



## **OREGON PINOT NOIR**

### *Winemaking Deconstructed*

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Oregon's geography, climate, and soil provide the basic ingredients for growing Pinot noir that reveals the nuances of the grape, the terroir, and the vintage. The opportunity to produce Pinot noir from one of the few places in the world this grape can be successfully grown brought the pioneers of our industry to Oregon. Successive generations of winemakers have followed, striving to produce great wine from this demanding and sensitive variety. It is the *raison d'être* that winemakers choose Oregon as their home.

#### **Winegrowing Choices**

There is great truth in the statement that Pinot noir must be made in the vineyard. Decisions and farming efforts made long before the grapes reach the winery will affect the specific flavor profile, intensity, level of ripeness, and the health of the fruit. From site selection, clonal selection, planting and trellising decisions through soil management, vine management, and yield, vineyard decisions affect quality and the way Pinot noir reveals its origin. These decisions alter the balance of tannin, sugar, acidity, aroma, and flavor that provide the raw material for the winemaker to craft into wine. The range of weather conditions during the growing season, and specifically just prior to harvest, also influences the way Pinot noir ripens and its resulting flavor profile.

#### **Winemaking Choices**

The challenge for every winemaker is to make the best wine. Exactly what "best" means is rooted in the philosophical perspective of each winemaker. Just as there are myriad decisions to make in winegrowing, another slate of decisions are encountered when the grapes enter the winery. Some winemakers use a wide range of techniques to reach their goals; others choose to be very hands-off. Specific philosophies determine the range of options considered, how and when to use specific techniques, and the level of intervention to choose. These decisions influence the way terroir, vintage, and grape are expressed and become the winemaker's style.

In this workshop, a panel of winemakers will discuss the range of options available throughout the winemaking process—from picking through final blending and bottling. We will discuss how these choices affect the wine and how a winemaker selects one path over another. You will see how different techniques affect a specific wine by tasting Pinot noir barrel samples. Each pair of samples illustrates the effect of two different choices at one point in the winemaking process. Winemakers achieve their philosophic goals by making specific winemaking decisions throughout the process of transforming the product of the vine into finished wine. The purpose of this seminar is to examine the role of the winemaker and understand how winemaking decisions help them achieve their goals.

**Points to Investigate:**

- How do winemakers decide when to harvest; how do they handle the fruit from harvest to fermenter; and how do these decisions affect the wine style?
- How do winemakers manage fermentation from beginning to end, and how do those decisions influence wine style?
- How do different aging and finishing decisions affect style?

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**Panelists:**

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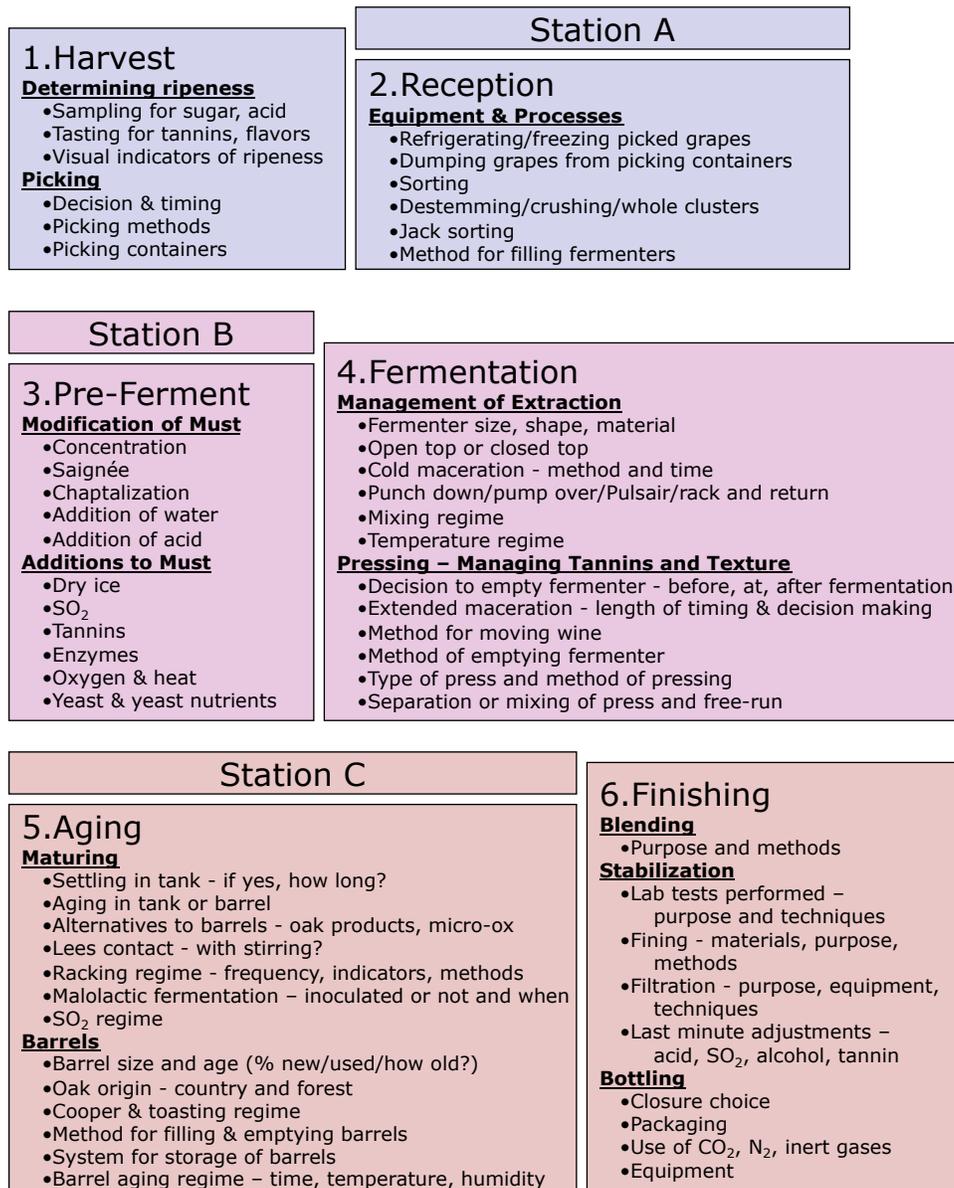
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## Stations and Stages: Table Of Contents

At three stations in the winery you will have the opportunity to taste and discuss unfinished wines that illustrate winemaker decisions at six critical stages of the winemaking process outlined below. Detailed background information about each stage can be found in the following pages. This diagram will be referred to throughout the seminar. Consider it a graphical representation of a table of contents for the more detailed materials provided in this section of the binder. On the next page, each numbered section on the diagram below is indexed to page numbers in this section of the binder. This will allow you to read as little or as much as you want about each stage, and serve as a handy training reference after Oregon Pinot Camp.

# Winemaking 101

## The decisions involved in making Pinot noir



# Oregon Pinot Noir: Winemaking Deconstructed

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## **Introduction**

At its essence, winemaking begins in the vineyard. Some vineyard factors are fixed and are decided at planting. These will not change over the life of the vine, and such decisions must be made carefully because they will affect wine quality for 60 or more years. Vineyard location, clone and rootstock selection, spacing, trellising, and row orientation will all affect the fruit grown at that site. Those choices set the basic structure of a vineyard.

Other decisions can be changed from vintage to vintage. The winemaker will have input and sometimes total control over seasonal variables in the vineyard. Pruning, crop load, cover crop, spray programs, and soil management can all be manipulated in response to seasonal conditions. Leaf pulling will affect the amount of sun the berries receive, changing the quantity and quality of tannins and their development. Crop level will affect fruit intensity and timing of ripeness. The timing of picking will affect the specific wine chemistries and flavor profile. These are just a few of the management choices controlled by the winemaker. Each of these decisions will affect the flavor spectrum, tannin development, color intensity, and wine chemistries: primarily pH, acidity, and sugar content (Brix). These choices and decisions are covered in greater depth in the vineyard chapters, *Farming for Quality* and *Soil Into Wine*.

At its most basic, winemaking is simply allowing the natural process of fermentation to occur. Juice is the liquid extract of fruit composed of water, sugars, acids, a wide variety of flavor molecules, and a category of extracts of the skin and seeds known as phenolics. Juice can be fermented with just the liquid portion, or, in the case of Pinot noir, with the juice, skins, seeds, and sometimes the stems. The mixture of liquids and solids is known as “must.” Yeasts are able to consume sugar and convert it to carbon dioxide (CO<sub>2</sub>) and ethanol, in roughly equal quantities by weight.

To produce great Pinot noir, the winemaker must do more than just manage fermentation. Decisions made long before the grapes reach the winery will affect the specific flavor profile, intensity of flavors, level of ripeness, and health of the fruit. All of these decisions will profoundly and irreversibly affect the basic nature of the wines that can be made from those grapes.

It is the winemaker’s job to integrate the factors in his or her control with the ones outside that control. The vine grows in response to its genetic code, the place where it is planted, and the weather. By making varietal and clonal selections, we control the genetics. We choose the vineyard location and the vineyard layout. The weather varies from season to season and is the most significant uncontrolled variable in winemaking. Winemakers know that the weather patterns over the growing season will vary and will affect the fruit composition, maturity, fruit condition, tannin development, and flavor profile. Fortunately, winemakers have the ability to respond in a multitude of ways to the specific fruit we harvest and influence the wines that are made. *The purpose of this workshop is to examine the role of the winemaker and understand how winemaking choices guide the entire process from vine to wine.*

The timing of harvest determines the raw material that the winemaker will transform into wine. Once picked, the winemaker decides how the transformation process will proceed. In the winery, the use of stems, percentage of whole berries, temperature profile of the fermentation, cap management, timing and intensity of pressing, cooperage choices, blending, and timing of bottling can be altered to reflect specific choices by the winemaker in response to conditions of the harvest, development of the wine, and stylistic goals of the winemaker. At each stage a

specific choice guides the wine down a different path, with each subsequent choice further defining the flavor and style of the final wine.

In reality, a great deal more happens during fermentation than just the simple conversion of sugar to alcohol. In addition to wine yeast (*saccharomyces*), musts contain many other yeasts, most of which can only tolerate a low level of alcohol, and a wide variety of bacteria. Non-wine yeasts can produce “off” aromas and flavors, consume vital nutrients, and interfere with completion of fermentation. Bacteria are able to consume both sugar and acid. In one instance, that can be a positive attribute to wine: the bacteria responsible for malolactic fermentation convert a strong acid, malic, into a weaker acid, lactic, serving to soften a wine’s mouth feel and add dimensionality. In most other instances, bacteria growing in juice or wine cause spoilage and a wide variety of unpleasant aromas and flavors.

Before, during, and after fermentation, flavor, color, and tannin molecules can be extracted, retained, or lost by decisions made by the winemaker. The extracts of skin and seeds will dissolve into wine by allowing the skins and seeds to remain in contact with the wine must. The length of time, the temperature, and the alcohol level all affect the level and balance of these compounds. This can occur before the fermentation (low alcohol) and is referred to as pre-fermentation maceration. If the skins and seeds are allowed to remain in contact with the juice after the end of fermentation (high alcohol), it is called post-fermentation maceration. Skin and seed tannins extract differentially based on temperature and alcohol level. This allows the winemaker to influence the ratio of skin and seed tannins.

After fermentation, the must is pressed to separate the liquid portion, the wine, from the seeds, skins, and stems (if used). The timing and intensity of pressing affects the level of extract and the balance of tannins, establishing the basic body of the wine. Extract too little and it can never be replaced. Extract too much and fining agents may need to be added to remove the unwanted tannins. Unfortunately there is no fining agent that removes only undesirable compounds—some positive attributes are stripped out as well. Ideally, winemakers extract exactly as much flavor and tannin as they want. That ideal can be very difficult to achieve.

After pressing, the wine is aged before bottling. The choice of aging vessels, the size of construction of those vessels, the amount of time the wine is aged, and the way the wine is handled during the aging process all affect the development of the wine. The use of small oak barrels as well as the blend of new and used barrels is the most obvious decision, but the choices go far beyond that.

As you will see, the winemaker has input into Pinot noir winemaking at an almost endless number of times. At every step of the way, from vineyard to bottle, the winemaker will make decisions that guide the wine in the direction he or she chooses. To aid in understanding how a specific decision is made, the outcome of that decision, and how those decisions fit into the entire winemaking process, we have separated winemaking decisions into the following general stages:

1. Harvest
2. Reception
3. Pre-fermentation
4. Fermentation and pressing
5. Aging
6. Finishing and Bottling

## **HARVEST**

The timing of harvest is probably the most critical decision made by the winemaker.

As the warm summer days in western Oregon's cool-climate growing regions begin to cool in mid- to late-September, Pinot noir and other wine grape varieties are reaching the final stages of ripening. Winemakers and vineyard managers begin making decisions about when to harvest specific blocks of grapes. Testing the fruit on a regular basis helps to determine the date of harvest that best suits an individual winery's house style. Earlier harvested Pinot noir can give bright, focused, red-fruited wines with higher acidity and lower alcohol levels, whereas late-harvested Pinot noirs can be more dense and opulent in style with higher alcohol levels, lower acids, and darker, more brooding flavors.

As fruit matures, the berries swell, with sugar levels rising and acid levels dropping. This process is enhanced with warmer weather and conversely, slowed down with cooler weather. Warm weather increases the rate that sugar accumulates, the rate the pulp softens, the fragility of the skin, and the rate the acidity drops. Warm nights decrease the acidity more quickly than cool nights. Flavor development requires time and is less influenced by temperature. Early warm harvests allow less time for complex flavors to develop and can produce more fruit-forward wines. Long cool falls allow the development of more complex and layered flavors and can produce more nuanced wines. The winemaker will decide to pick the fruit when it has reached a balance in the levels of sugar, acids, phenolic ripeness (i.e. tannins), and flavors that they seek.

### **Determining Ripeness**

Winemakers randomly sample fruit from each vineyard block to achieve an accurate representation of the diverse ripeness that may be found throughout the block. Walking through several different rows within the same vineyard block, they pick individual berries or clusters from different parts of the plant and from many different plants within that block. Berries and clusters are visually examined for color and homogeneous ripening characters. Seeds are examined both visually and by tasting to see how the level of tannin ripeness is developing. Brown seeds will denote ripeness whereas green seeds that are still somewhat soft or bitter-tasting can produce wines with harsh green tannins.

The sample thus obtained can be pressed to obtain the juice from the berries, and the juice is tested for sugars (Brix), acids, and sometimes tannin content. Most importantly though, the juice is tasted by the winemaker to see if the sugars, acids, and berry flavors have achieved the desired balance or if the fruit needs to hang on the vine longer for additional ripening. Once the fruit has been harvested, winemakers can adjust the acid and sugar level of the juice, but they cannot change the natural flavors. The individual style, the site, and the specific use for those grapes all affect the balance of flavor and ripeness that the winemaker is hoping to achieve. The flavor profile desired may be different for prized vineyard-designated wine than for a blending component for a lower-price Pinot noir.

Ripeness does not take place in a linear fashion. The grape has very few positive flavor attributes until about two weeks after veraison, the time when Pinot noir grapes change color. At this point almost 70 days have elapsed since the flowers were pollinated ("set"). Pinot noir is usually picked at between 100 and 110 days. Careful sensory studies have demonstrated that in the early phase, the flavors are simple with herbal and green tannin notes. As the fruit gains maturity, the flavors become riper and more complex with the green notes fading away. At some point, maximum complexity and intensity is achieved. After that, the diversity of flavors decreases and

the overripe flavors of prunes and raisins begin to dominate. Picking by flavor is complicated by the fact that all of the berries do not set on the same date. The vineyard is thus a mixture of fruit at slightly different stages of maturity. The job of the winemaker is to decide when the balance is correct and pick. This variability in fertilization and thus maturity also varies from vintage to vintage, sometimes with the bloom period taking place over as long as two weeks in a single vineyard block.

In western Oregon's cooler climate, winemakers do not always have the luxury of making a picking decision based solely on ripeness of fruit. Weather extremes in the fall months may create conditions that force the winemaker's hand. Because most Oregon vineyards are dry-farmed or under limited irrigation, we depend on rain to keep our vines alive and allow ripening to occur. The vine requires water to function. In drought conditions, flavors cease to develop and sugars stop rising, even in perfect weather. There are Oregon vintages where the vines have stopped maturing the fruit for lack of water, and a fall rain is critical to achieve fruit maturity and flavor development. Conversely, excessive fall rains can create problems by increasing the likelihood of rot (botrytis) or causing a lack of sun and heat required to finish the ripening process.

Winemakers are faced with several factors that can affect picking decisions: weather predictions, risk of disease, and fruit maturity. Fortunately, there are usually sunny gaps between fall weather fronts that create the opportunity to pick dry fruit that has recovered from the effect of rain. Recovery from a significant rain event usually occurs within three to five days, depending on temperature, the amount of sun, and soil permeability.

Unfortunately, the details of weather are not predictable, and the experience and skill of the winemaker in balancing the ripeness of each block with the expected weather conditions can play a significant role picking the best quality fruit. The important question is whether the fruit will benefit from increased time on the vine and thus further flavor development, or it will be more likely to deteriorate and rot. If the fruit is sound and the rain event is expected to be short, leaving the fruit on the vine can increase the quality significantly. To assume that rain or heat at harvest automatically lowers quality of a vintage is over-simplified and inaccurate.

### **Picking**

Once the decision has been made to harvest, winemakers, vineyard managers, and picking crews gather in the specific vineyard block, usually in the morning hours, to harvest the fruit in the cool of the morning air. Cool berry temperature helps protect the fruit from physical damage and decreases the need to cool the grapes prior to fermentation. This labor-intensive activity requires a larger number of workers than at any time during the growing season. The regular vineyard staff is often augmented by crews provided by labor contractors to allow the harvest to proceed in an efficient manner. A 40-acre vineyard can produce a hundred tons or more of grapes. Transportation to the winery is a significant logistical consideration, especially if the winery is located far from the vineyard. Farm trucks carry 6-12 tons and may require many loads to a distant winery after a long day of picking.

The grapes are usually picked by hand. This allows the whole cluster to reach the winery intact. The alternative is to machine-harvest. Automated harvesters move over the vines and remove the berries by agitating the vines to separate the berries from the stems. The freed berries drop onto conveyors and into large containers that are transported immediately to the winery. Technological advances have dramatically improved the quality of machine harvesters and

minimized potential damage to the berries. An advantage of machine harvesting is that it can occur during the cool of the night and fruit can reach the winery at temperatures below 45°F. National immigration policy and the availability of seasonal labor are forcing large vineyard operations to explore automated picking options.

When handpicking, the crews gather in the field at dawn. The pickers manually cut each cluster that is ripe from the vines, leaving unripe and diseased fruit behind. The clusters are collected in five-gallon pails or rectangular trays and carried to sorting crews that either stack the trays onto a trailer or empty the buckets into larger picking bins. These bins are 4' square and vary from 12" high, holding 500 pounds of grapes, to 24" high, holding one half ton of grapes. The boxes or bins are transported by tractor to a holding area and then loaded onto trucks for transportation to the winery. If the winery is on-site, this process is simplified and the boxes of grapes are immediately processed in the winery.

## **RECEPTION**

### **Equipment – Sorting Lines and De-Stemmers:**

The equipment used in the winery can have a significant effect on the way Pinot noir is made. Production capacity and budget often dictate specific equipment choices. Wineries producing tens of thousands of cases will have different equipment than very small wineries making hundreds of cases. Startup wineries on a shoestring budget will make different choices than a well-to-do investor wanting to create a showcase, state-of-the-art facility. The price point of the wine also affects the kind of equipment purchased. Wineries producing high-volume, low-price-point wines need to efficiently handle large amounts of fruit quickly, where a thousand-case, boutique winery can afford to hand-sort one cluster or even one berry at a time. Equipment used to sort, fill fermenters, empty fermenters, and press the must can vary widely in how gently the must is handled, and the choice will affect tannin extraction as well as the ease of use.

Luckily, excellent Pinot noir can be produced with a relatively few pieces of equipment. One thing every winery has is a forklift. David Lett (The Eyrie Vineyards) used to say that you could always figure out who was the winemaker because he was the one who knew how to drive the forklift.

### **Sorting**

Once the fruit is removed from the truck, it needs to get from the picking boxes or bins into the fermenter. Field sorting of the picked fruit is not always effective in removing unripe fruit, diseased fruit or MOG (material other than grapes). Winemakers often choose to make a more careful selection once the fruit arrives at the winery. This is accomplished by using a sorting line to make a final triage of the fruit before it enters the tank or destemmer, allowing the careful removal of unripe or diseased fruit. This can be as simple as a flat surface the fruit is dumped onto and hand moved to the destemmer or tank. It can also be very complicated, with bin dumpers, shaker tables to create a uniform layer of fruit, conveyers with slots and blowers to remove "shot" (unfertilized, green berries) and bugs, and vertical conveyors to elevate the fruit to the top of the tank. High production wineries may skip this step, relying on careful sorting in the vineyard.

Before 1995, most wineries in Oregon did not have sorting lines. Rot was not an issue in Pinot noir and sorting was considered a luxury few could afford. Vintage 1995 brought rain, clouds, and moderate conditions that were the perfect breeding ground for botrytis. Pinot noir clusters with rot were commonplace and the large crop and short picking window meant that vineyard

crews could not effectively sort out the damaged and unripe clusters. Frustrated winemakers realized that the large majority of the fruit was sound and could be used to make good wine, but they had no effective means to separate the good from the bad. Given that each 1,000-pound bin contains 10,000 clusters and 1 million individual berries, without specific equipment, hand selection was impossible. Thankfully, sorting equipment does not have to be expensive, and by 1996, some type of sorting line was in place at most wineries.

### Destemming

The winemaker may choose to have some or all of the clusters go through a destemmer that removes the individual berries from the stem. Those clusters go into a destemmer or destemmer-crusher. This is simply a device that tumbles the entire clusters inside a perforated drum, allowing the berries to fall through the perforations and the stems to exit separately out the other end into a bin for disposal. In some machines, the berries then pass between two long, soft rotating cylinders with a variable slot that serves to “pop” varying percentages of the berries before exiting the bottom. Gentleness, capacity, and ease of cleaning are the primary differences in these machines. Some winemakers choose to use a percentage of un-destemmed whole clusters in their fermentation. This is achieved by bypassing the destemmer and simply dumping the chosen amount of clusters directly into the fermenter.

Early in Oregon’s history, the quality of Oregon Pinot noir was significantly related to the improvement in de-stemmers. The slow, gentle machines used in the 1970’s were often replaced with faster ones that essentially ground up the berries, breaking seeds and releasing significant amounts of bitter tannins. As the machines improved and winemakers had more financial resources, new equipment began to be used that could remove berries without breaking the skins and the proportion of gently popped berries could be easily controlled. The bitter tannins released by the early machines began to be replaced by sweeter and riper tannins and wine quality improved dramatically.

From the de-stemmer, the berries are transferred to the fermenter. This can be as simple as having the destemmer located above the tank, with the must dropping vertically. It could also involve conveyors, pumps and hoses, or bins that are forklifted and dumped into a remotely located tank. The most important thing is that the berries be protected from any further damage during the transfer process, especially damage to the seeds. Broken seeds will lead to a rapid increase in bitter tannins during fermentation and a dramatic decrease in quality.

Most of the choices above have identical end results. Clusters are separated into berries that fill a fermenter. As long as the process is gentle and damaged or unripe fruit is separated out, there is little real difference in the choices made above to the wine produced. The same is not true for the fermenter and press. Both play a significant role in the style of the end wine.

### Cooling

As the fermentation tank is being filled with fruit from the sorting/de-stemming operation, the winemaker will choose whether to cool the tank either by glycol cooling jackets attached to the tank, or with the addition of dry ice to the must. Glycol cooling jackets have a smaller impact on the eventual wine style, and dry ice has a much more direct effect on color extraction by also freezing the berries. This is the time the winemaker adds sulfites to the juice to prevent oxidation and limit fermentation by indigenous yeasts and bacteria that are in the tank and on the fruit. Once the tank is full of fruit, the winemaker can make a laboratory analysis of the must and decide whether to make any adjustments.

## **PRE-FERMENTATION**

### **Modification of Must**

Once the grapes are in a fermenter—or in some cases, as the grapes are going into a fermenter—there are several things that may be added or subtracted from the must. (“Must” is what the mixture of skins, seeds, juice and, in some cases, stems is called.) Some of the things added, such as SO<sub>2</sub> and yeast, are so standard as to be considered universal in winemaking. We will explain these and other additions in the next section.

Here we will consider the more controversial aspects of winemaking—the actual modification of the must. Some modifications are additions, some are subtractions. Controversy exists because this is where tradition and “terroir” come face to face with technology and “modern taste.” If the grapes you harvest are underripe or overripe, too diluted or too desiccated, what actions should you take to correct these conditions? What actions should you be allowed to take? Is this “tampering” or “correcting?” Is it “right” to add sugar or to saignée (bleed juice from the must), techniques used historically in Burgundy, but not “right” to add acid or water or to use technology to remove water? That appears to be where the line is currently drawn by public opinion. Winemakers freely talk about the former, but are very reluctant to discuss the latter. Yet all of these techniques are legal under European and American wine law.

All winemakers would rather receive perfectly ripe grapes from the vineyard so that they need to make absolutely no modifications to the must. Ideally, the grape variety is a perfect match for the site—the climate and the soil of that site. And yet, the climate is not the same every year. Some years harvest is late, the weather deteriorates, and grapes must be picked before they are ripe or they are lost to the rain and rot. Other years, harvest is early. The fruit achieves a normal sugar level but the tannins and flavors are not yet mature. Waiting to pick will cause dehydration and high sugar levels, potentially leading to very high alcohol content in the wine. Not waiting to pick results in unripe and green, herbal flavors in the wine.

Some years are wet during the final ripening period; other years are warm, dry and/or windy in the run-up to harvest. To what extent should you be allowed to make imperfect grapes into more perfect musts?

*The winemaker must draw his or her own line between which modifications they condone and which they reject. Here are the resources available and the decision-making that might lead to their use.*

This chart outlines the resources in the left column and their effects on the must:

<i>Modification Resources and Effects</i>	Aromas & Flavors						
	° Brix	Acidity	Tannins	in Juice	from Skins	Color	Alcohol
Concentration	+	+		+			+
Saignée			+		+	+	
Chaptalization	+						+
Addition of water	–	–	–	?	?	–	–
Addition of acid		+					

## Concentration

Concentration is simply the removal of water from the must. Removing just the water and nothing else takes advanced technology. This practice was introduced by the First Growth Châteaux of Bordeaux in the 1990s and has evolved rapidly in the years since. All of these systems involve draining juice from a fermenter, dramatically concentrating that juice, and returning that concentrated juice to the fermenter, thereby enabling a modest concentration of the entire must. There appear to be four technologies available:

1. *Flash evaporation* – this was the first technology to be tried on wine musts. Essentially, little drops of juice are shot at a heated plate. Some of the water in the drop of juice is immediately vaporized, while the rest of the drop falls into a vessel where it is quickly cooled. There is concern about injury to flavors and aromas of the juice thus treated. It is not widely used in the U.S.
2. *Vacuum evaporation* – this technology was developed to resolve the problem of cooked flavors and aromas from flash evaporation. Must concentration takes place under a forced vacuum in which the juice is “boiled” but at a temperature of only 68 to 75°F and virtually pure water is evaporated. The machines are expensive and use a lot of electricity to create the vacuum, heat, and cool the juice. Around the world, this is the most widely used system for concentration of musts. (These machines can also be used to remove alcohol from wine at a later stage of production.)
3. *Reverse osmosis* – reverse osmosis is, in essence, molecular filtration. Water is pressed out of the juice through very small pores in a membrane by use of high pressure (approx. 1,150 lbs/sq in.). Very small pore size ensures that only water molecules are separated, whereas other molecular substances (e.g. sugar and acids) are retained and increased in concentration. These machines are slow and even more expensive than vacuum evaporation but have the advantage of being able to remove alcohol, ethyl acetate, or volatile acidity at a later stage of production by use of specific membranes.
4. *Cryo-extraction* – a process of freezing juice and removing the ice formed on the surface. When ice forms, the solutes such as sugars and tannins and other components of the juice tend to stay dissolved in the unfrozen liquid. The ice that is discarded is virtually flavorless. This very low-tech and low-cost approach has been used by several Oregon winemakers.

Concentration is considered as an option when grapes are diluted due to rain but are otherwise ripe. Those winemakers who use concentration believe it is a perfect solution to reversing dilution, since it involves no change in the extraction of flavors, aromas, and tannins from the skins. Those who oppose these technologies usually are concerned about the traditions of winemaking.

Must concentration cannot replace work that should have been done in the vineyard. A superior product cannot emerge from inferior grapes through concentration, because negative flavors are concentrated just as much as the positive ones. However, one could imagine a winemaker who, having grown reliant on the richness of aromas and body achieved through concentration, might in a difficult vintage pick before ripeness and achieve richness even as the flavors remain green.

Several wineries in Oregon purchased vacuum evaporation units in the mid 1990s, and a few others have recently acquired reverse osmosis capabilities. With ever higher expectations as to quality and consistency and the possibility of more erratic weather prior to harvest due to global climate change, technological means to concentrate musts are likely to become more common in Oregon.

### Saignée

Saignée (the French word for the medieval medical process of bleeding) is used when a winemaker desires to impart more tannin and color to a red wine. The process involves the removal of some almost-colorless juice from the must in the fermenter at a very early stage – it is also known as “bleeding” the fermenter. The red wine is intensified as a result of the bleeding because the volume of juice in the must is reduced relative to the surface area of remaining grape skins. And in some senses, the must involved in the maceration is concentrated. (Typically, the removed juice is fermented separately, producing a rosé wine as a byproduct.)

However, the concentration thus achieved is different from that delivered by true concentration technology. As the above chart shows, bleeding does not modify the sugar, acid, aromas, flavors, and alcohol. That’s because the same amount of those elements is being extracted into a smaller volume of juice during the fermentation process. But the juice that remains after the saignée is exactly the same—same sugar, same acid, same flavors and aromas, and the same potential alcohol. It is only those elements derived from the skins—the aromas and flavors in the skins, the tannins and the color—that are concentrated.

Saignée is a very traditional approach used in Burgundy when the crop level turns out to be higher than planned, but the grapes are otherwise ripe and in good shape—when the sugar and acid levels are appropriate. It can help when there has been some dilution, but there are limitations. Most winemakers would be reluctant to remove more than 10% of the juice from a fermenter, fearing too much tannin would be extracted if more liquid was removed (although there are experiments where 35% of the juice was removed and delicious wines were made). And, of course, if the tannins in the grape skins are not ripe, concentrating them adds to the astringency of the wine without getting any body or richness to compensate. To do a saignée requires no special technology and it is used in many wineries and many vintages in Oregon, except when there is desiccation.

### Chaptalization (addition of sugar)

Chaptalization is the process of adding sugar to unfermented grape must in order to increase the alcohol content after fermentation. The technique was promoted by the French chemist Jean-Antoine-Claude Chaptal, for whom it was named. Contrary to popular belief, this process does not make the wine sweeter but only increases the alcohol content. The sugar added to chaptalized wine cannot be tasted.

The process is considered controversial by some and has caused discontent in the French wine industry due to the perceived advantage that chaptalization gives producers in poor-climate areas. The historical criticism contends that the process allows winemakers to sacrifice quality in favor of quantity by letting vines overproduce high yields of grapes that cannot fully ripen.

The technique of adding sugar to grape must has been part of the process of winemaking since the Romans added honey as a sweetening agent. Though they did not understand the chemistry, Roman winemakers were able to identify the benefits of added sense of body and mouth feel.

This process has long been associated with French wine. The first recorded mention of adding sugar to must was the 1765 edition of L'Encyclopedie, which advocated the use of sugar for sweetening must over the previously accepted practice of using lead. In 1801, while in the services of Napoleon, Jean-Antoine-Claude Chaptal began advocating the technique as a means of strengthening and preserving wine (ref: Wikipedia).

From 1977 to 2007, Oregon Liquor Control Commission (OLCC) regulations strictly limited the amount of sugar that could be added to musts to that which would raise the alcohol by 2%. (This was about half the amount routinely allowed in Burgundy.) Sugar was added to Oregon musts in vintages such as 1984 and 1995, but the combination of global climate change and the high level of quality expected by consumers from Oregon made such regulations superfluous.

Today, sugar would be added to must in Oregon only to make a minor adjustment. If one did not have concentration technology in a dilute year, one might first saignée, then add sugar to ensure the finished alcohol was above 13%. In Burgundy, chaptalization is such a tradition that there are debates about which sugar source is best for Pinot noir (beet versus cane) and when to add the sugar to the fermenter (early versus late in the fermentation). While adjusting musts with low sugar levels to target a minimal alcohol level is commonplace, the level targeted will depend on the specific fruit and winemaker style.

#### Addition of Water

The addition of water to musts is another controversial practice, due to its abuse in bygone times and other regions. One can certainly imagine the temptation in warm growing regions to increase the volume of wine produced from a ton of grapes by simply adding water. Grapes would need to be picked very ripe for this to work, which is why it was not often used in cool-climate regions. Barely ripe grape musts, thinned down with water, produce...well...watery wines.

The same OLCC regulations (1977-2007) prohibited the addition of water to musts to prevent “stretching.” But soon after those regulations went into place, a funny thing happened. Whether it was due to global climate change or just normal climate variation we cannot know. Either way, we started to have, in certain vintages, too much heat, too much wind, and/or too little soil moisture. Grapes that appeared on track to be normal, ripe grapes, arrived in our wineries shriveled, overripe, over-concentrated. Winemakers who had worked in warmer climates knew what to do, add back the water that Mother Nature had removed prematurely—re-hydration.

Adding water has almost the exact opposite effect as concentration. Everything is thinned down a little, although what happens to the aromas and flavors of the must—and the resultant wine—may not be that simple. Most winemakers would argue that adding water to must tends to result in wines that have less overripe flavors than those made without the water addition.

Adding water is also an inexpensive way to ensure that fermentations go to dryness. If a must has too much sugar, the yeasts cannot finish fermenting all the sugar—they are killed by high alcohol—and the must ends up with residual sugar. The other positive result is that the finished wine does not have excessive alcohol. Winemakers in Oregon tend to want their Pinot noirs in the 13-14% alcohol range. Wines outside that range are seen from time to time, but winemakers have concerns about their balance and longevity.

Alcohol reduction can also be achieved with technology. Vacuum evaporation (and a version of it called “spinning cone”) and reverse osmosis can be used to remove most of the alcohol from a

small portion of the wine, which is then added back, reducing the total alcohol in the lot. But alcohol reduction cannot adjust the overripe flavors. That appears to be the unique role of water addition. The basic question is whether to pick at the optimal flavor ripeness and adjust the sugar content, or to pick at a specific sugar level and work with less ripe flavors. Again, this is a stylistic choice made by the winemaker and is often a response to specific vintage conditions.

### Addition of Acid

Finally we will examine a less controversial practice—the addition of tartaric acid to musts. Tartaric acid is unique to grapes and is the most abundant acid in wine musts. Malic and citric acid are also present, but typically in smaller quantities. Tartaric acid is often added to musts from grapes that have ripened too quickly in hot conditions or simply gotten too ripe. Heat, especially at night, reduces acidity in the grapes. This is especially a problem with young vines. Tartaric acid can be added to insure that the pH of the must and wine stays within an acceptable range, a range that helps protect the health of the wine and helps provide the balance typical of Oregon wines. Tartaric acid is typically used for this purpose; malic, citric, and other organic acids can be utilized by microbes and are therefore more difficult to manage. If tartaric acid is added in moderation to musts before fermentation, it is hard to detect in the finished wine. On the other hand, if acid is added to a wine just before bottling, the acid is less likely to integrate into the wine and its addition could be tasted.

Global climate change has typically meant that nighttime temperatures during the final Pinot noir ripening period are warmer than 20 years ago. That reduced diurnal temperature shift means that more malic acid is respired from the grapes during the ripening process, changing the acidity of the must.

Acid addition has a negative connotation because of its association with the other “stretching” additions (sugar and water) and because French wine law has forbidden the addition of sugar and acid to musts at the same time. Adding acid by itself is acceptable. Some wine writers have viewed the need to add acid as a way to cover up the fact that grapes are being grown in too warm a climate. “If you planted your Pinot noir in the right place, you wouldn’t need to add acid. Your Pinot would ripen with perfect acidity and sugar.”

Acid is considered to be the backbone of Pinot noir and plays a crucial role in food compatibility. Thus the addition of acid to “re-balance” the wine becomes an important quality and stylistic choice, especially for producers picking very ripe grapes. As with the other modifications to the must discussed here, there are winemakers and consumers who have negative associations with any adjustment to what Mother Nature delivers to the winemaker. They believe that the wine should reflect exactly the vintage. If the weather was hot leading up to harvest, then the wine should be higher in alcohol, softer in acid, more concentrated and sometimes with overripe flavors (raisin, prune). If it was rainy during the ripening period, then the resulting wines would be less concentrated, have higher acids, have less-ripe tannins reflecting more herbal or green flavors and increased astringency.

The choice to modify the must reflects the basic philosophy of the winemaker. The above techniques can significantly affect the style of wine produced. The decision about whether to minimally modify the must or not is easy in “perfect” vintages but is more complicated in cold and wet, or hot and dry years. Is the winemaker’s job to make the “best” wine in every vintage and use whatever techniques make that possible? Or is it their job to make wine that reflects a minimal intervention policy that varies directly in response to the vintage conditions? Will

consumers buy the less “perfect” wines that are not modified or do they want only the best wines every year? As the machines become more sophisticated with less negative side effects, their use will become more attractive. With climate change, vintage conditions may become more variable and modifications at some level increasingly commonplace.

### **Additions to Must**

In addition to sugar, acid, and water, there are several components that are commonly added to must by the winemaker. What gets added and how much are determined by: what is required to have a successful fermentation that goes to completion resulting in a sound, balanced wine and what style of wine the winemaker wishes to produce.

Some additions are made while the fermenter is being filled to create the environment and chemical conditions in the must to achieve a particular balance and level of extraction sought by the winemaker. For many Oregon Pinot noir producers, achieving the conditions necessary for an extended pre-fermentation maceration is an important goal.

### **Dry Ice**

Dry ice is added to chill warm fruit to a desired temperature. Dry ice is frozen carbon dioxide (CO<sub>2</sub>). It can also be used at higher rates to burst berry skin cell walls to facilitate extraction of color pigments and skin tannins. Dry ice can be added as pellets or as large blocks. Smaller pieces increase the surface area and increase the number of berries that are affected by freezing and cell wall disintegration, releasing more pigments and tannins into the must. Adding dry ice also excludes air and therefore oxygen from the juice at this early stage, starving many potential spoilage organisms of a vital growth factor. Colder temperatures slow the fermentation and allow a longer pre-fermentation maceration. Cooling jackets or portable heat exchangers can also be used to cool the must, but do not have the effect of bursting the cell wall. For this reason the decision to use dry ice can affect the style of the wine, and very different results are achieved with varying amounts.

### **SO<sub>2</sub>**

SO<sub>2</sub> is added to almost every must and wine and is one of the most basic and important quality control measures available to the winemaker. SO<sub>2</sub> acts as both an oxidase enzyme inhibitor and as a microbial growth inhibitor. SO<sub>2</sub> is added to the must early (within minutes or hours) to prevent browning and to inhibit native flora. If the native bacteria and yeast grow out of control, the result can lead to higher volatile acidity, “off” flavors and aromas, and possibly fermentations that stop with sugar still in the wine (stuck fermentation).

The impact of SO<sub>2</sub> additions is strongly affected by the pH of the must. If tartaric acid additions have been made, the acidity and pH will change, affecting the activity of the SO<sub>2</sub>. Almost all of the SO<sub>2</sub> added to the must will be bound up during the fermentation and eliminated at pressing. It is almost always added again at the end of malolactic fermentation to reduce the risk of oxidation and microbial growth.

The timing and rate of SO<sub>2</sub> addition varies widely and is dependent on the condition of the fruit and the type of extraction desired by the winemaker. Damaged fruit requires more SO<sub>2</sub> to control the growth of unwanted bacteria and prevent oxidization of the must. High levels of SO<sub>2</sub> will slow the initial growth of yeast, delaying the onset of fermentation and, at very high levels, increase the extraction of color molecules, which can lead to increased color in the wines. The way SO<sub>2</sub> is used varies widely between winemakers and according to the conditions at harvest.

### Tannins

The skins and seeds contain large quantities of naturally occurring tannins. The winemaker may choose to add additional tannin to augment the natural tannin level in the must. Commercially available fermentation tannins act as antioxidants in must in the early stages of fermentation because they react with oxidative free radicals more readily than the grape-derived pigments and tannins. Tannin also binds to damaging enzymes found in Botrytis and other molds. They are available in many forms and can be derived from grapes or oak (usually toasted). The decision to add tannin is based on the health of the fruit and is used to protect the color and phenolic structure of the wine in musts with damage from botrytis. Tannin additions can also be used to affect wine structure and mouthfeel. They can be added after fermentation when the quantity added can be more accurately titrated to the winemaker's intent. Tannin addition is a relatively recent option and is still not widely practiced.

### Enzymes

Various types of enzymes can be used in the winemaking process. The simplest are pectic enzymes. The addition of pectic enzymes increases the clarity of the wine and may help color extraction. These enzymes can have the added benefit of leading to wines with less haze and suspended matter, which facilitates greater clarity and easier filtration if that becomes necessary. Other commonly used enzymes during fermentation are those with cellulase activity. These help break open cell walls allowing the skin pigments and tannins to dissolve into the juice. These enzymes increase the level of color pigment and tannin in the wine and can increase color extraction and alter the phenolic profile of the wine. The decision to use enzymes or not is ultimately a stylistic choice and will be determined by the character of the vintage, the fruit from a particular vineyard, and the winemaker.

### Oxygen and Heat

When the winemaker decides that a cold soak has gone on long enough (see *Management of Extraction*), or the harvest temperature is very low, the must can be heated to create an environment suitable for yeast growth (>55°F). Heat is added through the use of jackets fixed to tanks or heat exchange panels inserted into fermentation vessels. Heated glycol or hot water is circulated through the jacket or panel, slowly increasing the temperature of the must. Yeast growth can be increased and the yeast kept healthy by increasing the oxygen level in the must. Oxygen can be added by an aerative pumpover: juice is pumped through a hose and allowed to splash into the top of the must in the presence of air, or by simply bubbling metered amounts of oxygen or air into the juice into the bottom of the fermenter.

### Yeast and Yeast Nutrients

Once a suitable environment has been created in the fermenter, yeast can be added to start active fermentation, or yeast will not be added at all if the winemaker has decided to let the ferment go native. There are many types of commercial yeast available to winemakers, all with their own special characteristics, from aromatic enhancement to high alcohol tolerance. The timing and quantity of yeast additions affects how quickly the fermentation starts and how rapidly it progresses.

Yeasts require a wide variety of nutrients to grow and perform their job of converting sugar to alcohol. Acid, high temperatures, and alcohol stress the yeast and can lead to "off" aromas and yeast death. Grape musts can vary dramatically in the level of these nutrients and are often deficient in one or more essential elements. An analysis can be done to determine whether and

by how much the must is deficient in the major nutrients required for yeast to grow and complete fermentation. Once fermentation begins, the required amounts of nutrients can be added to the must. This practice ensures healthy fermentations that go to dryness and produce low amounts of off aromas such as sulfides.

The types of nutrients that are added depend on the winemaker's preference and what is required by the must. Yeast nutrients fall into three categories: inorganic nitrogen, organic nitrogen/amino acid complexes (normally derived from yeast), and vitamin/micronutrient formulas. The timing and quantity of nutrient additions affect the speed and efficiency of the fermentation.

## **FERMENTATION**

### **Fermenters**

The most basic equipment choice in producing Pinot noir is the fermenter. Pinot noir is fermented in a wide variety of vessels. The size, shape, and material of construction vary widely. Each of these variables will affect the kinetics of the fermentation: the temperature profile, the rate of fermentation, and the way the cap can be handled.

#### Size and shape

Fermentation tanks are often constructed to maintain close to a one to one ratio between height and width of the must when the tank is filled. This minimizes the surface area, allowing the heat to accumulate, and limits the thickness of the fermentation cap, allowing easier manipulation as well as less drying out of the cap. The taller the fermenter, the thicker the cap and the more difficult it is to manage.

The choice of fermenter is based on the style of wine being produced, production volume, specific resources of the winery, budgetary constraints, and esthetics. Here are the most common options used in Oregon:

1. *Plastic bins*. These lightweight, inexpensive fermentation vessels have been the backbone of the Oregon wine industry since the first Pinot noirs we made. They are inexpensive, easily handled, and come in a wide variety of sizes. The smallest hold one-half ton of grapes and consist simply of a plastic liner that fits into a picking bin (4' x 4' x 2'). Larger sizes are available that are self supporting and have 2 to 3 times the capacity. Some are insulated and others are simply a single layer of plastic. Unless they are insulated, the short height of plastic fermenters tends to lead to cooler fermentations because they have a large surface area compared to their volume. The wines often have brighter and more forward fruit characteristics.
2. *Stainless steel tanks*. These have become the norm in larger wineries and those with greater capacities. They vary widely in size, from those containing as little as two tons to those holding 15 or more tons. Their advantage is that they are strong, easy to clean, come in an infinite number of sizes, can have fixed temperature control jackets, have doors to make emptying of the must simple, and look great. They can be open top or closed. A number of wineries have chosen to use moderate size, portable open-top stainless tanks with a capacity of 2.5 to 3 tons. They have enough capacity to create and hold moderate temperatures (in the 80°F range), considered to be the ideal range for extraction. They are small enough to make cap management simple and gentle (punchdowns) and light enough to still be portable.

Larger tanks allow for more capacity in a smaller space and are critical for large-capacity wineries. Because they have less surface area, they are jacketed to allow for temperature control of the must. Some are large enough that hand punchdowns are impractical. Other methods of keeping the fermentation cap moist have been developed that do this job efficiently, including pneumatic punchdown devices, Pulsair systems, and pumpovers.

3. *Plastic Tanks.* Produced from a thicker material than plastic bins, these tanks vary in size from 500 gallons, holding slightly less than two tons to those holding six tons of must (380 cases). Their capacity is limited by the strength of the material. Much less expensive than stainless steel, light and easy to move when empty, and able to be stored outside in the off-season, they are commonly used where space and budget are considerations. Heat passes through plastic more slowly than stainless, so peak must temperatures are slightly higher in these tanks.
4. *Roto-fermenters* are horizontal, closed tanks that can be rotated to mix the cap with the must in a pre-programmed manner. They require minimal attention and are easy to empty, but are very expensive to purchase and can lead to over-extraction.
5. *Wood Fermenters.* Open top, French oak fermenters are used by domains in Burgundy to produce their best wines. Originally rare in Oregon, these are becoming more common, especially for fermenting small lots from top-quality vineyard sites. They are usually of moderate capacity—from three to seven tons—and are beautiful to look at. Their exact effect on winemaking is unknown, but it is thought that their egg-like interior shape affects the movement of the must during fermentation and the wood acts as a limited insulator, changing the temperature profile of the fermentation. Some winemakers believe that a more nuanced and complex wine is produced in these traditional tanks. Their disadvantage is that they are very expensive and difficult to maintain.
6. *Glass-lined Concrete:* These are very uncommon in Oregon, but are the standard fermentation vessel in Burgundy. Inexpensive to construct and highly space efficient, the concrete limits the rate of temperature exchange. The must is slow to warm up and then slow to lose its accumulated heat. They can be open-top or just have a small closeable door to allow punchdowns.

## **Management of Extraction**

### **Temperature and Maceration**

The juice in Pinot noir grapes is colorless. This is the reason white wine can be made from black grapes that are quickly pressed. The color of red Pinot noir wine comes from the pigments in the skins of the berries. In the vineyard, the skin cells remain unbroken. Once the grape must enters the fermenter, the cell walls in the skins begin to break down and phenolic extraction begins.

The tannins contained in the skin are dissolved into the wine more readily than seed tannins during the early stages of fermentation. Meanwhile, the rate of extraction of skin tannins slows as fermentation progresses, but the rate of extraction of seed tannin increases. Green seeds impart more tannin to the wine than seeds that are brown and more mature. In an average year in Oregon, seeds do not get fully mature and have the capacity to impart drying tannin to the wine if the winemaker is not careful with extraction during the late stages of fermentation.

Fermentation by yeasts proceeds very slowly at temperatures below 60°F, and the yeasts are almost inactive below 40°F. By lowering the temperature, the onset of fermentation is delayed. If the initial temperature of the must is reduced, the length of the low-alcohol phase can be increased. This is called cold maceration or cold soak. The length of the cold maceration can range from a few days to a dozen or more. Control of the temperature profile can be used to regulate the relative ratio of skin to seed tannin, as well as the total tannin extracted. This same technique affects the entry of color compounds into the wine, all of which are present in the skins.

Once the fermentation is allowed to begin, the temperature will begin to rise as the process of fermentation creates heat. As activity of the fermentation increases, more heat is produced. Initially the yeast population is quite low. Under low alcohol conditions, the yeast begins to divide, and its numbers increase rapidly. With more yeast available, more sugar can be converted to alcohol and the rate of fermentation increases, creating even more heat. By manipulating the temperature, the activity of the yeast can be controlled and the length of fermentation increased or shortened. Higher temperatures also increase the rate of extraction of skin and seed tannins.

Winemakers have specific ideas about how warm a fermentation they like and may vary the temperature through the course of the fermentation. Musts from sites with higher levels of natural tannins may be fermented cooler to control the level of extraction. If the must exceeds the pre-determined temperature, the cooling jacket can be set to turn on, the temperature of the fermenting must will drop, usually by a few degrees, and then the cooling jacket turns off. Temperatures that exceed 104°F in the must can cause sudden yeast death and the failure of fermentation to finish. This is a major disaster and winemakers are very careful to not let this happen. “Stuck” fermentations can be very difficult to restart and provide a breeding ground for spoilage bacteria.

When the available sugar content decreases and the alcohol level rises, fermentation begins to slow down. Less heat is produced and eventually the must begins to cool spontaneously. Eventually the sugar is consumed and fermentation stops. Most winemakers choose to press around the time that the fermentation completes. The longer the must is in contact with the seeds, the more tannin is extracted from those seeds. The same may not be true with skin tannins, which appear to reach their maximum levels before the completion of fermentation. If the must is left in the fermenter after fermentation stops, a period of post-fermentation maceration begins. While research has shown that “total tannin” levels increase during post-fermentation maceration, many winemakers perceive that the tannin becomes “softer.” It is unclear exactly what is going on but researchers are now learning that both skins and yeast act to fine certain tannins from the wine while some tannins continue to be extracted and combine with other compounds in the wine to perhaps become less aggressive to the tongue. Post-fermentation macerations can last a month or more.

The choice of how long to macerate the fruit, both pre- and post-fermentation, is up to the winemaker, and can be used to create very different levels and types of extraction. These decisions are based on the amount of tannin in the skins at harvest, the health of the skins, the variations in site, and the style of wine the winemaker decides to produce.

### Cap Management

As the cap rises, grape skins rise above the liquid level of the tank, buoyed up by rising CO<sub>2</sub> produced by the fermenting yeasts. Once the skins become dry, the extraction from those skins

stops. The winemaker decides how often to re-immerses those skins and what technique should be used for the re-immersion. For Pinot noir, the key is to extract gently. Tearing, ripping, or shredding of skin tannins releases large amounts of bitter tannins into the wine. The specific technique used is based on fermenter volume, production volume, level of tannin extraction desired, and winemaker style. Those techniques include:

1. *Punchdowns*. This can be as simple as a stick with a plate attached perpendicularly to the end. The grape skins are physically pushed back into the liquid below, re-moistening them. As the fermentation rate increases, the cap becomes thicker and denser and harder to work. Winemakers may vary the rate of punchdowns based on the thickness of the cap and on the rate of temperature increase in the fermenter. For larger tanks, the punchdown devices may be attached to pneumatic rams worked by hand, or may be large, fixed devices that automatically depress the entire cap at specific intervals. The frequency and intensity of punchdown changes the level of tannin extraction and is controlled by the winemaker.
2. *Pumpover*. Liquid or must can be pumped over the top of the cap to keep it moist. To pump only liquid, a large sieve is placed in the top of the tank that projects deep into the must. That liquid is then pumped over the surface of the wine. Pumpovers can also be done by attaching a hose to a valve and pumping the must with a special pump designed to move both liquid and solid (must pump). Pumpovers are often used for larger tanks and tanks with tops that make it impossible to manually punch down the cap.
3. *Pigeage* (literally “by foot”). In a shallow tank this involves walking on the fermenting must to mix the cap. In larger tanks, it involves immersing most of your body in the wine and mixing in any way possible as you swim or crawl around. A very low-tech approach, it is the most personal cap management tool.
4. *Délestage* (“rack and return”). With this technique, the winemaker removes most of the liquid portion of the fermenter to another tank. The cap ends up at the bottom of the tank and the liquid is added to the top. It can be very gentle as there is literally no manipulation of the skins. It has the added advantage of re-oxygenating the skins, re-invigorating the yeast and increasing the health of the fermentation. The disadvantage is that it requires an empty tank for the juice and it takes considerable time to accomplish.
5. *Pulsair*. This is used commonly for large tanks that cannot be managed in any other way. It uses a very large bubble rising from the bottom of the tank to break open the cap and cause mixing. Along with the bubble, a large volume of wine rises, wetting the cap and aiding in its breakup. The bubble can be air, re-oxygenating the yeasts, or can be nitrogen avoiding further air contact. Because there is no physical contact and no pumping, it is considered to be a fairly gentle option.

There are also a range of “automatic” fermenters, such as the roto-fermenters mentioned previously, that incorporate systems to break up and mix the cap. Few are in use in Oregon.

### **Pressing**

The end of fermentation presents an opportunity to affect the balance and structure of the wine. In choosing when and how to press, the winemaker determines how long to leave the wine in the fermenter in contact with the skins and seeds. Longer time increases the amount of tannins

extracted from the grapes. Tannin level and the balance of tannin provide the fundamental structure of Pinot noir. This is one of the basic stylistic decisions made by the winemaker.

Winemakers have four different timing options for separating the wine from the skins:

1. If the wine is pressed before it has fermented completely dry, the wine will finish primary fermentation in tank or in barrel, and tannin extract will end at pressing. Early pressing is used when there is extreme tannin in the must or to accentuate fruitiness.
2. The wine could be pressed when active fermentation has substantially ceased, “at dryness.” Many winemakers find this a safe decision—no further fermentation in tank or barrel to manage, but not too much tannin either.
3. Waiting several more days is a point referred to as “cap fall.” Enough of the CO<sub>2</sub> produced by the yeasts has dissipated, allowing the skins that make up the cap to literally sink to the bottom of the fermenter. In the elapsed days, more tannin has been extracted.
4. The final option is to conduct an extended, or post-alcoholic, maceration. This technique keeps the must in contact with the new wine for days or weeks after dryness has been achieved, to extract the maximum amount of material from the grapes. Opinions vary about the effects of extended maceration on the tannin in the wine. While research has more recently shown tannin increasing, winemakers often perceive a softening of the wine during long extended macerations.

Once the winemaker has chosen when to press, he or she must choose the type of press, the press cycle, and whether to keep the wine that is removed directly from the fermenter (the “free run”) separate from that obtained by pressing the skins (the “press wine”).

Winemakers will often decide to press depending upon the taste of the tannins. Toward the end of fermentation, the wine is tasted once or twice a day to determine how the extraction is proceeding and to determine the exact timing of pressing. When the desired balance is achieved and the wine is ready to be pressed, the winemaker has the option to separate the young wine from the pomace in a variety of ways. The free-run can be separated from the press wine or mixed in any portion. The wine can be settled in tank or put directly to barrel. The pomace that is placed in the press can be separated at any stage of pressing into different lots. This allows the winemaker to maintain as many blending options for later might be desired. This regime can provide a large number of lots with different press characteristics. The final blend can then be constructed so that the desired tannin profile is reached.

### **Presses**

The job of the press is to liberate all of the desirable wine (liquid) from the solid portion of the must (skins, seeds, and stems). There are a variety of ways to move the fermented must into the press. If the fermenter is small, it can be dumped directly into the press with a rotator attached to a forklift. Alternatively the fermenter can be bucketed out into the press. This is commonly done with bin fermentation for lots less than one ton. These are the gentlest methods for filling a press.

The liquid portion in the fermenter can be separated by using a variety of sieves allowing the wine to be drained or pumped out, leaving the solids behind. A must pump can be used to pump the fermented must from the fermenter into the press. This works for the upper portion of the fermenter where there is a high portion of juice to solids. At the bottom of the fermenter, the solid content is higher and once the wine is drained away, the solids are shoveled or bucketed into the press.

There are several types of presses used in wineries. The simplest is a basket press. Essentially a cylinder with finely perforated sides, the basket is filled with must, allowing much of the free run wine to drain out. The wine is then pumped into tanks for settling or directly into barrels. Once filled, a ram compresses the must, forcing the liquid through the perforations, leaving the dry solids in the basket. The cylinder can be oriented vertically with the ram descending from the top (traditional basket press) or horizontally with the ram entering from one or both ends. The ram can be operated mechanically or hydraulically. Because the surface area is low compared to the volume, the pressure needed to press the must is relatively high. This extracts tannins differently from lower pressure presses.

The other common press is a bladder or tank press. Shaped like a large horizontal capsule (think hot dog), these presses are filled either from a valve in one end or from a door in the middle. These presses use a flexible, lightweight air bag—shaped like the hot dog split lengthwise—attached to the interior. This air bag conforms exactly to the shape of the press. When deflated, the press is completely empty. After filling with must, the area behind the airbag is slowly filled with air, pressing the must against perforations on the opposite side allowing the juice to escape. Because the retained solids are spread over a very large surface area (half of the hot dog), the thickness of the solids is minimized, allowing all the wine to be separated from the seeds and skins at very low pressures. These presses are very gentle, produce very few solids and give excellent yields. They can be programmed to press at various pressures, rotate after pressing to re-mix the remaining pomace, and run for specific time periods. They are also very expensive.

## **AGING**

### **Settling in Tank**

The purpose of settling in tank is to diminish the percentage of solids (including yeast, bacteria, grape solids, and other miscellaneous organic matter) that will settle out in the barrel during the aging process.

Allowing the wine to settle prior to racking (separating the liquid from the solids that have settled out) to barrel and the length of settling time are important stylistic considerations. This affects the way the wine ages and develops during its time in barrel, both aromatically and texturally. Some winemakers prefer to allow the wine to settle in a tank prior to barreling. This minimizes solids in the barrel and diminishes the potential for H<sub>2</sub>S/sulfide aromas and flavors. They may allow the wine to settle anywhere from two days to several weeks. The length of settling depends upon whether the wine is still fermenting (early pressing) and the amount of solids in the pressed wine. A few winemakers choose to filter the wine prior to barreling.

The other extreme is to completely bypass the settling process and fill barrels directly from the press pan. Different press fractions contain varying amounts of solids and tannin levels. Each barrel or group of barrels will vary within a single fermentation lot. It is more common to rack the press wine to a tank to create a homogeneous lot, settle overnight, then rack into barrels. This eliminates the heaviest solids, while including lighter, fluffier lees as the wine goes into barrel.

### **Aging in Tank or Barrel**

The purpose of aging is to allow the wine to mature slowly over time. The flavors and textures that develop change the wine from the primary grape flavors of young wines into more complex and nuanced flavors and textures. This takes place through complex and poorly understood oxidative and reductive reactions that occur spontaneously during the aging process. They are

also influenced by small amounts of oxygen, or air exposure, that results in a softening of the tannins and acids and polymerizations of the hundreds of compounds present in wine.

The same wine aged in barrel versus tank will develop differently. Barrel aging is a stylistic and financial decision. Aging a wine in barrels is more labor-intensive, requiring additional time to fill and empty, frequent topping, and individual cleaning and maintenance. Barrels take up much more space than a similar amount of wine stored in tanks. Using new oak barrels adds significantly to the cost of finished wine. One advantage of barreled wine is the ability to separately age and bottle very small lots. Wines of the highest quality are always aged in small oak barrels.

Aside from the flavors and aromas that will be gained from oak barrels, the defining element of difference between barrel and tank aging is the amount of air the wine sees and the way it is exposed to the air. Wines aged in barrel are more round, soft, and yielding. Wines aged in tank, without any external integration of air or oxygen by the winemaker via micro-oxygenation, will be leaner, crisper, and more fruit-forward. Some of the attributes of barreled wine can be incorporated into wine aged in tanks. These include exposure to new oak, metered amounts of oxygen, and less stirring. Although not exactly the same, high quality Pinot noir can be produced by aging in tank.

### **Alternatives to Barrel Aging**

#### **Oak Alternatives**

Oak alternatives are methods to allow wine to be exposed to the tannins present in oak and the resulting flavor effects without aging the wine in barrels. They are used for two main purposes: to tune up a wine that does not have any or enough new oak characters and to reduce green or underripe characters extracted during fermentation. A winemaker may choose to employ oak alternatives based upon a number of factors, such as wine price point, budget, fruit conditions at harvest, tannin levels of the wine, and the desired effect from oak exposure.

In order to add the flavor components derived from the wood extracts of small French oak barrels without using the barrels themselves, a number of alternative oak products have been developed. Their purpose is to infuse the wine in tank, or in barrel, with new wood, essentially putting the wood into the wine instead of the wine into the wood. Their main advantage is price and ease of utilization.

A commonly used oak alternative is a product called *Interstaves*. French or American oak planks from specific forests are milled into thin, long flat strips and toasted to specific toast levels. These long strips have notches that snap into place onto stainless rods or other supports inside of large stainless tanks. Because the oak does not undergo the labor-intensive process of being formed into a barrel, the cost is pennies per gallon of wine treated with a similar contact surface. The cost to use new barrels can be more than \$18 per gallon. Tank staves are also much thinner than barrel staves because it is not necessary for them to be rigid and support the weight of the wine as barrels are required to do. Less labor and less wood mean lower cost per gallon of wine produced. Other oak alternatives include pellets of toasted oak and powdered, toasted oak that is added to the aging wine.

Oak alternatives can also be used during the primary fermentation. This simulates the barrel-fermented characters one sees in Chardonnay. A white wine fermented in new oak results in a wine with well-integrated oak flavors and aromas. The white wine fermented in a stainless steel

tank and then aged in new barrels may not be as well integrated and may have harsher and poorly integrated woody/oak characters. Adding these alternatives during Pinot noir fermentation allows the early integration of oak character into the wine and is another way to expose wine to oak without the use of barrels.

### Micro-oxygenation

Micro-oxygenation is a technique developed in France several years ago integrating new technologies with the science behind the exposure to air during barrel aging. It provides an alternative to barrel aging that can contribute to making high-quality Pinot noir while controlling the production price and the cost to the consumer.

Micro-oxygenation is complex. It requires attention to detail and close monitoring of the development of the wine to determine when and how to administer the precise doses of oxygen. If too little or too much oxygen is used or the rate of addition is incorrect, the desired results will not be achieved. Monitoring wine development is done primarily through taste, though certain chemistries are followed. The administration of the oxygen is accomplished through the use of highly specialized equipment created just for this application.

Micro-oxygenation involves injecting extremely small amounts of pure oxygen into the wine. The amounts are very small and are measured in a few milliliters (teaspoons). Then imagine one-half of that volume of oxygen being administered to a liter of wine over the course of a month. The oxygen is injected through a filter that forms microscopic bubbles so that the oxygen gets absorbed into the wine instead of bubbling up to the top. The wine vessels used are usually stainless steel tanks. The oxygen added provides the raw material for the development and polymerization of tannins. The trick of using micro-oxygenation is to get just the right amount of oxygen into the wine precisely when it is needed.

Micro-oxygenation allows winemakers to control how a wine and its tannins are developing without having to use barrels and account for the variation in the rate of development in specific barrels. This is especially advantageous when large lots of wine are being made and the variations between barrels become a hindrance, rather than an advantage. Another benefit is that, by eliminating barrel contact, winemakers can minimize the risk of exposure to wine spoilage organisms which can colonize the interior surfaces of barrels (specifically *Brettanomyces*). These “bugs” are especially prevalent when large lots of wine are blended and returned to barrel, effectively mixing one contaminated barrel with hundreds of others and rapidly spreading the infection. Once a barrel is infected with “Brett” there is no easy way to eliminate the organism from the wood.

Proper micro-oxygenation can create wines with more pure fruit, less vegetal flavors and aromas, and less wine spoilage risk than barrel-aged wines. It also allows for the creation of a more positive mouth feel and enhanced textures than wines aged in tank using only *Interstaves* or other oak alternatives.

### Lees Contact and Lees Contact with stirring

Lees are the deposits of dead yeast cells and other particles that fall to the bottom of a container of wine during aging. The purpose of lees contact is to allow for the yeast cells, which ferment the wine, to autolyse, or break down and release their contents into the wine. This results in added richness, creaminess, and elevated mouthfeel while adding to the long-term ageability of

the wine. Stirring of the lees accelerates autolysis and increases the exposure of the lees to the wine by periodically re-suspending the lees within the wine.

The winemaker initiates the process of lees contact after pressing when deciding how long to settle in tank. The amount of lees in the barrel and the resultant effect of lees contact are determined by how many solids are removed during the initial settling time. If the goal is to increase the wine's body, texture, and richness, then more and longer lees contact will be employed, and the settling time will be minimal. Lees contact leading to autolysis of the yeast is accomplished over a number of months in tank or barrel. A secondary result of stirring the lees while the wine is in barrel is oxygen pickup into the wine, which will accelerate aging. By agitating the wine while suspending the yeast, residual CO<sub>2</sub> is blown off from primary and secondary fermentations, thus furthering the aging process.

### **Racking**

Racking is the movement of the wine from barrel to tank and back to barrel, or from barrel to barrel through various means, leaving the settled solids behind. The racking process may or may not include air contact, although racking without any air contact is difficult. One purpose of racking is to accelerate the aging of wine. Racking results in softening of tannins, blowing off of any H<sub>2</sub>S/sulfides, fermentation and malolactic characters, and separating the wine from its lees in preparation for bottling.

Racking regime and the frequency of racking vary widely between winemakers and between vintages. Some winemakers rack their wines regularly every year, one or more times regardless of the conditions. There are those that never rack except to go to tank to blend the various lots in a tank prior to bottling. Key indicators of a wine that is in need of racking include stinky sulfide aromas or a wine that is tight and not showing its "stuff." Cooler vintages, such as 1993 and 2007, may produce wines that are less opulent in style and may benefit by an extra racking to expose them to more air during the aging process.

The methodology of racking includes three different modes: pump, gravity, or pressurization systems. The winemaker chooses one of these methods based upon personal choice, the layout of the winery, the tools and conditions available, and the amount of air exposure desired. The methods of racking are highly variable with regard to the amount of oxygen picked up by the wine, as well as the level of gentleness.

Many types of pumps are available. Progressive-cavity and air-diaphragm pumps are the most gentle, essentially pushing the wine through the wine hose. Impeller and centrifugal pumps may agitate the wine as it is moved from barrel to tank or back to barrel, especially if operated at high speeds. Racking via gravity is another means and can be very gentle.

One pressure racking system, the *Bulldog Pup*, is commonly used in Oregon. This device is inserted into the barrel with the tip just above the level of the lees at the bottom of the barrel. The top of the Bulldog seals the barrel and Nitrogen pressure is applied through a small inlet on the Bulldog to gently push the wine out of the barrel.

Each method discussed above is at times more appropriate than the other. The wine may also be splashed into the receiving tank if additional aeration is desired.

## **Malolactic Fermentation**

The purpose of malolactic (ML) fermentation is to soften and round out the wine through the conversion of malic acid to lactic acid, a weaker acid. This conversion takes place through the action of a specific bacteria, *Oenococcus oeni*, growing in the wine. As the acid is reduced, the pH is elevated. Almost every Pinot noir produced completes malolactic fermentation.

Winemakers' attitudes and practices on the use, or non-use of ML cultures vary widely from cellar to cellar. ML bacteria are indigenous in wine. Many winemakers do not inoculate for ML and simply allow Mother Nature to do her thing. Others inoculate the wine in barrel, while others do so directly in the fermenter. The reasoning behind the timing of inoculation or non-inoculation varies. Some winemakers prefer a long slow ML fermentation because they believe it makes better wines. By delaying the pH shift, the wine may achieve better color stability by allowing the polymerization of anthocyanins and tannins to occur at a lower pH.

The downside risk of a delayed ML completion is the risk of growing spoilage organisms. During malolactic fermentation, the SO<sub>2</sub> level must be very low for the ML bacteria to grow successfully. SO<sub>2</sub> also inhibits the growth of spoilage organisms. If it is low, then *Brettanomyces* (a yeast), *pediococcus*, or *lactobacillus* (bacteria) may grow and create off characters in the wine. One goal of inoculating in the fermenter is to accelerate completion of ML by taking advantage of warm fermentation temperatures that ML bacteria prefer. The early completion of ML allows for an earlier sulfiting of the wine (adding SO<sub>2</sub>) affording protection against *Brettanomyces* and other spoilage organisms.

Another consideration is how quickly the wine needs to be on the market. An early-to-market wine needs to finish ML as soon as possible after harvest. There are several different strains of ML bacteria commercially available to begin the process quickly. Each has its advantages and disadvantages with regard to pH and temperature tolerance as well as organoleptic characteristics. ML bacteria, like all living organisms, are temperature-dependent and function best above a minimum temperature. As spring approaches in the winery, the temperatures warm in the cellar and ML bacteria do their magic, transforming a wine from being somewhat tart to a softer and rounder character. Color intensity may shift from ruby to more brick-red, and the wine can lose color if the pH rises too much as the wine completes ML. Winemakers check the pH prior to ML, and if it is above a certain level, add tartaric acid to prevent this from occurring.

## **Barrel Aging**

Barrels are part of the tradition and romance of winemaking. The use of barrels in winemaking goes back 1,600-1,700 years. The expectation of many consumers and producers alike is that the best wines, especially great Pinot noirs, are aged in barrel. Barrels are beautiful to look at and provide wonderful flavors and aromas that complement and enhance Pinot noir. French oak barrels can cost more than \$1,100 per barrel, and prices continue to increase. After the expense of growing or buying grapes, barrels are the next most significant expense that a winery faces. The cost to put wine into new barrels is passed on to the consumer. This cost is easily absorbed by super-premium wines, but the cost to put Pinot noir at a price point less than \$20 in new barrels can be prohibitive.

The primary effect of the barrel is to allow the wine to develop body and flavors that increase the quality and pleasure of wine. The exact processes that occur during the time in barrel are unknown, are certainly very complex, involving reactions of naturally occurring tannins. Tannins in the wine and tannins in wood molecularly bind with each other and with flavor and color

components, which naturally occur in the wine, to form new and larger molecules. These complex chemical reactions take place in the presence of very small amounts of oxygen introduced through the wood itself (wood floats because it has small pockets of air in the wood) and during the topping process when the barrels are briefly opened. The tannins soften and the flavors integrate during this aging (or “élevage”) process.

The natural porosity of oak allows oxygen trapped in the wood to slowly migrate into the wine, with water and alcohol evaporating out. Wood porosity is not uniform from tree to tree or even within a given tree. The reason for this variability is that barrel wood comes from trees grown in different geographical locations and diverse climates, rooted in soils of varying fertility. All of these factors affect the grain structure of the wood. Each barrel will be unique. The techniques used to clean barrels will also effect oxygen migration. Barrels are variable in the rate they age wine. This is based partly on the forest the oak is grown in, the method of construction used by the cooper, and the toast level.

Managing a barrel program is an art form of its own. Small lots of wine can be managed individually to maximize quality. Barrel choice can be tailored to specific lots and vineyard sites. However, lots of thousands or tens of thousands of cases can present a different problem.

### Choice of barrels

The standard barrel is 225-228 liters (60 gallons). It contains around 25 cases or 300 bottles of wine. Barrels considerably smaller and larger also can be found. Virtually the only wood used to build barrels for wine is oak.

Traditionally, fine Pinot noir has been aged in small French oak barrels after fermentation. The oak used to produce barrels comes from the “center” regions of France. The staves are split from logs and stacked and aged on pallets out in the weather anywhere from 18 to 36 months. The rain and sun cause a reduction in the raw, green flavors and a reduction of harsh tannins. Barrels typically are specified by forest, length of aging/drying time, grain width (indicating how fast the tree grew; north hillside vs. south), toasting level, shape (Burgundy vs. Bordeaux), export (metal hoops), or Chateau-style (metal and willow hoops). This is still the “normal” regime, but as barrel prices rise, there are some other options emerging for lower price points such as wood from other regions. Oregon oak offers certain resemblance to French wood in terms of flavor and phenology. Other oak sources include Hungarian, Russian, and other Eastern European forests.

The cooper, or barrel maker, builds barrels within a “house” style. The flavors are influenced by the details of construction: e.g. using a hot fire to toast and bend the barrel staves vs. using hot water to bend the staves. The goal is to have a curved stave that does not crack. The way it is bent will change the flavor and aroma imparted by the barrel, impacting the aroma and flavor of the wine aged in that barrel. Barrels can be specified with toast levels from light to heavy with multiple levels between those extremes. The heat used during the toasting caramelizes the wood sugars, creating variations in flavor and aromas from slightly toasty through heavily smoked. The toast level dramatically changes the flavors imparted to the wine. A heavy toast imparts the most intense flavors and can mask some more delicate wine flavors and aromas. A lighter toaster gives less oak, smoke, and caramel flavors and can reveal more nuances, especially in a delicate wine.

Winemaker stylistic goals strongly influence the types of barrels used, the forests, the toast levels, the percentage of new barrels, and the length of time the wine is kept in barrel. The vineyard and vintage also have an effect on how the wine will develop in barrels. The same wine

will vary in how it reveals the details of its flavor, aroma, and texture as well as how well-integrated it is in different barrels. Finding just the right fit for a specific terroir can be difficult to achieve. Developing a barrel program that optimizes the vineyard's terroir and winemaker's style can take many years to refine. Many winemakers will make different barrel choices for specific wines and alter the length of time in barrel based on how the wine develops in specific vintages.

### Barrel aging regime

The specific way barrels are handled and used varies widely from winemaker to winemaker. Everything from the preparation of new barrels (hot water soak, steam, or rock salt and water) to length of time the wine spends in wood can have an impact on wine style. Generally speaking, new barrels get some treatment to assure that they are "tight" and will not leak. This usually involves steaming or filling the barrels with water. Once the barrels are tight, the water is removed and they are filled with wine. Most Pinot noirs will spend at least 11 months in barrels. If the wine is removed before the next vintage, this allows the barrels to be reused for the next harvest. This saves cost on both barrels and storage space. Higher-end wines may be held in barrel past the vintage for as much as 20 or more months, adding to the aging costs and requiring the winery to have a second set of barrels and a place to store them.

Cellar temperature and humidity are important. Most cellars will follow the season's temperatures in a broad sense, warming in spring and cooling a bit in winter. A range of 55°F to 63°F is normal for most aboveground cellars. Cold temperatures will slow the rate of microbiological activity, whether it is the completion of alcoholic or the malolactic fermentation. Barrel rooms can be heated to encourage the malolactic fermentation to finish, usually to the mid-60s. There is a lower rate of activity in barrels during the winter in Oregon. Underground cellars are more temperature-stable and hold a temperature of close to 59°F year-round.

Cellar humidity has a significant impact on wine aging in barrel. Evaporation from barrels occurs through the wood pores with both water and alcohol molecules being lost. All of the other components of wine stay in the barrel. The net effect is that the wine is concentrated a small amount during barrel aging. The portion lost has been called the "angels' share." This is usually about one-quarter of a percent per month. If the winery produces 10,000 cases, this is about one barrel per month. Below 80% relative humidity the barrel will lose a higher proportion of water into the air. A cellar above 80% will actually encourage the loss of alcohol and a lowering of the resulting alcohol of the wine. This can be a useful tool to fractionally alter the alcohol level. Either way some volume will evaporate during aging and requires "topping" barrels with wine every one to four weeks depending on the temperature, humidity, and winemaker style.

## **FINISHING**

After the aging time is completed, it is time to prepare the wine for bottling. Finishing provides the final opportunity to modify the wine before it is placed in the bottle. Finishing can be divided into three categories: blending, fining and filtration, and any final adjustments or additions to the wine.

### **Blending**

Blending is probably one of the most important skills a winemaker learns. Oregon winemakers commonly separate and age as many lots of Pinot noir as they can. This allows them to see how different vineyards, different parts of vineyards, different age of plants, different clones of plants, and different winemaking choices develop in their cellars. From these distinct lots, the

winemaker creates the final wines. Experience plays a key role in these decisions. The winemaker tastes and evaluates diverse lots of wine and decides how these can be combined to create a finished wine that maximizes the positive attributes and minimizes the negative ones. It is frequently possible to take several wines that have obvious deficiencies, blend them together and create a wine that is significantly better than any of its component parts. At its most basic, a winemaker will blend new and used barrels of wine to create the right balance of wood tannins.

### **Stabilization**

#### **Laboratory Analysis**

Just prior to bottling, the winemaker runs tests to determine the wine's pH, acidity, alcohol, and SO<sub>2</sub>. If SO<sub>2</sub> needs to be adjusted, it is done now. Late acid additions are very uncommon, mostly because they do not integrate into the wine well at this late stage in aging. Small acid additions are sometimes used prior to bottling to "brighten" a wine that seems flat. The activity of SO<sub>2</sub> depends on the wine's pH and quantity of the active form of SO<sub>2</sub> in the wine. SO<sub>2</sub> levels drop over time, and the exact level at bottling is determined by the style of wine, its tannin profile, and the expected duration of aging. Winemakers measure active portions of the SO<sub>2</sub>, not just the total amount, and use that number to calculate the correct addition.

#### **Fining and Filtration**

Fining and filtration are tools for clarification and for tannin and flavor modification of wine. Wines can have a high volume of suspended solids that will not clarify by settling and need to be removed prior to bottling. Some wines have bitter and unpleasant tannins or other negative flavor compounds that need to be removed or modified. The decision to fine or filter a wine depends on the specific problem that needs to be addressed. The choice of what to do is often based on small experiments called bench trials. The winemaker takes small samples of wine and adds various fining agents or combinations of fining agents to determine their effectiveness in solving the problem. That information is then used to treat the entire lot. The most common fining agents are egg whites, gelatin, milk and casein (a milk protein), and isinglass (protein from the air bladder of a sturgeon). These are often effective in extremely small doses, measured in ounces per one thousand gallons.

Bitterness is one of the more common problems addressed by adding fining agents. As wines age and develop, tannin molecules connect into chains of varying lengths. Some of these are perceived as bitter or astringent and can be removed by adding specific proteins to the wine. Unfortunately, there is no laboratory test to analyze exactly what tannins are causing the problems or what treatments are most effective in their removal. Luckily there are a wide variety of fining agents, and the best treatment can be determined by bench trials using specific agents at varying doses. Although effective in removing undesired tannins, fining a wine always removes some positive flavor components.

Another common problem that a winemaker may have to address is the issue of hydrogen sulphide (H<sub>2</sub>S) "off" odors. Hydrogen sulphide can occur at any step of the winemaking process from fermentation to bottle aging, but is generated in the highest quantities during fermentation as a natural by-product of yeast metabolism. It manifests itself in wine as a rubbery, burnt matchstick, or rotten egg smell. The addition of a minute amount of copper sulphate before barrel aging or before bottling can be used to fine out these off-odors in a wine.

Of course the ultimate goal in fermenting, pressing, and aging is to end up with all of the extracts and flavors that the winemaker wants, and nothing extra. That way, nothing will have to be removed. That is a lofty goal indeed.

Filtration used to be commonplace and did not have the negative associations that it has come to have today. In the best hands, a basic plate and frame filter with paper pads can act to polish the tannins, removing coarse, unpleasant characters and leaving, smooth, supple, sweet tannins and a lovely wine. But that is not easy to do. Like fining, filtration may remove some positive elements. Admitting that you filter can bring very negative associations, so winemakers often avoid the practice. It is difficult to filter well, and the art is being lost.

In certain circumstances filtration is necessary. White wines are commonly filtered. Every wine with a partial or no malolactic fermentation must be filtered. Every sweet white wine must be filtered. Essentially, if the wine has bugs and if the bugs have something to eat, then they will eat it and cause problems. If there is food in the wine (sugar, malic acid), then the bugs have to go. Filtration removes the bugs. Unfortunately there are some bugs that will eat anything, and if those bugs are in the wine, especially in significant numbers, they could grow and have very negative consequences. Those bugs are indigenous yeasts called *Brettanomyces* (Brett). The difficult thing with Brett cells is that they are very unpredictable. They may be present in the wine and not grow; often the winemaker does not even know that they are present. They may be present and only grow in a proportion of the bottles, producing very uneven lots: some perfectly normal and some very “Bretty.” And they can grow like crazy, creating characteristic flavors and aromas throughout the lot.

When a wine must be filtered to remove bugs, the winemaker must decide how best to accomplish this task. Large bugs (like Brett) can be removed with relatively coarse filter pads that remove less positive attributes than tighter pads designed to eliminate the much smaller malolactic bacteria. Crossflow membrane filtration is being used more commonly because it avoids absorbent paper pads, instead relying on polymer tubes with precise pores that essentially “sieve” out the organisms. This eliminates the potential stripping effect of absorbent cellulose pads. However, crossflow filters operate at very high pressures, and it is not clear how those pressures affect the wine.

### **Bottling**

This sounds so simple: fill a bottle and seal the top. In reality, bottling is one of the most difficult tasks performed by the winemaker and can be extremely stressful. This is the last opportunity to influence the wine. Winemakers have poured their heart and soul into getting the wine as close to perfection as possible. The wine has spent all of its life in the winery and now you have to decide that it is ready to leave and that you have done everything you wanted. If this sounds like a recipe for neurosis, you are correct. Months before any bottling date, all of the bottling components must be ordered: labels, corks or other closures, foils, and glass (bottles). They must all arrive at the proper time, with the proper information. Mistakes can be very expensive.

### **Closures**

A plethora of closure options are currently available. From a winemaking perspective, it is a question of how much or how little oxygen is able to move through the closure over a span of years. When properly applied, screw caps allow essentially no air transfer. Because of this, the winemaker must be careful to eliminate any reductive characters before bottling and make sure that the wine has seen a small amount of air to further development of the wine after bottling.

They are very inexpensive and include the “foil,” further reducing packaging costs. Because they are formed from soft metal, they may be damaged by rough handling. Screw caps can cost less than \$0.15 per bottle.

There is a clear difference in both the short- and long-term impacts between these anaerobic closures and traditional cork. Cork contains air cells (it floats) and has been shown to allow the entry of very small amounts of air over the span of years. A wine sealed by cork will age differently over many years than a wine sealed with an anaerobic closure. Cork is a natural product. The amount of air transfer varies with the particular cork and is likely to account for some of the variation between bottles, especially after many years of aging. This is still the most common closure for premium Pinot noir in Oregon. Cork is the most expensive closure currently available and can cost in excess of \$0.80 per bottle.

Synthetic corks eliminate the possibility of TCA contamination or “corked” wines. They vary widely in their specific permeability to oxygen and have been shown to absorb some aromatic substances. The effectiveness over extended time periods has not been demonstrated and some winemakers avoid their use for wines intended for extended aging. They cost between \$0.10 and \$0.15 per bottle.

Glass closures are beginning to be used to seal wine bottles in Oregon. Originally developed in Germany, they provide a very secure seal, do not absorb aromatic compounds, and provide an almost anaerobic seal. Their cost is somewhere between synthetic closures and cork.

### Packaging

Most wineries look to professional designers for assistance in their packaging design. Winemakers often have specific input into label design, foil design, and sometimes in the selection of bottles. Label copy may be written by the winemaker or it may be the task of the marketing staff or a combination of the two. Label shape and paper stock are sometimes limited because the winery’s labeling machine has specific limitations. Bottles are often a stylistic statement. Heavier and thicker bottles that suggest more expensive and “better” wine are waning in use. Wineries concerned about their carbon footprint are selecting lighter bottles produced locally. At its essence, packaging is about creating a physical expression of the goals of the winemaker and winery. In Oregon, a high percentage of wineries are owned by the winemaker. In that case, the package is closely linked with their stylistic goals.

### Bottling Machines

Many Oregon wineries do not own their bottling equipment because it is expensive to purchase and challenging to maintain. The use of a mobile bottling line is a quality alternative that is an attractive option. The critical task of the bottling line is to fill the bottles with a minimal amount of oxygen uptake during the bottling process. Bottles are commonly sparged with an inert gas to reduce the amount of oxygen in the bottle. Nitrogen is most commonly used. Argon is highly effective but is expensive. Carbon dioxide can be used but is absorbed into the wine. During bottling, wine sprays out of the filler tube, filling the bottle. If the atmosphere in the bottle contains less oxygen, then the wine is less aerated in the process. Vacuum corkers are common and reduce the pressure in the headspace during corking to the same as atmospheric (otherwise the cork compresses the air as it is inserted). Winemakers can use different gasses to sparge and use different flow rates to allow more or less aeration to take place during the bottling process. This final “breath” or lack thereof, will affect the rate of flavor development and the evolution of

tannins after bottling. A larger “breath” will move the development process further along than a highly anaerobic bottling.

## **CONCLUSION**

Winemakers direct the style of Pinot noir they produce by making a wide variety of vineyard management, picking, fermentation, aging, and finishing decisions. Vineyard decisions, from planting to harvest, strongly influence the flavors, tannin development, and soundness of the fruit that the vine will produce. The winemaker’s response to fall weather conditions and disease pressure allows for fine-tuning of fruit maturity and cluster health even in difficult harvest conditions. It is not a question of rain or heat, rather a question of how the fruit in a particular block is responding to the conditions and when is the best time to pick the best quality and ripest fruit.

Once the fruit has been picked, the winemaker evaluates the condition, flavor profile, and tannin development and decides how to sort and handle the clusters. The decision to use whole clusters, to destem, and to break the berry skins begins the process of extraction. That process continues as the winemaker decides the temperature profile of fermentation, whether to inoculate, and how to manage the fermentation cap. At the end of fermentation the winemaker decides when to press, how hard to press, and how to manage the press fractions. These decisions determine the balance of fruit, tannins, color, and body of the young wine.

After pressing, the wine may be settled and then is racked to containers to age. The use of barrel or tank, the type and amount of oak the wine sees and in what form affect the flavor and tannin profile further. Additional techniques such as lees contact, micro-oxygenation, and use of oak alternatives further guide the wine’s development.

After aging, the wine is prepared for bottling. Depending on the specific needs of the wine, this may be as simple as racking to blend various lots or may involve fining or filtration. Specific problems have a variety of solutions, and the winemaker decides on the course of action that maximizes the positive outcome and minimizes any negative impact on wine quality. Finally the wine is bottled.

At every step of this process, the winemaker makes an evaluation of the wine at that moment in time. The consequent decision guides the wine toward his or her vision of what the wine should be. This occurs many times during the winemaking process, with each step further defining the wine. Sometimes the decisions are easy and the wine “makes itself.” At other times the skill and experience of the winemaker are critical to achieving that vision. It is said that in easy years anyone can make good wine. It is in the tough vintages that the best winemakers emerge. Great wine can be made in any vintage, and that is the goal of every winemaker.

*Written by Mark Vlossak for Pinot Camp 2008, with the assistance of Pat Dudley, David Adelsheim, and the other seminar panelists. Edited by Anthony King, Andrew Davis, and Annie Shull in 2010.*

# OREGON PINOT NOIR

*Winemaking Deconstructed*

*Moderators and Panelists*

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## **MODERATORS**

### **James Cahill**

Winemaker James Cahill is a veteran of 18 vintages in Oregon, including five years as Assistant Winemaker/Operations Manager at Beaux Frères and two years as Vineyard Manager and Co-winemaker at Elk Cove Vineyards. For the past decade, he has managed winemaking and operations at Tony Soter's Mineral Springs Ranch in Carlton, where he currently contributes his broad range of talents and an unbridled enthusiasm for Oregon Pinot Noir and sparkling wines. This year James and Brian Sypher announced a partnership with Tony and Michelle Soter in North Valley Vineyards.

### **Jesse Lange**

Jesse is a second generation winemaker and winegrower working at his family's twenty-eight (!) year old, 60-acre estate in the heart of the Dundee Hills. Jesse had his start in viticulture by assisting his parents, Don and Wendy, in planting (read: pounded posts and weeding) the original 8 acres of Lange Estate in 1988. Jesse's formal enology and viticulture training occurred at New Zealand's Lincoln University while on student exchange from Oregon State in 1999. Jesse also spent two years under winemaker Bruce McGuire at Santa Barbara winery. He enjoys serving his industry and community by participating on the Board of Directors for Oregon Pinot Camp, the Willamette Valley Winegrowers Association, and former President of the Dundee Hills Winegrowers Association. Lange was named Snooth.com Winery of the Year in 2011 and Wine & Spirits Magazine Winery of the Year in 2012. He enjoys fly-fishing for steelhead, trying not to die during triathlons, running with his Golden Retriever Maggie, and just about everything else halfway athletic and fully outdoors.

## **PANELISTS**

### **Melissa Burr**

Melissa is a native Oregonian. After attaining a science degree at PSU she changed her career path from medicine to winemaking, taking courses at Chemeketa and OSU. She worked several years at local wineries before joining Stoller Family Estate as winemaker in 2003. She had a part in helping to design the Stoller winery, the first LEED certified (Leadership in Energy and Environmental Design) winery in the US. Melissa strives make the best wines possible and enjoys the experience each vintage has to offer.

### **Bryan Croft**

While studying Economics and Geology at the University of California, Davis, Bryan Croft developed a passion for wine. After graduation, drawn to the Stags Leap District of Napa Valley where he would work for the next four years, Bryan learned an invaluable lesson that would become the foundation of his winemaking style, balance through blending. In 1996, inspired by what others had been achieving to the north, he left Cabernet country to pursue Pinot Noir in Oregon. For seventeen vintages now at Firesteed Cellars, Bryan has continued the winery's tradition of defying what was thought possible for a value-priced Pinot Noir, crafted world-class bottlings that showcase the ageability of Oregon's premier variety and created highly-acclaimed, richly aromatic white wines, Pinot Gris, Riesling and Chardonnay.

### Derek Einberger

As Winemaker and Vineyard Manager, Derek tends and shapes Patton Valley grapes from bud break to bottle. Raised in the Napa Valley, Derek felt drawn to wine making, but the road to Patton Valley took some twists and turns. He studied sculpture at the University of Redlands before moving to Portland to work in the arts. While biding time as a server at McMenamins Kennedy School, Derek took to brewing, practicing the brewer's art and science first at McMenamins, then at the Alameda Brewhouse, and finally at Bridgeport Brewing Company. Many batches of beer later, Derek found himself slowly pulled toward wine, working harvest positions at Vietti in Northern Italy, Joseph Phelps and Twomey Cellars in California, and Domaine Serene in the Willamette Valley. These positions led to a job as Lemelson Vineyard's Cellarmaster where he remained until 2010, when Derek joined Patton Valley. When Derek's not making wine, he's working on his house, playing with son Crosby and wife Jen, getting outdoors, traveling, and even making sculpture once in a great while.

### Ryan Harms

When Ryan first ventured to Oregon in the '90s to test his feet in the wine industry as a curious young harvest intern, he knew he'd be back. A native of the Midwest, Ryan spent the latter part of his childhood in upstate New York outside the Finger Lakes wine region. He received his bachelor's degree in environmental science from Binghamton University in New York. After realizing that corporate America was not for him, in 2001, Ryan convinced his wife that Oregon's vineyards were calling him, and across the country they came. Ryan spent time working for some of the most well-respected Pinot Noir producers in the Willamette Valley, including Bergstrom Wines, Torii Mor Vineyards and Winery, Rex Hill Vineyards/A to Z Wineworks and Hawks View Cellars. In 2005, Ryan founded Union Wine Company. His mission was to keep the craft he loved alive, while producing everyday wines that people could afford to drink. By combining modern mechanization and skilled craftsmanship at their industrial winemaking facility in Tualatin, Union Wine Co. produces three different series of uniquely Oregon wines under Ryan's leadership: Kings Ridge, Underwood and Alchemist.

### Gary Horner

Gary is winemaker for Erath Winery, one of Oregon's pioneering Pinot noir producers and the first winery in the Dundee Hills. Gary's interest in wine evolved in the mid 1980's while working as a clinical pharmacist. Selling his motorcycle to buy home winemaking equipment, a new career was born. In 1988 he moved to the Willamette Valley where he started making wine commercially at various wineries, including Bethel Heights, Witness Tree and Benton Lane. Joining Erath in 2003, Gary is committed to creating high quality wines by carefully balancing tradition with the latest winemaking technology, melding artistry with science. Respectful of the delicacy of Pinot noir, he avoids over-extraction and is judicious about barrel selection, thus showcasing the wine's soft, fruit forward characteristics. Gary's winemaking philosophy is "to make the best Pinot noir the region has to offer—distinctive, authentic, and uniquely Oregon."

### Thomas Houseman

Thomas' winemaking career unofficially began in the basement of his parent's home in Hampton Roads, Virginia. His Welch's grape juice and orange juice concentrate wines are lost in time, but we're sure they'd be showing well if any remained. Thomas went on to New York City, where he pursued a career in modern dance. Traveling the globe performing was great but it did not get him much free beer. So, he bought a book and taught himself to brew.

With the creativity of a dancer, the eye of a scientist, and the encouragement of friends who loved the free beer, the passion for fermenting reemerged. Thomas left the stage and went back to school at CSU Fresno in the enology program. It was there he fell in love with Pinot noir.

And, across the globe he embarked again, first to California's Anderson Valley, then to New Zealand, and finally to Oregon. After four years at Ponzi Vineyards, Thomas saw the opportunity to express himself at Anne Amie Vineyards where he has been able to refine his winemaking style.

He is happy he can still use words like balance, grace, fluidity, elegance, power and style- words that once described his dancing, now describe his wines.

#### Nate Klostermann

Nate was appointed to winemaker at Argyle Winery in March of 2013 after serving as Argyle's enologist since 2005. While studying food science at the University of Minnesota, he developed a budding interest in wine production. After getting a taste of the industry at Falconer Vineyards along the Mississippi River in Red Wing, MN, he packed up his beat-up Acura Integra and drove west to Dundee, OR. Starting as a harvest intern and quickly promoted to enologist, Nate studied under the tutelage of the legendary, Rollin Soles. Quickly falling in love with the sparkling winemaking process, Nate embraces the year round challenges sparkling wine production entails. As he has learned from Rollin, he believes that making great sparkling wine carries over and improves the winemaking techniques for still Pinot Noir, Chardonnay, and Riesling. A firm believer in ageability, Nate constructs wines that drink well when young, but also build depth and complexity with time. He has also worked in Australia at Petaluma and Knappstein wineries, developing a keen interest in Clare Valley Riesling.

#### Florent-Pierre Merlier

As head of Van Duzer's winemaking program, Florent-Pierre "Flo" Merlier embraces cool climate wines that are elegant, vibrant and expressive. To achieve the desired refinement, Merlier has driven the focus on small lot processes, and sorting and gentle handling. A native of Burgundy, France, the physics and chemistry undergraduate was captivated by winemaking when he helped a good friend operate a 40-acre family domaine in Burgundy. He subsequently altered his career path from cinema to wine and in the process met his wife, Krista, an Oregonian, interning at the same winery. Merlier capped his study at the University of Dijon with a Diploma of Viticulture before relocating to the US in 2009.

#### Scott Shull

Scott Shull founded Raptor Ridge Winery in 1995, a sought-after producer of Oregon Pinot noir, Pinot gris, and Grüner Veltliner. As winemaker, Scott handcrafts about 7,500 cases of artisan wine each year with the help of his wife Annie who manages Sales, Marketing and Distribution. The Shulls strive to produce wines of complexity, finesse and of place. Located in the Chehalem Mountains, Raptor Ridge Estate is a 27-acre vineyard, planted to the above mentioned varieties.

Additionally, ten distinguished regional vineyards supply fine wine grapes to Raptor Ridge under long-term contracts. Scott and Annie are founding members of Oregon Pinot Camp and Annie was President of OPC '08, and has served on its board. Scott is President Emeritus of The Chehalem Mountains Winegrowers Board, a Board Advisor of the ¡Salud! vineyard workers healthcare charity, and was a founding director of the Oregon Wine Board and the Oregon Winegrowers Association. Occasionally, the Shulls see each other at home.

### Alex Sokol Blosser

Alex Sokol Blosser, son of Sokol Blosser's founders Susan Sokol Blosser and Bill Blosser, grew up working in the family vineyards and winery. After starting college in Texas, he realized his heart lay back on the family farm, so he returned to Oregon to finish his college degree and acquire more wine industry experience. In 1998, after working in neighboring vineyards and with a Portland wine wholesaler, Alex started full time at Sokol Blosser, simultaneously worked for the president, his mom, Susan, while earning his MBA degree. When he achieved his MBA, Alex became Vice President of Sales at Sokol Blosser. In addition to his sales duties, Alex took time every year to work harvest.

Now as Co-President with his sister Alison, Alex actively participates in the Oregon wine industry, including spearheading the project to develop six new American Viticultural Areas in the northern Willamette Valley in 2002. Alex is also Winemaker, overseeing the vineyard and winemaking at Sokol Blosser. Alex currently serves on the board of the Willamette Valley Wineries Association. Alex has twin boys, Nikolas and Avery.