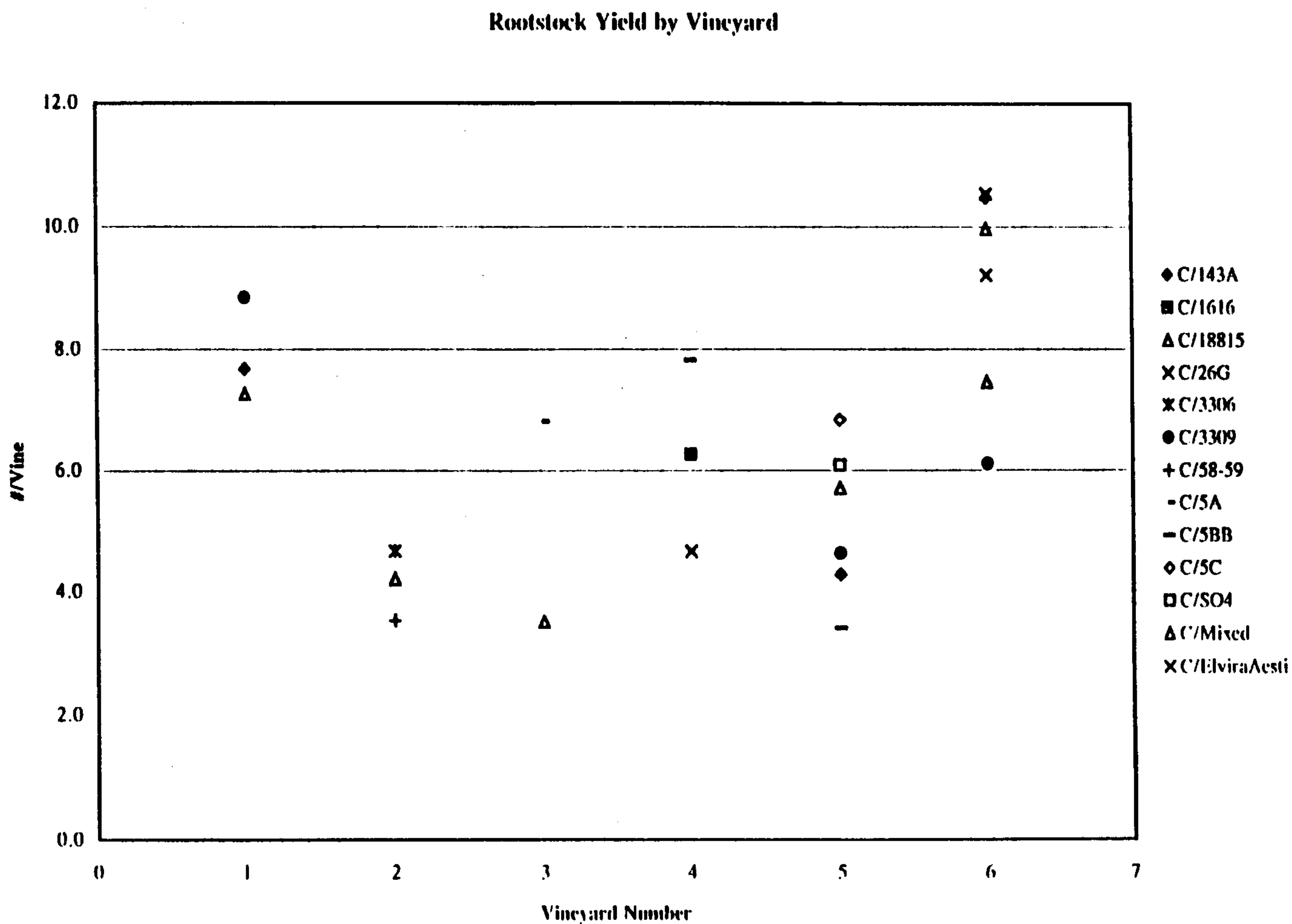
Average Vintage Sugar



	95	96	97	98	99
Reg Chard	23.1	19.5	22.9	23.3	22.0
Botrytis		23.0		29.0	29.5

Markko Vineyard

02/13/2000



Chardonnay
Five Year Average

MARKKO VINEYARD
CHARDONNAY
Vintage Summary

Scion/Rootstock	No. Vines	Vintage Year — lbs/vine (9 x 7)					Comment
		95	96	97	98	99	
C/143A	702	7.5	4.4	4.2	5.4	12.0	Vinifera in parents
C/1616	110	7.4	4.0	6.5	4.3	9.0	
C/18815	271	11.9	4.3	6.2	7.9	17.2	Looks good
C/26G	138	8.1	1.5	6.4	5.7	10.1	Geisenheim Select
C/3306	31	4.4	6.6	5.5	2.2		Wet site
C/3309	295	7.7	3.2	3.6	5.1	8.2	Low vigor/popular
C/58-59	41	4.1	2.5	3.3	4.1		Dr. Frank selection
C/5A	149	4.7	8.3	3.0	3.2	5.9	Good survival
C/5BB	288	6.8	4.2	2.6	4.4	9.4	Very vigorous
C/5C	204	6.2	6.0	3.3	6.5	12.2	
C/SO4	255	5.9	5.1	2.4	5.7	11.4	Bull wood
C/Mixed	538	8.3	4.6	3.9	5.8	11.2	
C/Elvira-Aesti	73	14.0	5.6	5.6	7.5	13.5	Native/Dr. Frank sel
Total	3095						
Yearly Average		7.5	4.6	4.3	5.2	10.9	
°Brix, regular harvest		23.1	19.5	22.9	23.3	22.0	
°Brix , late harvest (botrytis)			23.0		29.0	29.5	

MARKKO VINEYARD
CHARDONNAY
Vintage Summary

Chardonnay/Rootstock SUMMARY 1994 to 1999								Primary	Secondary
	5-Year Average lbs/vine/vineyard							Vineyard #5 = -25°F Vineyard #1-6 = -22.4°F	
Vineyard No.	1	2	3	4	5	6			
Vineyard Planted	69-71	69-71	71	73	73-83	83			
C/143A	7.7				4.3	10.5		98	86
C/1616				6.3				98	68-84
C/18815						10.0		92-100	62-91
C/26G				4.7		10.5		92-100	66-80
C/3306		4.7					Wet Site	100	66
C/3309	8.8				4.6	6.1		100	92
C/58-59		3.5						na	na
C/5A			6.8		6.8			98-100	50-70
C/5BB				7.8	3.4			100	92
C/5C					6.8			100	82
C/SO4					6.1			na	na
C/Mixed	7.3	4.2	3.5		5.7	7.4			
C/Elvira						9.2		97	78
C/Aestivalis								100	79

GROWING YOUR OWN: VINIFERA GRAFTING EXPERIMENTS (1999)

Ron Barrett, Kinkead Ridge Vineyard
Ripley, OH

Abstract: A review of the rationale behind, material, and technique used and results from, two small scale grafting trials. Practical implications are emphasized.

Whey, you ask, should I as a grape grower, take on the responsibility of producing my own planting material? A good questions, since few farmers have loads of extra time to devote to a new project which might, after all, result in failure. The answer resides in the fact that the words "rich" and "farmer" are seldom found adjacent to one another! Cost is almost always a consideration and the cost of plants per acre of vinifera (typically $2500 to $5000) has kept many with good sites from experimenting with vinifera. With these techniques, you should be able to produce plants for $300 to $1250 per acre, and be assured of an ongoing supply of good quality plants of a known pedigree. You get the satisfaction that comes from being self-sufficient free of nursery-caused problems such as substandard plants or switched varieties. Once you start producing your own plants, you will find out how easy it is to make these same mistakes.

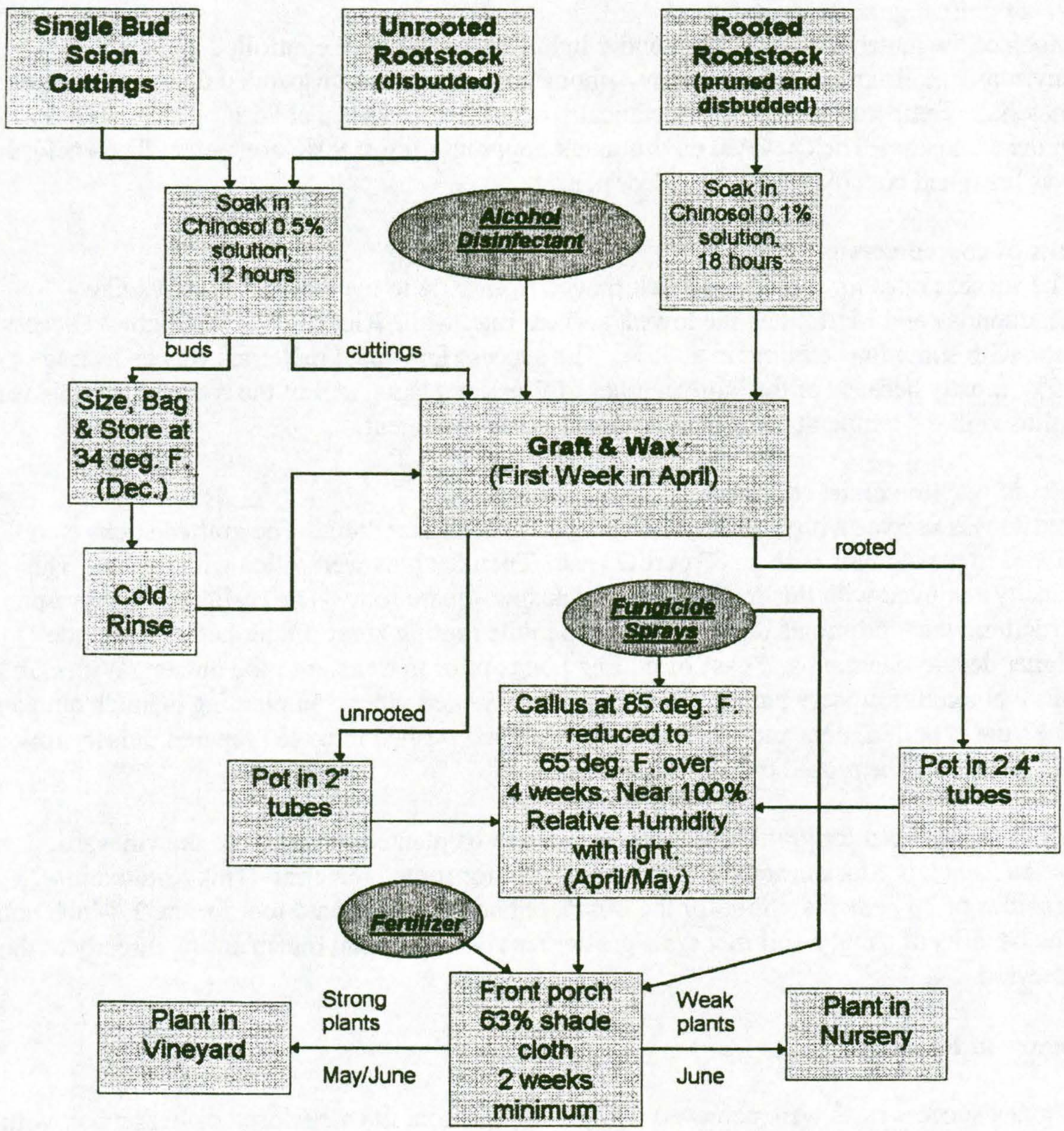
Having (I presume) made the decision to try your hand at grafting, you will need at minimum the plant material, a grafting tool, some supplies, and a callusing box. Access to a greenhouse, though not essential, will enable you to make stronger plants, particulary if spring turns out to be cold. Well-sized, virus-free rootstock and scion material is essential for success. Cuttings can be disinfected for fungus and bacterial diseases, but viruses are much toughter to eradicate.

Rootstock performance is a complex interplay dependent on scion, climate and site characteristics. No blanket statement of suitability can be made without years of evaluation. That having been said, we know that low to moderate vigor rootstocks are essential for both good quality wines and winter hardiness. Also, rootstocks which are genetically similar to native wild ones should do well in the same region. With the above in mind, the best bets in southern Ohio are Riparia, Cordifolia and Rupestris crosses represented by 4453-M, 3309-C and 101-14 Mgt. SO4 was also used in some of these trials.

Scion material (budwood) is generally easier to obtain than rootstock. Here again the virus status of the wood is critical. Material should be free of fanleaf, leaf roll and corky bark viruses. Rupestris stem pitting and other secondary viruses can cause trouble, but often the best clones are not completely virus free so compromise is in order. Don't skimp on quality here. Budwood is relatively cheap and new clones with improved quality are now becoming available from many reputable nurseries.

Grafting technique itself is as varied as the individual performing it. I adapted a technique described by Steve Price, then Oregon State University, in the February/March 1994 issue of the OWA (Oregon Winegrowers Association) Grapevine. Mark Nissel (Painter Fork Vineyard) and Carl Jahnes/Mick Seiler (Flint Ridge Vineyard) were successful using slightly different methods. Below you will find a grafting "recipe", if you will, which when modified to suit your circumstances, should yield good results. Attention paid to process details and our observations from 1999 will be rewarded by great grafting success. With grafting, the devil is truly in the details.

Kinkead Ridge Grafting Technique 1999



NOTES ON TECHNIQUE:

1. Use 0.5% Sodium Hypochlorite (bleach) solution to disinfect benches etc. Disinfect pruning and grafting tools with alcohol.
2. Fungicide sprays may be necessary as often as every three days. Saturate with Benlate at 4.5 g/gl. + Captan 50 at 9 g/gl. alternated with Rovral at 7 g/gl.
3. Keep the wax temperature slightly above the melting point and follow immediately with a cold water dip.
4. Rooted cuttings are usually produced from undersize cuttings planted the year prior to grafting. The top bud is pruned off and roots are pruned severely to fit in the cardboard tubes. As with unrooted cuttings, buds near or above the soil line are removed with a knife.
5. Scion rootstock diameters must be closely matched for best results. This is especially critical for unrooted graftings. If a mismatch is unavoidable, align the cambiums as well as possible and hope for the best.

Painter Fork Vineyard
Grafting Trials

Different callusing treatments

* Much of the material was callused under light in a temperature controlled and enclosed environment. Light was provided by 4-foot fluorescent lights suspended 6" over the grafted material. Temperature was thermostatically controlled and keep at 86°F by a ceramic heater in the enclosure. The enclosed environment kept humidity at 90% or greater. The enclosure was lined and covered with 4-mil clear plastic.

Results of rooted versus unrooted

* The success rates for rooted rootstock ranged from 50% to over 80%. Varieties like Chardonnay and Merlot had the lowest success rate, while Riesling had the highest success rate, with some flats coming in at 85%. The success for rooted materials was on average 75%, mostly because of the large number of Riesling plants. All of the rooted materials was callused in the temperature controlled enclosed environment.

Results of perlite versus soil mix

* Perlite was used as a high density callusing and rooting medium. The grafted sticks were placed in plastic bins with an 8" perlite base. Then the bins were filled with perlite. The density achieved with this method is 50 sticks per square foot. The perlite has a very open structure which promotes high oxygen rates in the rooting zone. Other benefits include higher density planting and ease of pulling plants prior to transfer to the nurser. With care the survival rate for nursery planting is as high as for potted vines, but planting is much quicker. The vine is pulled roots and all from the perlite, and pushed into the prepared nursery row. The perlite can be reused once it is disinfected.

* Soil mix was used for grafts that were intended to be planted directly into the vineyard. I used a 2-inch pot for unrooted and a 2.4-inch pot for rooted material. This resulted in densities of 36 per square foot for the 2-inch pot and 25 per square foot for the 2.4-inch pots. The benefits of using a soil mix are a greater survival rate upon transplanting directly to the vineyard.

Summary of Results

* Highest success rates were achieved with rooted material in an enclosed callusing box with both temperature and humidity controlled.

* The rooting medium, either perlite or soil mix, did not affect the callusing success.

* Transplant success is highest for rooted material in a paper pot, followed by unrooted material in a paper pot, lastly by unrooted material in perlite.

Conclusions

There are many factors to consider when attempting to do your own grafting. If the vines are intended for a nursery planting that will later be dug and field planted, then the simplest method with the least labor can be used. Callus in perlite and transplant to the nursery. If you want to plant the vines in a new vineyard, you have to options: either use unrooted material and plant in a 2-inch pot, or for more vigorous vines, use rooted material in the larger 2.4-inch pots. Here the choice can be dictated by cost. Unrooted material is about half the price of rooted material. If you have access to rootstock, you can cut your own and plant it to develop rooted cuttings for the following year's grafting.

Improvement and Recommendations for 2000

* Expansion of the enclosed callusing area to include all the grafted plants.
* Use only rooted material unless winter damage requires additional grafting.
* Put all grafted vines into pots.
* Improve weed control around transplanted vines.

Kinkead Ridge Vineyard - Grafting Statistics

Variety	Rootstock	Type	Overall Yield
Petite Verdot	101-14	rooted	92%
Sauvignon Blanc	101-14	rooted	91%
Sauvignon Blanc	3309	rooted	85%
Viognier	3309	rooted	82%
Roussanne	3309	rooted	63%
Viognier	4453	rooted	90%
Roussanne	4453	rooted	71%
Riesling	4453	rooted	92%
Riesling	4453	unrooted	58%

Kinkead Ridge Vineyard - Observations

1. In general, 101-14 callused first followed by 4453 and 3309. After callusing, overall growth and shoot vigor was highest on 3309.
2. Although 4453 is compatible with Viognier (note grafting success), they appear to lack affinity. Thus, overall growth is poor.
3. Roussanne showed some incompatibility with 4453 and especially 3309, but once callused, affinity and hence growth was adequate.

4. As expected, rooted graftings callus faster, better tolerate size mismatches and environmental shocks and grow more profusely than unrooted ones.
5. Graft unions are initially very weak. In particular, with rooted material, top growth can be lush and strong. Winds can cause significant graft union breakage. Plants need to be carefully staked and tied when planted.
6. Plants newly pulled from the callusing box are quite sensitive to environmental stress. Here's where access to a greenhouse followed by a period under shade cloth would be ideal. At a minimum, a protected environment with 65% shade should be provided for a minimum of two weeks.

Kinkead Ridge Vineyard - Changes for 2000

* Because of their slower development, I am going to start callusing unrooted cuttings one week earlier than rooted ones.

* Free water on leaves for extended periods is an invitation to botrytis. I am going to better manage humidity, and remove the callusing chamber cover earlier.

* I am going to be more careful when waxing plants. No more than two dips followed by a cold water dip will be used. Some primary buds were killed by heat last year.

* As stated before, staking will be employed early on to minimize losses.

* Minimum daily callusing temperatures will be stepped down 5° F per week until 65° F is reached. Last year excessive heat promoted diffuse callusing and excessive unbalanced growth in rooted grafting.

Facilities, Tools and Materials Required

* Callusing box/chamber - needs accurate and reliable temperature control. Must be kept near 100% relative humidity. Adequate light to keep shoots green.

* A "halfway house" - a greenhouse is ideal. A front porch/shade house may suffice.

* Nursery - soil preparation, water and weed control are critical.

* Planting material - budwood cuttings plus either rootstock cuttings or rootstock rootings.

* Omega grafting too. - $1000 German benchmount or $80 Hungarian hand operated.

* Waxing pot/wax/cold water pot - an old hot plate & sauce pan will work if temperature control is excellent.

* Sizing board - 8 holes 3/16" to 7/16" in 1/32" increments. Hardwood is best.

* Potting supplies - pots or paper tubes, nursery trays or bins, soil mix or perlite.

* Disinfection/disease control - chlorine bleach, isopropanol (rubbing) alcohol, chinosol. Fungicides: Benlate, Captan 50, Rovral.

MATERIALS

This short list is not meant to be exclusive. Other supplies may perform as well, but the following have been historically reliable:

Item	Company	Contact	Phone	Web address
Rootstock, budwood, and grafted plants	**Erath Vineyards** 9409 N.E. Worden Hill Rd. Dundee, OR 97115	Joann Stoller	1(800)539-9463	www.erath.com
Rootstock, budwood and grafted plants	**Sonoma Grapevines** 3600 Fulton Rd. Fulton, CA 95439-0293	Daniel Robledo	(707)542-5510	www.sonomagrapevines.com
Cardboard sleeves, and custom nursery flats	**Monarch Manufacturing** 13154 CR 140 Salida, CO 81201	Bob Gomez	1(800)284-0390	www.monarchmfg.com
Chinosol, grafting wax	**Presque Isle Wine Cellars** 9440 W. Main Rd. North East, PA 16428		1(800)488-7492	www.piwine.com
Hand grafting tool, misc. supplies	**A.M. Leonard** 241 Fox Drive Picqua, OH 45356	Amy Preuss	1(888)558-8665	www.amleo.com
Soil mix, perlite, general horticultural supplies	**Teufel Nursery** 12345 NW Barnes Rd. Portland, OR 97299		1(800)483-8335	www.teufel.com

NOTES: Soil mix (I use Sunshine #4) and Perlite are best sources locally because of shipping costs. I choose the "Erath" punch option and light weight stock for the Monarch sleeves.

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DEVELOPING AN EFFECTIVE FUNGICIDE SPRAY PROGRAM FOR WINE GRAPES IN OHIO

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The following information is intended to be "food for thought" for developing a fungicide spray program for wine grapes in Ohio. The spray schedule presents various fungicide options that can be considered by growers. It is important to note that the schedule is intended to provide simultaneous control of black rot, powdery mildew, downy mildew and Phomopsis cane on leaf spot. The schedule is also intended to provide fungicide resistance management, primarily against the powdery mildew fungus. Note that there are usually several fungicide options that can be selected. This schedule does not contain all of the fungicides currently registered for use on grapes. Remember, these are only **"Suggested Guidelines"** for use in developing a fungicide program. The final program that you develop will depend upon the disease complex in your vineyard as well as economic considerations.

SUGGESTED GUIDELINES FOR DEVELOPING A FUNGICIDE SPRAY PROGRAM

FOR WINE GRAPES IN OHIO

This program is intended to provide simultaneous control of Block Rot, Powdery Mildew, Downy Mildew and Phomopsis Cane and Leaf Spot, as well as Fungicide Resistance Management

Application Timing	Material (and rate/A)
1 inch shoot	Mancozeb (3 lb/A)

NOTE: Mancozeb alone for Phomopsis only. If powdery mildew is a concern this early in the growing season, use:

Mancozeb (3 lb/A)
PLUS
A sterol-inhibiting fungicide
[Elite (4 oz/A) or Rubigan (3 fl. oz/A) or Nova (4 oz/A)]
OR
Flowable Sulfur 6F (4 qt/A)
OR
Wettable Sulfur (8-10 lb/A)

3-5 inch shoot or 10 days after last spray	Mancozeb (3 lb/A) PLUS A sterol-inhibiting fungicide [Elite (4 oz/A) or Rubigan (3 fl. oz/A) or Nova (4 oz/A)] OR Flowable Sulfur 6F (4 qt/A) OR Wettable Sulfur (8-10 lbs/A)

NOTE: If powdery mildew is a major concern, Rubigan, Elite or Nova are the fungicides of choice to combine with Mancozeb. Also, be aware that the efficacy of sulfur for powdery mildew control declines below 65°F. If cool temperatures persist (below 65°F), Rubigan, Elite or Nova should be used instead of sulfur for powdery mildew control early in the growing season. For sulfur sensitive varieties, use Rubigan, Elite or Nova. If powdery mildew is not a problem, Mancozeb alone can be used.

NOTE: Always check the price (cost per acre per application) of each fungicide. At the rates recommended, fungicides costs may vary considerably.

10-12 inch shoot or 10 days after last spray	Same fungicides as 3-5 inch shoot
Immediate prebloom or 10 days after last spray	(Strobilurin Fungicide) Abound (11-12 fl oz/A) OR Sovran (4 oz/A)

NOTE: It is important to alternate different fungicide chemistry in the program in order to prevent the development of fungicide resistant strains of fungi, especially powdery mildew. Our intention here is to alternate the sterol-inhibiting fungicides (Rubigan, Elite or Nova) with the strobilurin fungicides (Abound or Sovran).

First postbloom spray no longer than 10-14 days after last spray	(Strobilurin Fungicide) Abound (11-12 fl oz/A) OR Sovran (4 oz/A)

Second postbloom spray no later than 10-14 days after last spray	Mancozeb (4 lb/A) PLUS A sterol-inhibiting fungicide [Elite (4 oz/A) or Rubigan (3 fl. oz/A) or Nova (4 oz/A)] OR Flowable Sulfur 6F (4 qt/A) OR Wettable Sulfur (8-10 lb/A)

NOTE: In order to prevent or delay the development of fungicide resistance to the sterol-inhibiting fungicides (Rubigan, Elite or Nova) and the strobilurin fungicides (Abound or Sovran), should not be used more than 3 to 4 times (preferably 2-3 times) each per season.

Summer Sprays Should Not Exceed a 14-Day Interval

Third post bloom spray 10-14 days after last spray	(Strobilurin Fungicide) [Abound (11-12 fl. oz/A) or Sovran (4-6.4 oz/A)] OR Mancozeb (3-4 lb/A) PLUS Flowable Sulfur 6F (4 qt/A) OR Wettable Sulfur (8-10 lb/A)

NOTE: A sterol-inhibitor fungicide (Rubigan, Elite or Nova) can be used postbloom for powdery mildew control; however, season-long use of the sterol-inhibitors will greatly increase the risk of fungicide resistance development. Especially if early season disease control is good, emphasis for powdery mildew control later in the season should be placed on sulfur, a Strobilurin fungicide (Abound or Sovran),a fixed copper fungicide or JMS-stylet oil.

NOTE: Watch the 66 days PHI on Mancozeb. If you get within 66 days of harvest, Captan can be used in place of Mancozeb. The danger of black rot infection should be over by this time. Berries should be resistant to black rot. The Mancozeb or Captan is included for downy mildew control only. If downy mildew is a problem, the high rate of Sovran should be used.

Fourth post bloom spray 10-14 days after last spray **These fungicide choices will be used through harvest**	(Strobilurin Fungicide) [Abound (11-12 fl.oz/A) or Sovran (4-6.4 oz/A)] OR Mancozeb (3-4 lb/A) PLUS Flowable Sulfur 6F (4 qt/A) OR Wettable Sulfur (8-10 lb/A) OR Fixed Copper Fungicide used alone

NOTE: If dry weather persists and the risk of downy mildew is low, Mancozeb or Captan should not be required and sulfur can be used alone for powdery mildew control. If weather is wet and downy mildew is a problem, a downy mildew spray needs to be included. A fixed copper fungicide will give good control of both downy and powdery mildew. Especially on susceptible varieties, powdery mildew will need to be controlled throughout the growing season.

NOTE: For botrytis bunch rot control, the following fungicides are available:

Rovral (1.5 lb/A)
PLUS
Latron B1956(6 fl oz/100 gal)
OR
Vangard (10 oz/A)
OR
Elevate (1 lb/A)

These will be used only on bunch rot prone cultivars. The first spray should be made when disease is first observed or at veraison (or shortly thereafter). Then wait until a combination of threatening weather and/or disease development to make a second spray (at least 2 weeks after the first spray). On late maturing varieties a third spray may be required.

NOTE: Some tests in New York have indicated that Rovral at 1 lb/A plus Vangard at 5 oz/A may have an additive effect and provides good bunch rot control.

NOTE: The Sovran label states that it cannot be applied more than 4 times per season. The Abound label states that it cannot be applied more than 6 times per season. If possible, try to use 2-spray (back to back) blocks of a strobilurin fungicide alternated with fungicides with different chemistry.

LIGHT AND FRUIT SET

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The role of light in fruit set of grapes is unclear with some studies indicating an important role for light (1,2,3) and others a less important role (4). Fruit set of two French-American hybrid grape cultivars was reduced by exposure to low light conditions from shortly after bloom through harvest in previous Ohio studies (1). The effect of a short period of reduced light on fruit set of grapes has not been studied.

Two greenhouse studies were established to investigate the role of light in fruit set and berry development. In the first, a series of five light levels was established using either supplemental light or various (30, 50, 80%) densities of a neutral shade cloth. The treatments were established on potted 'Chambourcin' vines beginning at bloom and maintained for five weeks.

In the second study, potted vines of 'Chambourcin', 'DeChaunac', 'Seyval blanc' and 'Vidal blanc' were subjected to 80% shade for 5 days. The periods of shade were imposed just prior to bloom, at bloom and 2 or 4 weeks after bloom.

Although absolute light intensity varied from day to day, the treatments established 5 very distinct light environments. There was a strong positive linear relationship of light, and fruit set with supplemental light resulted in 59% set, 80% shade only 12% set (Figure 1). The same relationship existed for cluster weight. A negative relationship existed for peduncle growth and berry weight up to 50% shade showing the strong effect of crop load on these parameters (Figure 2).

Juice pH and soluble solids increased as crop load decreased with decreasing light intensity. Berry color as measured by hue angle increased with the decreased crop caused by decreasing light. Development of color over time was more rapid with light crop loads and delayed as crop increased with increasing light intensities.

Leaves of 'Chambourcin' that developed while under the various light regimes were altered having less mass per area and more chlorophyll per unit area as light decreased. Of course leaf photosynthesis measured in the light environments was directly correlated with light level. However, when the vines were removed from the light environment and placed in a high light environment all leaves had similar photosynthetic rates.

Similar treatments applied to 'Vidal blanc' produced similar trends in the various parameters measured, however, the degree of response was less than in 'Chambourcin'. If the extreme treatments (supplemental vs 80% shade) are compared for fruit set, 'Vidal' had a 38% reduction, while 'Chambourcin' had a 79% reduction.

In the second experiment where four French-American hybrid cultivars were given a 5-day exposure of heavy shade at different times around bloom 'DeChaunac' and 'Vidal' were not influenced. However, 'Seyval' and 'Chambourcin' were sensitive to short exposures of shade. Fruit set of 'Seyval' was reduced by a period shade prebloom and at bloom, but there was no difference in cluster weight (Fig.2). 'Chambourcin' was more sensitive with a significant reduction in fruit set due to a 5-day shade treatment at bloom and cluster weight was reduced by shade at bloom and bloom plus 2 or 4 weeks after bloom. Shot berries were increased on both 'Seyval' and 'Chambourcin' by 5-day periods of shade applied 2 or 4 weeks after bloom. The effects on juice composition at harvest were minimal and related to crop load.

Although caution should be exercised in extrapolation of these results to field conditions, there appears to be differences in cultivar sensitivity to light around bloom. Sensitive cultivars like 'Seyval' and 'Chambourcin' can have reduced fruit set as well as yield. More attention may be needed for these cultivars in pruning and training to insure good light exposure and distribution in the canopy. Even short periods of shade as commonly occur in Ohio may influence fruit set, yield and shot berry production in some years.

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Figure Captions:

Figure 1. 'Chambourcin' cluster from supplemental light (left) and 80% shade (right).

Figure 2. Influence of various light intensities on cluster wt and berry size of 'Chambourcin'.

Figure 3. Fruit set (A) and cluster weight (B) of 'Chambourcin' and 'Seyval' exposed to a 5-day period of shade (80%) at various times around bloom.

Figure 1. 'Chambourcin' cluster from supplemental light (left) and 80% shade (right).

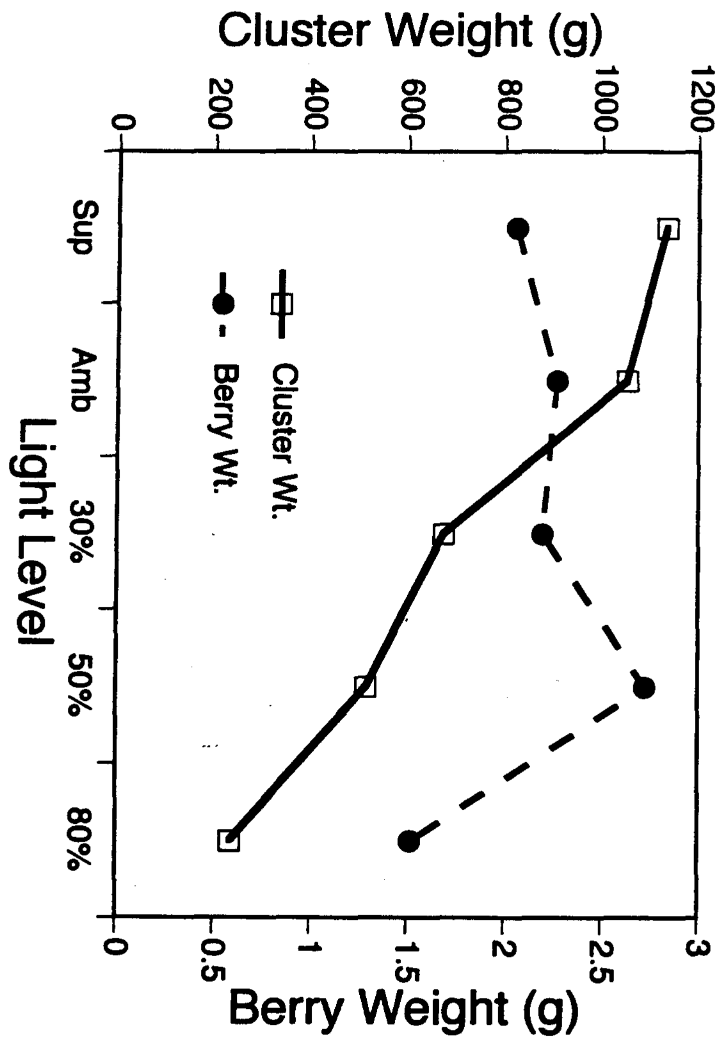

Figure .2 Influence of various light intensities on cluster wt and berry size of 'Chambourcin'.

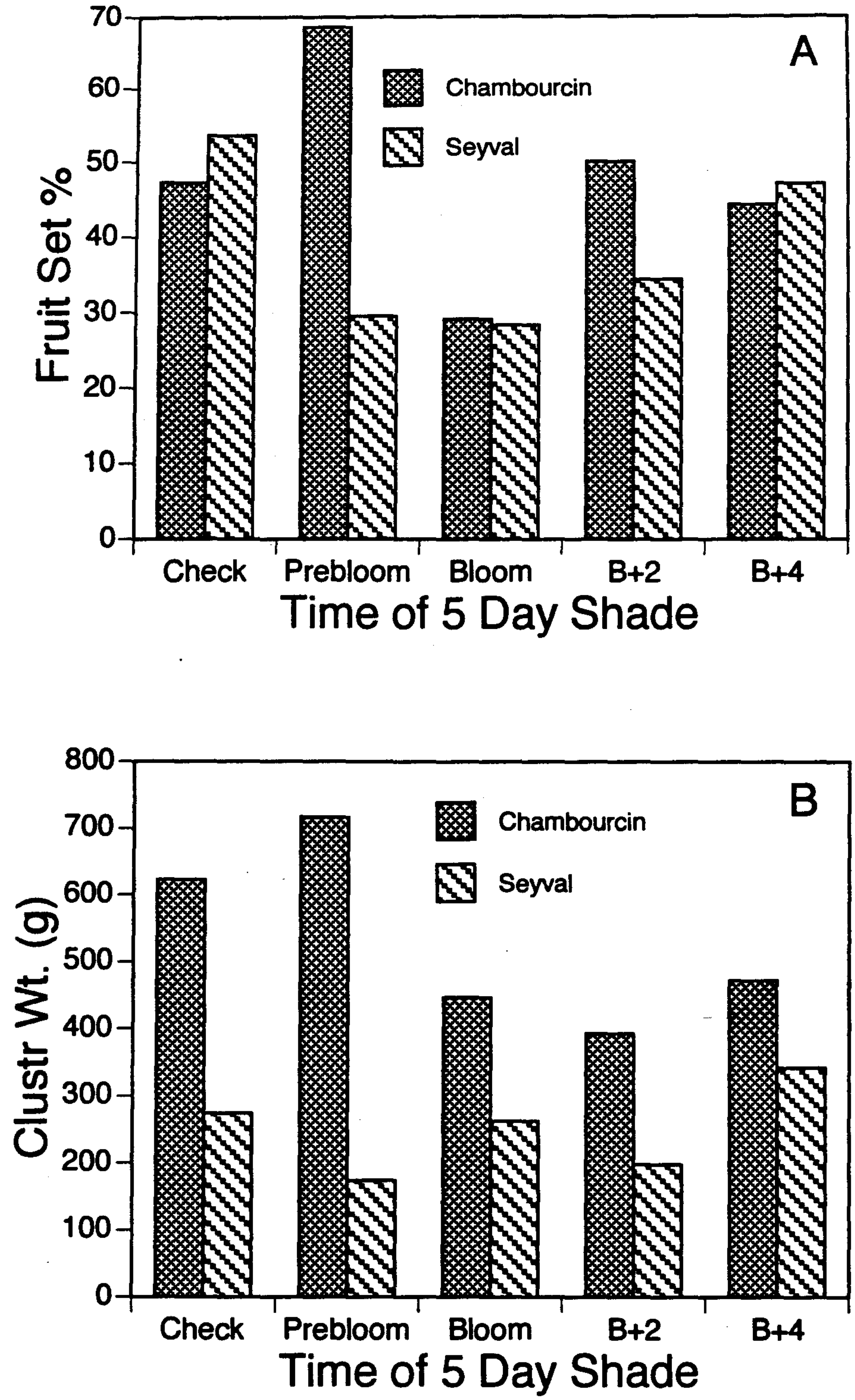

Figure 3. Fruit set (A) and cluster weight (B) of 'Chambourcin' and 'Seyval' exposed to a 5-day period of shade (80%) at various times around bloom

SOIL AMENDMENTS AND MULCHES IN TREE HEALTH MANAGEMENT

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Composts and mulches can be used successfully to improve tree vigor and health. Unfortunately, these organic amendments also can be applied in ways so that negative effects are the end result. Many factors contribute to success or failure in these soil organic management practices. This paper reviews the most critical factors that must be considered if mulches are to be used successfully.

Fresh versus composted organic matter: Most fresh plant materials cause negative effects on plant growth and/or health for some time after application. For example, fresh straw used as mulch increases water retention in soils, immobilizes nitrogen resulting in poor growth and it also increases Phytophthora root rot. Fresh ground wood seems to have similar effects.

Composted yardwaste prepared from ground wood and grass clippings has the opposite effect. It improves plant growth, improves both drainage and water retention and can provide biological control of Phytophthora root rot. The same results have been obtained with composted tree barks.

In gardening, the type of organic matter used must be considered also. Vetch plowed into soil as green manure increases Pythium damping-off of lettuce if the crop is planted within the first week after plowing. However, 10 days after plowing when the green manure is fully colonized by soil microorganisms, the disease is suppressed and biocontrol prevails.

Why do fresh amendments or mulches have these temporary negative effects on plant health? Fresh plant tissues incorporated into soil release sugars, proteins and other water soluble nutrients when they first begin to decay. This stimulates many plant pathogens as well as other soil microorganisms. Fresh organic matter undergoing high rates of decomposition also binds water making it "slippery" when wet . The soil under mulch prepared from these materials remains too high in moisture content and this can aggravate root rots.

As soon as the organic matter is partially decomposed and competition for food begins among soil microorganisms, beneficial effects begin. Pathogens now are suppressed or killed and beneficial microorganisms thrive, including mycorrhizae. The structure of the soil is improved which results in improved water retention under dry weather conditions and better drainage during periods of high precipitation. Soil fertility is affected also. While organic matter decomposes, nutrients are released and fulvic acids are formed. Fulvic acids are resistant to decomposition and polymerize to form humid substances in soils. Fulvic and some humic acids remain dissolved in water in soil early during the decomposition process. They chelate trace elements such as iron, zinc, manganese, copper, etc. and improve the availability of these elements in soils. This is one reason why manures and sludges "green up plants" on some high pH soils.

Highly stabilized sources of organic matter such as that in muck soils or peat, as well as humic substances in mineralized farm soils, do not provide these same beneficial effects. Pathogens typically cause heavy losses in such soils unless pesticides are used.

Are all composts or mulches equal? Composts prepared from yard wastes, manures and sewage sludges tend to release significant quantities of nutrients for plant growth. They also may be high in salt content which can present problems. These products need to be applied based on the fertility requirement for the crop. However, since the nutrients are released over several years, large amounts can be applied relative to the same amounts of nutrients in fertilizers. One half bushel of these products per tree gives positive effects on tree crops for the reasons given above.

Composted manures and sludges contain large quantities of fine particles and tend to stimulate the germination of weed seeds. These types of materials should be incorporated into the soil during planting of trees. They are not ideal when used as mulches. Coarser products should be used as mulches.

Hardwood bark, hammermilled pallets, etc., tend to consist of large particles and these products immobilize nitrogen unless composted first. The best procedure is to nitrify this material with manure or composted sewage sludge (15% by volume), poultry manure (30-60 lbs/cubic yard) or urea (2 lbs/cubic yard). It should then be composted in windrows at temperatures of 120° F at 50-70% moisture content for 6-8 weeks. This product is very effective if applied as a mulch at a volume of one or more bushels per tree.

Composted yard wastes also enhance soil fertility and have provided biological control of diseases caused by several soil-borne plant pathogens. The fine particles (less than one inch in diameter) screened out of composted yard waste make excellent soil amendments for top soil preparation. The coarse fraction (greater than 1 inch in diameter) makes an excellent mulch that has long lasting beneficial effects.

Timing of application: Fresh undecomposed materials and composts high in salinity must be applied in the fall or winter when pathogens and the crop are least active to allow for leaching and provide beneficial effects later. Composted sewage sludges and manures high in salinity applied in the spring or summer when *Phytophthora* and *Pythium* are most active, often increase disease pressures rather than provide control. Application of these products in the late fall or mid-winter allows for leaching of salts and provides positive rather than negative effects. Several producers of composts have learned to monitor and control the salinity and fertility effects of composts. It is possible today, therefore, to use these products beneficially at any time of the year and avoid negative side effects. The best approach is to blend high nutrient content materials with tree bark to provide long-lasting beneficial effects.

Optimum depth of mulch layer: Most mulches need to be applied at a 2" depth to provide weed control. Some landscapers apply mulches to a depth of 4-6". Woodchips applied to a depth of 4" decrease the colonization of trees by mycorrhizae as shown in a reforestation trial in Alberta. A 2" deep layer enhanced tree establishment and colonization by mycorrhizae over the control in that work. Many reports have shown that mycorrhizae are stimulated by organic amendments if the correct amount of material is applied, and this also promotes plant health and vigor.

Some mulches, as mentioned above, can be very high in nutrient content and salinity. Composted manures and yard wastes, for example, may contain up to 1% potash on a dry weight basis. The nutrients in these materials must be considered or toxicity may result. Fertility guidelines must be followed for these materials.

How long do effects last: The disease suppressive effect of a 2" layer of composted hardwood bark lasts well into the third year. The lignin (dark material) and waxes in bark resist decomposition and this is the reason for the long-term effect. Composted yard wastes break down much more rapidly because the principal material is cellulose which decomposes readily. A 2" deep layer of such mulch lasted well into the third year on strawberries at The Ohio State University and through three years in a mulch study on trees in nurseries. Composted manures and green manures decompose even more rapidly and should be incorporated into the soil. The length of time that each product lasts depends on the chemistry of the original material and many other factors.

Summary: Mulches and composts if used properly provide beneficial effects through any of several mechanisms. It is best to apply composted products. Raw products should be applied in the late fall or winter. Do not apply more available mineral nutrients in the mulch than the amount required for the crop. Compost or manure analysis complete with soil analysis and crop need should form the basis for application rates. The frequency of application varies from crop to crop and product to product. It is most important to use these products when trees are first planted.

REPORT ON 5th INTERNATIONAL SYMPOSIUM ON COOL CLIMATE VITICULTURE AND ENOLOGY JANUARY 16-20, MELBOURNE, AUSTRALIA

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The first Cool Climate Symposium was held in Eugene, Oregon in 1984. This ground breaking symposium led the way for future symposia held in Auckland, New Zealand in 1988; Mainz, Germany in 1992; and Rochester, New York in 1996. The conference in Rochester was jointly organized with the Annual Meeting of the American Society for Enology and Viticulture/Eastern Section. I was ASEV/ES director and chairman for Special Events for that symposium.

The program in Melbourne featured key lecture sessions from international experts from prominent cool climate regions, free paper presentations, a poster viewing session, and numerous workshops and seminars on- and off-site.

The Australian Wine Industry at a Glance: 200 Years Old and Growing!

The first grapevines were brought to Australia by the First Fleet of English settlers who landed in Sydney, New South Wales in 1788. These initial plantings had mixed success. Thirty years later, however, established vineyards were thriving as suitable land in areas such as the Hunter Valley (100 miles north of Sydney) were discovered. By 1850 winemaking had been established in all six states. The development of the wine industry 150 years ago was dominated by European settlers from Germany, France and Britain, bringing European wine tradition - both grape growing and winemaking - to the continent. During the last 50 years, European migration and with it the growth and development of Australia's wine industry has accelerated. The 1999 record crush exceeded the previous record in 1998 by a full 20%, the vine baring acreage increased 50% from 1994 to 1998 alone.

- Acreage (98): 240,000 acres
- Wineries (98/99): 1115
- Wine grape production (99): 1,180 000 tonnes
- Wine production (97/98): 170 million gallons
- Wine exports (98/99): 54 million gallons (US$ 660 million)
- Wine imports (98/99): 6 million gallons (US$ 70 million)

Production by state (1998):

- South Australia: 50%
- Victoria: 24.1%
- New South Wales: 23%
- Western Australia: 2.6%
- Tasmania: 0.2%
- Queensland: 0.1%

Top 5 Varieties (1999):

- Chardonnay: 260,000 tons
- Shiraz: 228,000 tons
- Cabernet Sauvignon: 146,000 tons
- Semillon: 98,000 tons
- Colombard: 45,000 tons

The 1999 vintage consisted of 60% white and 40% red grapes. In the last decade increased plantings of grape varieties other than the top 5 have risen dramatically. In the reds Pinot Noir and Merlot are rapidly expanding, in addition to Grenache and Mourvèdre, both widely planted a century ago, but nearly abandoned since. In the whites increased plantings of Sauvignon Blanc, Chenin Blanc and Verdelho are observed, while small but growing productions of Viognier, Marsanne and Gewürztraminer demonstrate Australia's quest for renewal. Due to diverse latitudes, altitudes, meso- and macroclimates, every Australian state has cool climate regions for viticulture and enology. Victoria with its host city Melbourne has over half of the 20 wine regions classified as cool. Five premium cool climate growing areas (Yarra Valley, Mornington Peninsula, Sunbury, Macedon Ranges, and the Geelong Bellarine Peninsula) comprising more than 150 wineries are located within an hour's drive of Melbourne.

How Cool is Cool?

Several talks addressed the definition of a cool climate or cool climate region. Parameters like Heat Degree Days, temperature summation, sunshine hours and various means and averages and deviations from those have been used to create models. It was evident from the presentations and discussions that none of the models was able to fully describe the complex and variable nature of a region or even sub-region. Depending on the parameter chosen only individual aspects of a region could be addressed. Several regions in Australia are good illustrations of this dilemma. The "classical cool climate region" of the Adelaide Hills is known for its sparkling wines, crisp, fruity and high acid Chardonnays and Rieslings, but it produces also some of the best Shiraz like the Grange or Magill Estate from Penfolds. The Clare Valley to the north of Adelaide features the same surprising combination of outstanding wines from such diverse varieties as Riesling, Shiraz and Cabernet Sauvignon. Yet it has the same Heat Degree Days as Rutherglen, renowned worldwide for its dessert wines, the fortified Muscats and Tokays. The reason for this apparent contradiction is the diversity in macroclimates within even the smallest region. And within each macroclimate there are variations due to site, sun and wind exposure, altitude and other factors. The take-home message is to know the location, chose the proper sites and cultivars, use cultivar-specific vineyard management and cultivar-specific vinification. In addition to knowing the means and averages it is equally important to be aware of the deviations, the daily fluctuations, the frequency and severity of catastrophic events like frosts and winter kills. Researchers at Cornell University are currently working on a high resolution atmospheric model called Local-Area Agricultural Weather Simulation System (LAWSS) to predict temperature extremes and consequently winter injury, site-specific development of the crop and pests on a 1-100 hectare scale. Ultimately the goal is to reach a 100m resolution. If there was one agreement between the presenters it was that temperature, influenced by sunshine and sunshine hours, is the most important factor determining viticulture.

A cool climate region can be generalized as an area, where viticulture is more marginal providing specific challenges but also opportunities. No region is only cool. Thus understanding the implications of the climate of a particular area and reacting appropriately (site, vineyard and cultivar selection, management practices in vineyard and wineries) is crucial to the success of an operation. The definition of a cool climate, therefore, might be better looked at in terms of advantages and disadvantages it provides.

<u>What makes a cool climate (not) great?</u> - N. Bulleid

Advantages:
- allows distinct types and styles of wines which cannot be produced elsewhere
- the generally smaller scale allows a better expression of terroir
- the often marginal operation increases the influence of people:
  - boutique winemaking
  - hand-marketing (if at all)

Disadvantages:
- increased risks
  - humidity
  - diseases
  - catastrophic events
  - deficiencies in composition and flavor in marginal years
  - boutique winemaking

Solutions
- recognition of problems, shortcomings and reaction to them
- being realistic and sincere in recognizing problems, faults and defects as such and taken appropriate action

- first response:
  - go to cool climate conferences and symposia
  - get together with collegues from cool climate areas to share knowledge and experience
  - **support cool climate research**

Recognizing and reacting to these factors are the base to producing the - at first glance - surprising mix of very different varieties as demonstrated very impressively in the Adelaide Hills and the Clare Valley.

Vineyard Management

Yield and Wine Quality - M.C.T. Trought

- excessive yields inevitably lead to inferior wine quality
- low yields do not necessarily lead to superior quality because low yields can produce excessive vigor and ultimately poor quality
- balanced growth providing well exposed fruit is required. To achieve balanced growth the potential yield of site has to be taken into account
- the potential yield is determined by the accumulated heat
  - climate events affect yields for **2-3 seasons**
  - the deviation from long term means allows to determine the earliness/lateness of a season. Warm early season weather leads to even bud break and an improved set. Warm late season weather cannot correct earlier deficiencies, but can lead to advanced "maturity" in terms of sugar accumulation which may or may not equal physiological ripeness of the fruit. The only way to find out if physiological ripeness has been reached is frequent tasting of the fruit in the vineyard
  - the seasonal development and the anticipation of late season weather (deviation from means and averages!) allow to take preventive/corrective measures such as thinning and leaf removal. The most important and reliable parameter influencing yield is cluster number

Characteristics of Grow Tubes and Their Relationship to Growth - R. Wample

- improved growth similarly in all tube types tested
- maximize water use efficiency by increasing temperature and relative humidity
- decrease net photosynthesis (Pn), transpiration (TR), and hardiness
- the base of the tubes must be in the soil
- the shoot growth is positively correlated to the length of the tubes
- the tubes must removed in the fall

I observed grow tubes in almost every vineyard where new vines were planted. And they were there for their intended purpose: to optimize water use efficiency. In most places in Australia it is very difficult if not impossible to grow grapes successfully without irrigation.

And water is very, very scarce! It is the most important factor limiting the expansion of the industry. It has become even worse in the last few years due to several successive droughts. Global climate patterns affected by El Nino have definitively left their mark in Australia.

<u>Partial Root Zone Drying</u> - M. Stoll

- a two drip systems alternate was used
- the root system was part moist, part dry
- the vines were never under moisture stress
- the system reduced vine growth leading to:
  - lower cytokinin levels
  - better bunch exposure
  - deeper root growth
  - increased water use efficiency
  - increased amount of red pigments
  - improved wine aroma and flavor
- the system reduced water requirement by 50% with only minor effects on yield

Several wineries I visited indeed used water for both, irrigation **<u>and</u>** selected water stress late in the season mainly to reduce berry size thereby increasing color and concentration of flavor in selected cultivars (Shiraz, Cabernet Sauvignon).

<u>The Influence of Leaf to Fruit Ratio on Grapevine Photosynthesis, Vegetative and Reproductive Growth</u> - P.R. Petrie

- net photosynthesis (Pn):
  - at maximum 30 days after leaf emergence
  - declines throughout season
  - declines with aging, but increases with increased source/sink ratio
- net photosynthesis (Pn) remains high with:
  - inadequate leaf area
  - excess fruit
- fruit development is delayed if inadequate leaf area is present
- fruit is produced at the expense of vegetative organts

Conclusion: REMOVE FRUIT FROM NEWLY PLANTED VINES!

<u>Canopy, Fruit and Wine Characteristics of Cabernet Sauvignon in Coonawarra</u> - T. Proffitt

- comparison of the 2 main soil types in Coonawarra: the red to red-brown "terra rossa" and the "deep black cracking clay" soil
- the terra rossa soil limits water access leading to:
  - balanced open canopies

- early maturing and earlier harvest thereby reducing the risk of exposure to later harvest rains
- smaller, more concentrated berries with increased color and phenolics
- fuller bodied wines

- the clay soils don't limit water access and produce wines of inferior quality
- the wine quality could be improved by reducing growth through
  - perennial cover crops providing competition for the vines
  - root pruning

My tastings of commercial wines in Coonawarra grown on these 2 soil types confirmed his experimental results.

Effect of Viruses on Grape Yield and Wine Quality - F. Mannini

- viruses removal resulted in:
  - more growth, higher chlorophyll levels
  - higher net photosynthesis (Pn)
  - increased anthocyanin content
  - increased levels of free and bound terpenes
  - increased yield (Fan Leaf, Leaf Roll)
- virus in rootstock are more effect than in scion
- greater problems with multiple viruses

Conclusion: If possible avoid viruses.

The Search for Terroir

The Search for Terroir - a Question of Management - D. Martin

Definition: "**Terroir** is the conjunction of all attributes of a given region that contribute individuality of the wines produced there. These attributes can be historical, geographical, ***human***, biological and environmental."

D. Martin

There are many different definitions and interpretations of the term "terroir". Whereas some of them focus solely on climate and soil the French do include the human aspect. It was a common thread throughout the presentations and confirmed by my observations in the vineyards and wineries that human intervention ("what do I do with the grapes and wine") is the overall dominant factor influencing grape and wine quality. This theme was perfectly summarized by the following quotes:

"GREAT WINES DO NOT JUST HAPPEN!"

"*Climate* affects wine *style* but does NOT dictate wine ***quality***"

Graham Due, 95

Winemaking Practices and Wine Quality

The Effect of Pre-fermentation Enzyme Maceration on Color Extraction and Stability in Pinot Noir - L. Vanhanen

- treatment: 12 hrs at 68°F, with and without SO_2
- the treatment had no effect on basic wine analysis (pH, TA, alcohol, free and total SO_2)
- all treatments increased total phenols (most: enzyme + SO_2 combination)
- there was no increase in monomeric anthocyanins
- there was an increase in polymeric anthocyanins
- the treatments increased color intensity and density
- after 18 months bottle age:
  - there was a decrease in monomeric and polymeric anthocyanins
  - there was **no decrease in color density**
  - it was speculated that a breakdown of protective polysaccharide-protein colloids might occur

Conclusion: The pre-fermentation enzyme maceration promotes pigment polymerization!

Management of Malolactic Fermentation with Regard to Flavor Modification - S. Krieger

- treatments: comparison of simultaneous yeast and bacteria inoculation with post-fermentation inoculation with 3 different commercial bacteria cultures
- the time of inoculation had no effect on chemical composition and flavor
- the time of inoculation had no effect on final bacteria level
- **the time until completion of MLF was strongly dependent on inculation level**
- the simultaneous inoculation with yeast didn't result in yeast inhibition
- the diacetyl content was inversely related to the inoculation level. Leaving the wine 1 month on the less with occasional stirring ("bâtonnage") reduced the diacetyl content to below the sensory threshold

CAUTION: The simultaneous yeast/bacteria inoculation may lead to increased levels of volatile acidity (VA) and/or sluggish/stuck fermentations!

A second presentation by M. Nygaard ("Timing of Malolactic Fermentation in the Vinification Process") confirmed these results. She also warned that the presence of bacteria in high sugar solutions can lead to higher acetic acid levels (volatile acidity) and/or sluggish or stuck fermentations. She concluded that the timing of inoculation - including a pre-fermentation partial MLF - is basically a stylistic tool to influence a wine.

Other MLF experts in the audience warned that the alcoholic and the malolactic fermentation are 2 separate biological processes and should be kept separated. The potential small time saving with simultaneous inoculation is probably not worth the additional risk.

Untypical Aging (UTA) in White Wines - Origin and Prevention - W. Sponholz

- it was first observed in Germany in 1988 and has since been confirmed in France, Italy, Switzerland, South Africa, Oregon and New York State
- early descriptors used were "naphtalene", "dirty wet towel" and "Mediterranean flavor"
- the premature aging of wines is at least partially due to limited nitrogen **uptake** during vine growth even when sufficient nitrogen was present (water stress!)
- supplementing the must with nitrogen didn't resolve the problem

Micro-Oxygenation - Th. Lemaire

- purpose: to deliver the exact amount of oxygen to the wine needed at all stages of its maturation
- aims and benefits:
  - oxygenation of yeast during the alcoholic fermentation to prevent sluggish or stuck fermentations
  - softer, richer tannins; rounder and more supple mouth feel
  - color stability: early polymerization results in more intense, oxidation-resistant pigmentation
  - aroma integration: enhanced fruit forwardness and integration of oak aromas; reduction of undesirable vegetal characters
  - reduction of sulfides and other reductive aromas
  - lees maturation: increased body, freshness and acid perception
  - longevity potential: treatment does not age wine prematurely. It is **not** aimed at promoting the early release of new wines
- parameter to be monitored:
  - taste
  - dissolved oxygen
  - turbidity
  - spectrophotometry (at least visible light)

CAUTION: Micro-oxygenation can sometimes give the opposite result to the winemakers expectation. Its installation and development needs focus and a long-term view

Cool Climate Pinot Gris - Summary of Workshop and Vineyard/Winery Observations

- Vineyard: low yields (2-3 tons/acre)
  Our experience at OARDC doesn't indicate that higher yields in the range of 5-6 tons/acre hurt fruit quality. So far I was very happy with our fruit at that tonnage. The flavors

indicated to me that full physiological ripeness was reached at harvest with Brix levels between 22-24°.

- Winery: "classical" stylistic variation: stainless steel versus barrel fermentation, optional sur lie aging with and without lees stirring and malolactic fermentation.
  The wines tasted reminded me of the ongoing discussion among producers what Pinot Gris should be, if there is a common identity helping the consumer to identify it. As there was and currently is no agreement worldwide there was none at the workshop which is not surprising considering the diversity of styles worldwide. The styles covered about the same range a Chardonnay would. In general the quality was very disappointing. The wines were in most cases light, simple, even neutral and lacked varietal character.
- Food & Wine:
  A common theme was that the wines were produced to accompany but not overwhelm food. This seemed to me more like an excuse than a valuable argument to explain shortcomings
- Research:
  No research was presented. From various discussions I concluded that our group at OARDC is doing everything necessary to provide the parameters for Ohio growers and winemakers to produce the best Pinot Gris for Ohio.
- **Ohio: On the right track**
  The Pinot Gris produced in Ohio (including our research wines) compares favorably with the wines tasted

General Observations from Vineyard and Winery Visitations

- the production of a top quality wine starts with cultivar-specific **site selection!**
- wineries pay enormous attention to the vineyard. The key for success is a close cooperation between the vineyard manager and the winemaker
- the Scott Henry training system and variations of it are used with almost all varieties at least partially
- physiological ripeness is the key to superior fruit and wine quality. Winemakers are aware of the fact that sugar levels do not necessarily indicate physiological ripeness, which is best described as ripeness of the flavor components, tannins and overall balance. Physiological ripeness varies from region to region. It may be achieved at 18-19° Brix for Finger Lakes Riesling, whereas Clare Valley Riesling has to be at least 23° Brix.
- **Caution:** Several wines had wonderful aromas indicating flavor ripeness, but the flavors were not balanced with the alcohol, and the wines tasted "hot".
- special attention is paid to variety- and vintage specific vinification
- the control of phenolics in the vineyard and the winery is essential for superior wines. The evaluation of the ripeness of the phenolics **mandates** frequent tasting of the fruit, the skins, seeds and stems (!) in the vineyard
- whole cluster pressing is common depending on variety and vintage
- the best control of the quality and style of a wine after fermentation is achieved by separating the press fractions of both, red **and** white wines

– a variety of different equipment - some dating back to the late 1800's - was used successfully to produce high quality wines. The key is to know your own equipment, maximize the advantages and minimize the disadvantages

Global climate changes occurring now and predicted for the future dictate constant observation and adaption. Current problems are not the same as those the future will bring. A pre-conference colloquium on climate changes addressed these issues.

<u>Global Climate Change</u> - S. Barlow

- current problems are not the same as future ones due to global climate changes
  - build-up of CO_2: 600ppm/50 yrs
  - ozone depletion will cause increase of UV-2 radiation
  - temperature increase: 1°C/50 yrs
  - greater extremes
- meaning for viticulture
  - increase of 150 day degrees
  - 10-14 days advanced maturity
  - improved water use efficiency
  - improved Pn efficiency
  - more outstanding vintages
  - ***different cultivars will have to be grown!***

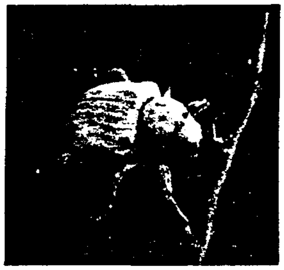
<u>Impact of UV-B-Radiation - a Case Study</u> - M. Keller

- UV-B is 5% global solar radiation
- UV-B is absorbed by ozone
  - ozone layer is thin (10ppm)
  - decrease 1990-1999: 15%
  - UV-B increase 1990-1999: 12%
- UV-B: 280 - 320 nm
  - contains high-energy photochemicals
  - damages DNA
- effect on plants (3.5 - 4.5 w/m^2)
  - decreases of leaf area
  - decrease net photosynthesis (Pn)
  - decreases water use efficiency
  - produces more lateral shoots
  - ***inhibits powdery mildew!***

Even though Australia's emergence was based on the discovery of gold in 1851 it is - at least in the grape and wine industry's (optimistic) view not the only road to riches. The symposium concluded with telling quote from Hubert de Castella:

"To get GOLD, you need sink only about 18 inches and plant vines"

Hubert de Castella, 1850's



CONTROL STRATEGIES FOR SOIL INSECTS IN THE VINEYARD

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Grape rootworm, *Fidia viticida* Walsh: This leaf beetle occurs from New England to North Dakota and south to Texas. Hosts of this pest include native and cultivated grapes (*Vitis* spp.), Virginia creeper, *Parthenocissus quinquefolia,* and redbud, *Cercis canadensis.* The larval (grub) stage of the grape rootworm feeds on roots and can cause serious damage to cultivated grape vines. Adult beetles emerge from late May through early to mid-July. They are grayish-brown in color and approximately 3/8 inch in length. After emerging, adults begin feeding on plant foliage and mating occurs. Mated females begin laying eggs 3 to 7 days after copulation. Eggs are deposited in clusters under the bark of canes and stems. They are about 1/20 of an inch long and white to creamy-yellow in coloration. Hatching occurs in 10 – 15 days at which time the newly emerged larvae move from the hatching site to the soil where they begin feeding on the grape roots. Larvae will feed on the roots throughout the growing season. Some larvae will complete their development in one season and emerge as adults the following season while others may take a second season to complete development.

Control of the grape rootworm is best accomplished through insecticide treatments directed at the adult beetles. Timing of spray applications is important. Telltale symptoms indicating the presence of the rootworm are the chain-like feeding trails on the leaves in late June. Treatments should be applied when the first beetles are observed in the vineyard, and scouting for adults should be conducted weekly there after. If additional beetles are detected a second application may be required. If treated 2 succeeding years the rootworm will not likely strike again for many years.

Grape colaspis, *Colaspis brunnea* (Fabricius): A small beetle about 1/5 of an inch long and pale yellowish in color. It is present in the eastern and central states. Adults devour the leaves of grape, strawberry, and many legumes. The larval stage of this insect resides in the soil feeding on the roots of grape, strawberry, cloves, soybeans, rice, and grasses. Adults emerge in June and are active until fall. Control of this pest may be achieved by treating the soil with chemicals recommended for white grubs. Adults may also be targeted with pesticides that are labeled for foliar application.

GRAPE COLASPIS (Eumolpinae)

Grape root borer (GRB), *Vitacea polistiformis* (Harris): This clearwing moth is a major pest of grapes in the eastern United States. It mimics the appearance of a dark brown wasp with narrow yellow bands around the abdomen, and is about one inch in length. The roots of both wild and cultivated grapes are subject to attack by the larval stage of this insect. In southern Ohio, adult moths

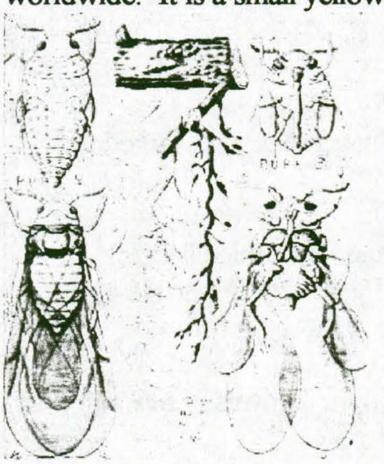
emerge from the soil in late June, July and August. Eggs are laid on grape leaves and weeds within the grape trellis. In late July and August eggs hatch and larvae travel to the soil where they feed on the vine roots for 22 months. Damage caused by the GRB has resulted in enormous losses to the commercial grape industry. It has been blamed for the destruction of entire vineyards in Florida, South Carolina and Missouri.

Control of this pest is difficult due to its cryptic life style. Once the larvae have become established within the root system, control is almost impossible. Current control methods are targeted at preventing newly hatched larvae from reaching the root system. Methods include the mounding of soil around the trunk and surrounding area or use of polyethylene plastic under the trellis. At present, the most acceptable method of control is an application of insecticide applied to the soil surface immediately under the trellis at the beginning of the adult activity period. This method excludes newly hatched larvae from reaching the root system. The only effective pesticide currently labeled for this usage is chlorpyrifos (Lorsban), which is highly toxic and presents considerable human and environmental risk. This broad-spectrum pesticide is currently on the Food Quality Protection Acts list of chemicals that may be ban from usage. The federal government has already band the use of this product on federal property.

The use of alternative control methods like mass trapping of the male population and pheromone confusion technique utilizing the Shin-Etsu rope pheromone ties are at best marginally effective. These methods are best suited for small isolated vineyards. Vineyards with large areas of undeveloped and uncultivated land surrounding them usually have too much external root borer pressure for these techniques to be effective.

Currently at Ohio State University, we are evaluating the use of entomopathogenic nematodes to control the grape root borer. Preliminary laboratory bioassays are encouraging. New strain/species of nematodes have shown promise and field trials may begin as early as next year.

Grape phylloxera, *Daktulosphaira vitifoliae* (Fitch): Grape phylloxera is a destructive grape pest worldwide. It is a small yellowish colored aphid-like insect. Its life cycle involves survival on the roots throughout the year and on the leaves, of some cultivars, during the growing season. In the case of root infestations of phylloxera, the insects over-winter as immature forms on the roots. In the spring, they mature and produce eggs that hatch into nymphs. The nymphs then start new galls on the roots. A vine will die if its roots become heavily infested with phylloxera. However, this usually only occurs in warm climates where root colonies are not retarded by cold weather. Under such conditions, susceptible cultivars are grafted onto resistant rootstocks to prevent damage by the root form. This is currently the only means of controlling the root form of this pest. The foliar form may be controlled with properly timed applications of Endosulfan (Thiodan). However, this product is currently the only highly effective foliar treatment we have and it may eventually succumb to the Food Quality Protection Act.



Researchers are currently evaluating the use of entomopathogenic nematodes for controlling this pest. Preliminary work has shown the female form of phylloxera to be susceptible to infection by nematodes. Additional work is needed to determine what strains/species of nematodes are best suited for further study and development into possible control strategies for this pest.

Japanese beetle, *Popilla japonica* (Newman): This metallic green and coppery colored beetle is present throughout most of the eastern United States and may be particularly abundant where large areas of turf are present. Adult beetles feed on the foliage and fruits of hundreds of plants of which grape is a favorite. Adult beetles begin emerging in late June or early July and may be present until frost. Egg laying takes place throughout the summer. Eggs are laid in the turf where they hatch and the young larvae begin feeding on the grass roots. They remain in the soil until emerging as new adults the following year. Vineyards with large areas of turf in or adjacent to the planting may experience greater numbers of this pest. The adults are easily killed with foliar insecticides. However, more than one application may be necessary since the beetles are present for an extended period in the summer. Insecticide treatments directed toward killing the grubs in the soil are usually applied in the spring or fall and may be the best choice to control this pest. Alternative methods of control utilizing bacterial diseases or nematodes are available and may provide adequate results.

Rose chafer, *Macrodactylus subspinosis* (Fabricius): The adult rose chafer is a straw colored, gangly legged beetle that attacks the blossoms and foliage of a wide range of plants including grape. The beetle occurs generally east of the Rocky Mountains in areas with light sandy soils. The larvae feed in the soil on roots of various grasses and weeds emerging as new adults in late May or early June. Adults are active feeding, mating, and laying eggs until early July. One generation occurs each year.

Control measures are usually targeted at the adults. Insecticide treatments are applied to foliage when the first adults are observed in the field. In heavily infested areas, a second application may be necessary. Grub control is not usually practiced, but the same insecticides recommended for white grubs and Japanese beetle grubs are effective. An attractant for the adult rose chafer is available and has shown promise in mass trapping efforts.

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Cornell University: http://aruba.nysaes.cornell.edu/ipmnet/ny/fruits/grapes/g...

Penn State University: http://fpath.cas.psu.edu/extpub.html

General Search for Grape Pests: http://ink.yahoo.com/bin/query?p=grape+pests&hc=0&hs=0
(This last site will give you thousands of grape sites)