

Student questions: Chris Loxton's colloquium on "Science and the Art of Winemaking"

1/11/17

Question 1: What are the most common mistakes that rockies make?

Rookies sometimes make the mistake of making too much wine, or making a style of wine that they like, but which not enough consumers like, and in both cases, they can't sell enough money to keep up cash flow and then get into financial difficulty. I sometimes also see inconsistency in style. Without the proper training, they make a few good wines, but then in a bad year (with rain, for example), make some mistakes and the wine quality is less, and then they can't sell it fast enough and again this leads to cash flow problems.

Question 2: I would have never guessed that the surrounding temperature and allitude has a lot to deal with what kind of wine you will be making. What areas in Arizona would be ideal for wine making?

An ideal climate would have not so much rain in late summer near harvest, very little frost danger in Spring, and enough water to be able to irrigate when necessary and not be too hot in summer (the degree day requirements for grapes mean that you want just enough heat for ripening, but not too much). All this means that there are areas in the foothills south of Tucson and other areas in Southern AZ that are suitable, and some near 3000 foot elevation near Sedona, for example, that should be suitable.

Question 1: What are the characteristics of a high quality grape (i.e. What makes a grape "high quality")?

A high quality grape at harvest would have the following: Good flavor, have low astingency seeds and grape skins, have a pH in the range 3.3-3.6 (with some latitude), a total acid level that might be 5-8 g/L, good color concentration in skins when mature, and be free of mold and rot and bird/insect damage. We would like to get these things with sugar concentrations that are in the range 22%-26%, depending on winery style. Some things we can fix, by adding acid, for example, but some conditions, such as high pH and high acid are difficult to deal with in terms of microbial stability. There are sometimes financial penalties on growers when grapes are delivered with high temperature, mold and rot issues, and material other than grapes in the loads. There are sometimes bonus payments when certain markers for "quality" are met, sometimes based on color measurements, or good color and chemistry. In other cases there may be bonus payments based on the winemaker's percieved quality of the final wine.

Question 2: What conditions would you recommend to make a fruity (low alcohol) red wine (soil type/conditions, growing conditions, grape type, fermentation(s), storage, etc.)?

For the lower alcohol we need to pick grapes at lower sugar, so would want to get true grape ripeness in terms of flavor, color and acid/tannin balance at these lower sugars. This might happen in cooler climates or by using grape varieties that don't have a lot of tannins, so that the early picking does not give an astringent wine. Additionally we would use grapes such as Gamay, Grenache or Zinfandel that are known to make fruity and lower astringency wines. To make such a style I would probably try to keep as much fruit in the wine as possible, thus perhaps using cultured yeast (usually then moer fruity), keep lower fermentation temperature so as not to volatilize easily lost compounds, and then not mask the fruit with oak flavors, thus using previously used barrels or possibly even aging the wine in tank. Excellent examples would be the Beaujolias wines of France, and some of the Grenache based wines of the Rhone Valley that are aged in big tanks and not barrels. You could also do this the way I make a Rose, but instead of pressing the red grapes as soon as harvested, you could crush the cold grapes, leave for 2-3 days to pick up color prior to fermentation, and then ferment this dark juice in tank and then age the wine in tank for a few months before bottling, thereby minimizing tannins, and retaining fruity characters.

Question 1: What qualities of a grape determine what kind of wine they will make beyond fermenting the grape juice with the purple skins?

The grape variety will have a big impact on the kind of wine. Some make lighter wines (Pinot noir) as they have less color and tannin in the skins. Cabernet sauvignon has lots of color and tannin, and just makes a bigger style wine. Then we have early picking or late picking, and the changes in flavor these bring. Also, the winemaker can arrest the fermentation to make a sweeter style wine, possibly even very sweet to make a dessert-style wine. So just for the Zinfandel grape, we have early picked, very little color extraction, then cold ferment in tank and stopping fermentation with 1-2 percent sugar and we have "White Zinfandel". The same grapes picked a few weeks later and fermented in tanks with skins for several weeks until there is no residual sugar and then aged in barrels and we have a Zinfandel table wine. Pick these same grapes a few weeks later still when the grapes start turning into raisins and when we start making red wine we find that the fermentation stops when the alcohol reaches 15% or so even though there is still unfermented sugars of 3-6% as the yeast has been killed by the higher alcohol and residual sugar and we have a "late-harvest Zinfandel" dessert wine.

Question 2: Do you use the same kind of barrel for all of your different kinds of wine or does the barrel type differ from wine to wine?

I use barrels from 5 different barrel makers, much like you would use different spices in cooking. I find that they each have differing qualities that they bring. Some barrels seem to work better for certain vineyards or style, and sometimes I use one type of barrel for certain characters (sweet notes, but not toasty), while another barrel might give more tannin, while another might be used to bring a toasty note. By combing the wine from these different barrels before bottling I am able to construct the flavor profile that I want. It probably is impossible to get all the notes I want from just 1 barrel and the research on wood toasting and choice show us that different temperature in toasting and different wood qualities are responsible. I personally want a wine to have some complexity and this is one of the tools to get it. (we don't want to paint with just one color!)

Question 1: By reusing the same barrels do you create a “buffer” in a way to prevent too much variation in taste between harvests?

Yes. If I change to different barrel makers that have different flavor profiles then this can effect my wines. Sometimes I do, after several years I found that the barrels from one particular maker added too much of a smokey note and I stopped buying them. In the last year I have changed one particular type of barrel to a much lower wood temperature toasting as for one particular vineyard it again added a more toasty note than I wanted. This sometimes happens even though I've tasted the same barrel in another winemaker's program and really liked it, but for my fruit it just didn't.

Question 2: Would you say that the genetics of the grape or the climate and environmental conditions define how well the wine will taste?

All are important. The taste of the wine reflects each of these, and that is why I cannot duplicate the taste of some other producer's wine. On a positive note, it means that winemakers are happy to share information, as what works for one may not work for another as the fruit is different. Each winemaker has to find out what works for their own fruit and their own style.

The genetics of the vine is one factor to determine the overall style (Pinot is generally lighter while a cabernet is usually a bigger bodied wine). Winemer cjoices for how ripe and how much oak flavor also determine style. “Terroir” (or the environment with its climate, soil and farming) determine the actual flavor of the wine. I make 3 Zinfandel wines, one is often peppery and tannic, another has raspberry flavors and another dark cherry flavors and yet I make them all identically and they are all grown within 10 miles of each other.

Question 1: How much would a change in soil composition and chemistry determine the success of a vineyard for a certain batch of wine?

It is very important to check the soil chemistry before planting. Some soils (Serpentine soils) are very unsuited to grape vines and they just don't thrive. Low or high pH soils can be difficult for nutrients to become available and the vines don't thrive. It has become a normal practice to try to alter soil pH by using lime or oyster shells, and nutrient deficiencies are often remedied by sprays on the leaves or with fertilizer delivered through the irrigation system. Water drainage is particularly important and it is useful to put in sub-surface drains when standing water is of concern as this leads to root damage and too much vine growth.

Question 2: Since the temperature of the air helps determine the feel of the wine, would a hypothetical vineyard in a near desert-like environment have a more distinct flavor of wine compared to those in the conventional areas where vineyards are commonplace?

While the desert conditions would give us conditions that minimize molds and mildew which are a plus, and would limit growth which is a plus, it would be a minus if the vine had too much stress and started to drop leaves or had short branches with not enough leavers to ripen the crop. In easter Washington, for example, the desert conditions can lead to particularly good grape and wine quality where we have supplemental water that can be used to keep the vines healthy.

Question 1: As was shown during the presentation's aerial images, soil composition can vary greatly even within small areas. For small vineyards such as the one in the presentation (~10 acres), do farmers ever attempt to homogenize the soil composition at the top layer by employing a backhoe and tilling equipment for soil mixing?

This is usually done, even in bigger vineyards, and helps but it just isn't feasible to move huge amounts of soil and there are county regulations regarding this as well as it can lead to soil erosion. Our vineyard was levelled to facilitate farming and ripped to 5 feet deep to break up a concrete-like hard pan layer that had formed which would have stopped any root penetration. This is also the time to amend soils if the pH is not right and in our acidic soils (pH in 5.5 range), lime was used for the amendment.

Question 2: How big of an impact has genetic engineering had on the vineyard industry? Are designer grape varieties being employed specifically for wines?

Genetic engineering has not had an impact on the wine industry. I think this is primarily due to marketing reasons and it would be a PR nightmare if the press singled out anyone using GMO plants or organisms. This might be a pity really as bacteria have been developed that will not produce the buttery flavor of malol-lactic conversion and there are yeast that do not make hydrogen sulfide during fermentation. Instead the industry has taken the approach of isolating natural yeast or bacteria with favorable characteristics. Similarly, there are efforts to insert genes that would bring resistance to certain diseases and viruses in vines. Instead, the industry has done much slower grape breeding by crossing grape varieties in the lab to breed new varieties with the traits we want (cold hardiness for MN wineries, or disease resistance). One issue is that it is hard to generate marketing enthusiasm for new varieties as the consumer seems to like the few grape varieties that they are familiar with (and that is a pity!).

During the presentation it was said that in extreme cases barrels can be reused over 100 years. Are there any necessary sanitation steps needed to keep reusing the barrels?

While those 100 year old barrels were black from use, the wine was a high alcohol dessert wine which limits growth of unwanted organisms. In my own case, each time the barrel is emptied it is scrubbed with a peroxide solution on the outside, then the inside washed with warm water, then pressure washed to remove any tartrate crystals and sediment adhering to the inside walls, then rinsed with ozonated water to kill organisms, then stored empty with a sulfite solution to inhibit mold growth until it is used again. Cleanliness is important!

Question 1: Why doesn't California allow for the addition of sugar to their wines, is this a statewide regulation or a code of conduct among Californian winemakers? Does this have operational drawbacks compared to areas that do allow the addition of sugar?

The is a state law. In California this is really not an issue as we have enough sunshine and not much rain until harvest so adding sugar to increase the potential alcohol is just not necessary. In cooler years, such as 2011, better growers anticipated trouble ripening grapes and so they dropped some fruit off the vine so that the remaining smaller crop was able to ripen.

Question 2: If some of the science shows that barrels don't necessarily predictably enhance the flavor of a vintage, why do some still purchase the very expensive barrels?

In part this is marketing as when people come in on tours they see the lovely barrels. In addition, we have become accustomed to the taste of new oak in more expensive wines and so some people think that if a little bit of oak is good, then a lot must be better! Even when the particular flavors are not so predictable, what is predictable is that the new barrels will have lots of impact, and they should give some toasted wood flavors, so it goes some way towards what the consumers expect.

Question 1: How does the age of oak barrels affect the final taste of the wine?

Much like a tea bag, the barrel gives lots of flavor the first time and then less each successive time until it is basically neutral by the 5th use. When I don't want oak flavor the wine goes into previously used barrels; when I want some oak flavor it goes into a mix of some new with the remainedr older (for Pinot noir I use 1/3 new, 1/3 1 year's use and 1/3 2 years prior use, then blend all together before bottling.)

Question 2: How big is the difference in wine taste when natural/indigenous yeasts are used compared to commercial yeasts?

I have tasted experiments in France and here in the US on this and while these are far from perfect (were the juice samples really the same, was the fermentation identical in all respects except yeast?), what I found was less fruitiness in the uninoculated wines, but more complexity and more richness. It's a trade-off I'm willing to make to get complexity. Think of 1 note, compared to many notes in music. All the different yeast types seem to be adding something.

Question 1: When the wine is stored in the oak barrels, can the barrels be rotated occasionally or must the barrels remain stationary?

Why would you want to rotate the barrels? I keep mine on metal racks and they just stay in place until I bring the wine out of barrel, sometimes staying there for a year or more. I don't want to stir up the sediment that has fallen to the bottom of the wine and thus the wine will be clearer when I bring it out of barrel.

However, this is a very interesting question because during the first few months in barrel I insert a stainless stirrer into the barrel and re-suspend the sediments to make sure that the yeast complete fermentation and the bacteria finish the malo-lactic fermentation. Re-suspending the yeast cells also helps scavenge dissolved oxygen in the wine and spreads mannoproteins that are released as the cell walls decompose and this adds a richness and creaminess to the wine. I have seen barrels in France that are on a pedestal with rollers wheels so that instead of opening the barrel and possibly introducing oxygen, the barrel is simply rolled, thereby suspending the lighter sediments without doing the stirring.

Question 2: Is there any advantage to manually crushing the grapes by hand for juice, rather than using a machine to do the crushing ?

I do use a machine to remove grapes from the stems and to crush them lightly if I desire to do this. Doing so by hand would not be feasible as it takes too long. When the grapes are in the grape tank for fermentation, that is when I mix the grape skins with the juice by hand. I like to do this as I can see how actively the juice is fermenting, can immediately tell if there are any off aromas that would indicate that there is a problem (specifically H₂S from stressed yeast, or ethyl acetate from bacterial action) as well as feeling how warm the fermentation is getting. There are robotic systems that do what I do, but it keeps me 1 step away from the process and I might lose some of that direct feedback.

Question 1: Do you sell or distribute to AZ?

I presently do not have distribution in AZ to sell to stores and restaurants and will be obtaining the licenses so that I can ship directly to residents for their private use.

Question 2: What is the fastest way to get involved in the wine making process/business? What programs are out there to learn in order to work at a vineyard on a professional level?

It is a very common thing for wineries to take on interns for the harvest season. Such jobs are advertised and I did 4 of these in Australia and CA before getting a job. It gave me very valuable experience in a wide range of winemaking styles and issues. There are many winemakers that have used these jobs as a springboard for professional jobs in the industry.

Question 1: You mentioned that after the second fermentation process, the bacterial process, that sulfite is added. I know there are sulfite free wines. Would removing this affect the flavor of your wine?

There are not many sulfite free wines, but yes there are some out there. Sulfites are added for 2 reasons, as an antimicrobial, and as an anti-oxidant. Too often I find that sulfite free wines either have acetic acid and ethyl acetate (its finger nail polish remover) that probably comes from bacteria in juice during fermentation, or oxidized flavors due to the lack of sulfite addition prior to bottling. Oxidized wines also have a brown color. This is particularly evident in white wines, as they lack the tannins of red wines and tannins offer some oxidation protection. I have had one good sulfite free wine from a winery here in Glen Ellen, but the wines are not consistent.

Question 2: You discussed the type of oak barrels you prefer, which use furfuryl alcohol extraction, containing specific flavor variations depending on the toasting of the oak. Because the components of the oak flavors change each year, how do you choose which barrel type you will use, when you have so many variables with your vineyards producing different flavors as well?

I have done barrel trials over the years and have come up with matches of barrels and wines that seem to work for me. I have also been fortunate to taste some of the trials done with other wineries and these help guide my process. It's a slow process though, as you only get one chance per year at harvest and each harvest is different. This means that you don't want to make changes too readily, nor based on just one barrel due to the variations we have talked about. I have one barrel maker that I've worked with for 20 years, but others have been part of my program for less and it's an evolutionary process.

Question 1: Are any other type of woods, other than oak, used for wine barrels and if so how does it effect the flavors?

Acacia is used for some barrels and it seems to have less impact and less vanilla characters (although I haven't used them). Some tanks in CA have been made with Redwood, but they are large and usually some effort is made to make sure they have little impact on flavor. Barrels and tanks are mostly White oak, either from Europe or from the US. (It is possible to tell which was used in wines as there are Cis lactones in European oak and trans lactones in US).

Question 2: What actions are taken when plants in the vineyards are affected by bugs or disease?
I don't use pesticides but are not organic due to one spray of roundup, but wouldn't get certification even without roundup, just in case we had a problem that required extreme measures. We saw this recently with the accidental introduction with European grape vine moth. There was mandatory spraying if the state found these bugs within a certain distance of the vineyard and CA was successful in its eradication of this bug. This was unusual, but it has a specific host (grapevines). There is another pest, the sharpshooter, and it feeds on plants and introduces Pierce's disease that kills vines. The best thing is to eradicate hosts (such as blackberries) and to remove infected plots so that the disease cannot spread. I had to remove 1 acre of vines in 2013 due to a virus, there were so many plants to pull it was not effective to remove and replace individuals.

Question 1: Mr. Loxton was talking about a process using a filter that would take out smaller molecules like alcohol and others, my question is why would he need to take alcohol out of a wine and for what purpose?

The drought and hot weather has meant that on several occasions I had had more alcohol in my wine than I wanted. To my taste, I found the wine hot with high alcohol and the wine was not balanced. I found that removing about ½ percent of the alcohol made the wine much more balanced, improved the fruitiness and seemed to make the wine less astringent. I would have preferred to pick earlier but conditions and flavors of grapes were not conducive for this.

Question 2: Mr. Loxton was setting the scene in his lecture, telling us about his 4 different types of soil environments such as water content, minerals make up, soil depth, slope, elevation, surrounding vegetation, etc., my question is how did he know that those differences would lead to difference types of grape with different characteristics? I don't remember what his degree and job prior to taking over the vine yards was.

My family has grown grapes since the 1890's and I've found that grapes are sometimes lovely to eat on one part of a ranch, but not ready on another part, even when it is the same grape variety. So I always look for changes in slope or soil or from different irrigation blocks as potential sources for differences and then sample separately to see if this is true. Visual clues might be soil color, weeds, presence of rocks etc. Even when I don't see differences in some years, they might show up in others. In wet years like 2010 and 2011, I saw big differences in the top of the hill versus the water logged soils at the bottom of the hill and picked these separately. The visual clues were the size of berries and the shoot length that were changing as I walked up the rows (nothing beats getting out and walking in the vineyard and looking at the plants!). I ended up keeping the two wines separate, bottling the best from the upper section as the more expensive wine and blending the lower section into a lesser wine. Keeping everything separate for 6 months allows me to taste the wine and then make decisions to either keep it separate or put it together. Putting everything together as grapes won't allow me to un-blend later if I don't like the result (and green bananas and black ones don't average out to taste like 2 yellow ones).

Question 1: What effect has climate change, and the regional drought in California, had on the crop yields and wine industry as a whole?

I can't really unravel climate change from the big variation that we get from year to year. The drought has meant that yields have been very low in 2014 and 2015 especially, as the vines have become more stressed. We have also seen more virus and nutrient deficiencies being expressed by the vines. This causes huge problems when the bigger wineries need consistent productions because of their marketing plans. In addition, use of water by agriculture has become a much better issue politically.

Question 2: What is the most difficult part of trying to control the numerous variables in order to keep the "style" a popular brand recognizable, or do these variations make it impossible to replicate a previous vintage?

The biggest thing to remember when all is changing is to focus on just what is your goal. Consumers will allow wines to have some year to year variations, but not big changes in style.

Question 1: Since the extraction of the wine was done before alcohol was made, and since no yeast was added (alcohol is a byproduct of yeast), will the alcohol content of this wine versus another wine be the same? ie will I get as drunk on his wine as I would with another brand?

The extraction done prior to fermentation is of color and flavor, without much tannin extraction as this is mostly done later in fermentation by the alcohol. Following this extraction, the "native yeasts" do their job of turning sugars into alcohol, and so the alcohol levels are not so different than with other fermentations. It should be a little lower as some of the sugars are used to make yeast cell mass as the yeasts multiply, and my use of "open" containers for fermentation leads to some alcohol loss as it evaporates compared to closed systems. I might expect ½ to ¾% less alcohol for the 2 things combined. Interestingly, it would be expected to be different if I had a more humid environment in my fermentation area as I would lose alcohol, but not so much water, from the fermentation tank due to the partial pressures. I have not done such a study as I don't have the ability to control humidity but it might be interesting. Other producers wines would have higher or lower alcohols more based on picking decisions as regards sugar, than in my methods.

Question 2: In the area on his land where the vines are growing like crazy, so crazy that he wanted to keep the weeds growing with the vines to keep their growth monitored. Will the nutrients eventually be pulled out of the ground, if so when? And how would he combat that?

The weeds compete during the growing season, but with no water in Summer we find that they do brown off sometime in August or September and then decompose back into the soil to all start again the next cycle, so I might expect that it will take some time to deplete the soil. On the other hand, we are pulling off 4 tons of fruit from an acre of vines and this does remove potassium and phosphorus, as well as micronutrients. By measuring the nutrient levels in the leaves several times a year I have occasionally made potassium and phosphate additions to the vines and have also added composted grape skins back into the vineyard to supplement as needed.

Question 1: Is it true that popular modern wines today are more and more alcoholic?

Yes, and I would say that this is unfortunate. I think it is related to marketing as later picking (hence higher sugars and thus more alcohol) produce wines that are less acidic, less astringent and have a sweetness that comes from ethanol. All these things make a wine easier to consume without having food. For me, these same factors make the wine often less attractive with food, and I suppose I have a Eurocentric notion of wine with food. Certain critics like the softer style and they get higher ratings, and then sell faster and for higher prices, so its hard to say that they are wrong. It comes back to each wineries sense of style (or maybe its profitability?)

Question 2: I have heard that smokey wines used to be a huge fad, and are now a little passe. Smokey wines are achieved through taste added by smokey barrels, and smokey barrels are simply toasted for longer. How smokey do you buy your barrels?

This is true as well. For Pinot noir, many producers used a barrel maker known for these heavy toasting and some even had the ends of the barrels toasted for more toasty notes and some even used “Heavy Toast” barrels. These are used much less these days and I have not used barrels with the “heads” toasted in 15 years, and have significantly backed off on even medium toasted barrels for my program in the last 5 years, striving for more freshness and more red fruit notes on my wines. Innovatibe barrel producers who can monitor the temperature of their toasting program closely are now making this possible with good reproducibility. As toasting decreases ellagitannin content, this suggests that wood selection and aging prior to barrel making is going to be very important so we don’t have green wood characters. Since becoming available in 2013 I have been using barrels toasted to the lower temps (160C, or 170C with gradual ramping up). For other producers, each has their own concept of toasting, but I have transitioned to more “Medium” toasting rather than “Medium+).

How is a blended wine achieved, such as the Pioneer Cuvee that is sold on the Loxton website?

Blending is a little magical as like in cooking, 1+1 does not make 2. Normally I look at components and get a feel for what they might bring, and also for what they lack. Then you start with a matrix and start doing the trials. My preference is for 6-10 wines, all done without knowing what they are, all done in the morning in isolation, and no sipping, just spitting! I don’t have another tester. I need to rank from favorite to least favorite, then I find out what they are. The next day I might refine the search based on the first day and then repeat as needed. Duplicate to make sure you are consistent. When I’m confident I make the blend in tank then put the wine back to barrel and let it stay for at least a few months. Then I fine tune with 1-5% changes. Easy with 2 components, but more difficult as the number of components increase. This is very much an art, as there will be a variety of answers if a panel were to do the same thing. (One can’t paint a picture with a panel!) It’s an educated guess as one has to project forward until the wine is released and then aged. This is why I like to work with the same vineyards every year as I can look back at notes and be guided to some extent by how those wines have evolved.

Question 1: How do catastrophic weather events like floods impact vineyard irrigation and grape growth?

In winter when the vines are dormant it is no problem. During the season lots of rain promotes fungal infections but can also mean that you can't get in to spray if you have soils that get waterlogged or allow the tractor to become stuck. Wet soils also promote vine growth delaying ripening and can bloat the grapes leading to less concentration. This is where soil and slope really make all the difference so that we can get this water away and get back into farming for quality.

Question 2: What kind of system do you use for irrigation? For example, do you build infrastructure like dams or channels to control natural water flow?

We use drip irrigation, delivered into the vine row and using water from a well. The drip emitters can be purchased for different flows and we irrigate only as necessary for no extreme stress on the vine. This might be twice a week, with 6-8 liters per plant, less if it is cool, more if it is hot. It is much more efficient than the methods you name.

Question 1: As stated in the lecture a wine estate can have multiple soils that produce different tasting wines and these different soils can make it frustrating keeping track and growing one set of wine. My question is could you use hydroponics to compensate for the different soils or would this be even more frustrating and costly?

A vine might produce 2 bottles of wine, so this would mean a huge hydroponic system to make anything commercially. In addition, it might be harder to get the vine out of vegetative growth and into having fruit as the sink for energy.

Question 2: Could you ferment the wine the way you ferment the beer chicha by taking the unfermented wine mash and essentially adding human saliva to it? Aside from being "gross" would this work or would the fermenting agents in saliva cause the wine to rot or change the flavor?

I have nothing.

Question 1: Seeing the complexity of wine production (soil properties, weather, techniques, etc), how global warming and climate change could affect wine quality and production and wine industry in general?

The industry is looking at this closely as it would mean a change in the grape varieties that are grown in the regions we now have, and some growth in areas that are not now being used. There are considerations as to how we might mitigate these effects, such as now direction, and even the use of misters to lower temperatures where water use is not so critical. Frost in Spring, heavy rain at harvest, and extreme heat are all very problematic for the industry.

Question 2: What have been or how could be the effects of the severe drought registered the last years in California in wine industry?

See answer above. Crop yields have been down dramatically in the 4th year of the drought. Water use for agriculture has become a hot issue politically. This has implications for frost protection which for many growers means using water as well as for irrigation of vines in Summer. As a consequence, there is renewed interest in non-water using frost prevention by using wind machines.

Question 1: I have heard that Arizona is an up and coming market for wine making. What is it about the soil, overall geology, and climate of Arizona that makes it desirable to winemakers?

Partly answered above. Dry conditions mean less mold rot and mildew pressure, dry conditions mean we can get vines into stress but we need enough water available to manage that stress. We don't want frost in Spring, so we can't get too high in the mountains.

Question 2: California is the sixth largest economy in the world. Given this fact, in combination, with the recent passing of recreational cannabis, how do you see the wine industry advancing?

Do you predict stiff competition and/or would you, personally, be open to a partnership of sorts?

These 2, now legal, drugs are quite different to my way of thinking. I see wine as part of the meal, and that is why I have the wine style that I do.

My only comment would be that a vineyard task was not done at the right time on a vineyard I buy grapes from last year because the workers were in short supply because of demand from the cannabis crop and that was concerning.

Question 1: You mentioned that adding sulfites provides a buttery flavor to the wine. Wouldn't a wine with a higher level of sulfites be more likely to cause a hangover?

Adding the sulfites did not cause the buttery taste as this came about as a by-product of the bacteria turning malic acid to lactic acid with diacetyl being the byproduct. The addition of sulfites at the end of this process kills the bacteria and inhibits the yeasts and this stops them from metabolising the diacetyl into other things that don't taste buttery. The amount we add though, should then decay with time by binding with compounds in the wine so that at bottling there is not enough to cause head-aches in all but very sensitive people.

Question 2: You mentioned that you used composted grapes to give back to the soil what the vines took out. Can you explain a little bit about the composting process you use? (For example, are these the skins from the fermented red wine grapes or the post-extraction green grapes? Or both?)

Wineries generate large quantities of skins and stems from the grapes using in winemaking (both green and red varieties, both pre and post fermentation). In some countries these were using to make alcohol from distillation but it is a valuable resource which is now being taken from wineries and then composted. After 18 months or more, this is available for use. The one I use has been organically composted after mixing with some cow manure and is turned and monitored to get high temperature to destroy seed viability. pH is amended and it comes with analysis of trace materials and I've found it to be very useful. There are county regulations about how and where this stuff is made as there can be issues with water run-off into streams.

Question 1: How long it takes to have a equal taste of wine?

Developing a sense of style and knowledge of wine is a process. Everyone has a sense of taste, but it takes time to associate various wine faults with flavors etc. and there are tasting classes for this. Then developing a sense of style takes much longer and may be a life's work? I have been in a few groups where we sample wines from a particular region or grape variety to learn about the wines and I find this most profitable if I also know about the region, its climate, its soils, its geography so that I can understand why they are. I have been doing this my whole professional life in the business and for some time prior to that.

Question 2: The minimum time for a wine to restore?

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Question 1: Has your background in physics allowed you to innovate the process of winemaking in anyway, or even contribute to your idea of a "style" of making wine?

If anything it makes me ask the question why are we doing this particular thing. In a very tradition bound industry, some people do things because that is how its always been done. Sometimes it is better to make your own mistakes than just make the mistake of your grandfathers. So I am inspired by tradition, not bound by it. A good example is my use of screwcaps for some (not all) of my wines rather than using a random piece of bark with its unknown oxygen permeation, its uncertain chemistry and its requirement that we have a tool to get it out.

Question 2: What differences did you notice from the climate in Australia where your family had a vineyard to Sonoma Valley where you grow now? How did your family experience help you in building your own brand?

Sonoma Valley has a cooler climate and more rain in winter than where my family have vineyards. This helps to get better grapes for the luxury end of the market. I would have had to go to a different area of Australia than my family to do this if I had stayed in Australia. The Australian connection has helped some, as I've been exposed to different ways of doing things and that is always useful when confronting the vagaries of nature. It can also help a business be a little different and that can help in marketing when there are 80+ wineries in the Valley and 400+ in the county.

Question 1: In the same barrel, can the taste of the wine be different?

This has been looked at from oxidation/reduction potential as we open the barrel every 2-3 weeks to replace wine that evaporates through the wodd. A small amount of air comes in at that time so that the top of the barrel is slightly different than the wine at the bottom of the barrel. It is important to remember this when getting a sample from the barrel.

Question 2: How many times a barrel is used before it is being discarded?

I buy 25-30 new barrels each year, and as I'm not expanding production very much, this means discarding the same number each year. I keep barrels for 7-8 years and they may then become planters in people's yards, or I have sent barrels to the whisky and tequila industry, or used in making things like tables etc. In the place where I saw 100 year old barrels they are regarded as containers, discarded only when they are broken and unable to be repaired.

What is the biggest concern in the wine-making industry?

Vine disease and viruses, marketing and the economy, extreme weather events and/or global warming. These seem to dominate the trade magazines.

Question 1: I know you said that different soils/mineral content and environments produced different grapes, but what was the testing method used on the soil to determine what grapes would grow best?

Soil samples were taken from various parts of the vineyard and at various depths and sent to the lab to look at water holding capacity and sand and clay content. pH, salt, K, P, and other micronutrient levels were also measured. These are compared to recommended levels for different agricultural crops and these values are readily available. In our own case we were cautioned on high clay content in one area, also that soil pH was rather low in some areas and a lime amendment was recommended and it was suggested that K and P were in the low range and that this might be an on-going concern that would require additions.

Question 2: What was most beneficial to your pursuit of winemaking, the experience from family history of winemaking, or the classes taken at the college?

Both were important, classes particularly so as it gave a more basic understanding of the reasons behind what we do. However, what I found most helpful for my winemaking was joining a professional association here in the Napa/Sonoma area where we would meet about once a month to hold meetings regarding specific topics. The winemakers would meet and decide topics for the year and then winemakers would bring in their experiments and we could hear what they were doing and taste their experiments. The industry is very interesting in this way where information is shared quite openly and at the production level it is not so competitive.

Question 1: What are tannins and what role do they play in the wine making processes?

Tannic acids are compounds found in leaves, grape skins and wood. There are probably plant defense compounds to stop bugs eating leaves. They can have a dry astringency by taste, and winemakers talk about "good" tannins and "bad" tannins. Bad are chalky, but good tannins contribute to positive taste sensations. They play an important role in preserving wine as they have anti-oxidant qualities. A winemaker must manage the tannins extracted from the grapes, seeds and wooden barrels, and manage the aging of the wine to allow some of these to polymerize and change so that the wine is ready to be consumed. When things go wrong, it becomes necessary to blend wines to get a more pleasing result, or other wineries do a more traditional "fining" where proteins derived from eggs, milk or gelatin help precipitate the tannins and modify astringency. I don't do this except for a few wines, preferring to avoid the problem rather than fixing the problem.

Question 2: What effect does water stress have on the quality of the grape?

Water stress earlier in the berry development leads to smaller berries and as the color and some of the flavor is in the skin of the grape this means that winemakers want small berries to increase skin to juice ration in the fermenting tanks. Too much water stress and the vine does not grow enough leaves to fully ripen the crop, and too much water stress late in the season can lead to leaves being dropped before ripening and this means poor quality fruit without much flavor. So this means that it is vitally important to determine plant water stress and this is being done in a number of ways with varying success. I think that aerial imaging will be very important, although I walk around the vineyard looking at leaf angles, tendrill angles and leaves turing away from the sun to get a visual clue on the plant water stress.

Question 1: Does sugar always equal higher alcohol content?

Yes, unless the winemaker stops the fermentation with some sugar left unfermented. This happens in dessert wines such as Ice Wines made in New York and Canada, and I do this when I make my late harvest Viognier and Late harvest Zinfandel wines which can have 5-10% sugar left in the wine. These are wines to Have after a meal, with fruit or chocolate respectively.

Question 2: Why did you choose Sonoma Valley for your vineyard? You mentioned that parts of Sonoma County are warmer/cooler than others. Was the intermediate temperature best for the grapes you wanted to grow?

Like much of life, an opportunity came up and I took it. I was working in Sonoma Valley so I was familiar with the area, it's a great place to live, being just 55 minutes from San Francieso and there are many other wineries in the area (a critical mass, if you will!) and this means it brings in more consumers as there are many choices. Additionally, as I purchase some grapes, it means that I don't have to go far to get grapes from warm areas, or far to get grapes from cold areas. Hence I can make whatever I really want.

Question 1: You mentioned that real cork is traditionally used for wine stoppers. How is the wine's chemistry altered if, for instance, a rubber stopper were used instead?

An ideal stopper would not alter the flavor of the contents of the bottle, would seal well and would be easy to open. Most beverages use a screw cap for this purpose. The wine industry in the US and Europe mostly stays using a piece of cork bark, tolerating the fact that some have contamination from mold growth that imparts a musty character, some let too much air in, they crumble with age, and you have to have a tool to get them out. To get around the mold issue, some have gone to plastic, but research on oxygen permeation has shown that many of these let too much air in and are best for short term storage. Another option is a glass stopper with an "o" ring, but remember the Challenger, it might be an issue for white wines if they are left in the fridge. I think a rational choice would be a screwcap, but it does have perception issues in the US, although they are used in Australia and New Zealand for up to 90% of wines. Unfortunately, perception means a lot, apparently more than Engineering. This is also true in other fields, sound and video recording, when engineering brings us choices that the consumer just doesn't want.

Question 2: You mentioned that higher sugar content in the grapes allows the yeast (I assume) to make the wine more alcoholic. Roughly how much of the sugar in the wine is consumed by the yeast?

If we are making “dry” wines to have with meals, traditionally this would be fermented down to about 1g/L residual sugar and this is about as low as is possible. Humans perceive sugar in wine (depending on acid levels) at about 5 g/L, so some wineries will aim for residual sugars of about 3-4 g/L as this seems to make the wine seem richer and smoother (think of adding sugar to bad coffee, it makes it seem better). So if we let the yeast ferment all the way to dryness with all sugar consumed, the alcohol content in the wine will be approximately (initial sugar content in % sugar) x 0.6. So at 23% sugar which is about where we pick a lot of white grapes, we get $23 \times 0.6 = 13.8\%$ alcohol.

Question 1: When grape vines are mature and setting fruit, what kind of mineral concentrations (in EC or ppm) are ideal for supplementing (already present) soil nutrients through the irrigation lines?

You might want to add trace elements to help the vine if they are below ideal requirements. First you want to look at leaf stem analysis to find out what you actually have, and make sure that you have good data, maybe not for the whole field, but for each region that you suspect might be different. There are labs that do this and then they have recommendations. K and P can be put through the drip lines for irrigation, but micronutrients often they can be added to the leaves when we spray for mildew control. I have done K and P addition by broadcasting supplements on the soil to be washed in by winter rains. The same for B in a hillside vineyard (needed for fruit set), but B can easily be toxic. I have added Zn and Mo by leaf application. There are very good crop recommendations for most of these trace elements available on the web.

Question 2: Do grape vines experience an increase in crop yield through the inoculation of the rhizosphere with mycorrhizae, similar to other food crops like pumpkins?

It seems that this is true. We are now seeing much more emphasis on soil health as part of our overall vineyard program and we are now looking at soil water profiles, vine nutrient status as measured by analysis of leaves so that we can add micronutrients, as well as sending soil samples out for soil microbes analysis.