SENSE OF PLACE

Terroir in Oregon Pinot Noir

The purpose of this workshop is to examine the intent of the winemaker and understand how winemaking choices affect the entire process from vine to wine, in an interactive tasting and discussion with Oregon Winemakers to explore and demystify the Oregon *terroir*. While we mostly share the same plant materials, we will discuss the differences and the complex interactions between soils, sense of place and effect of the microclimate. Tasting will illustrate these factors that influence winemaking goals, style and of the end wines that are the landmark of Oregon.

Where we grow Pinot noir makes a difference and creates the Oregon paradox.

The workshop contains three sections:

Taste the dirt
In this flight, three pairs of Pinot Noir (pair made by the same producer) from the 3 major soil type are blind tasted (sedimentary, loess and volcanic). We will examine how soil affects water holding capacity, nutrient intake, and finished wines.

Aspect
In this flight, taste how elevation, wind influence, and other factors affect the intricacy and personality of Oregon wines. We will discuss how wind influences phenolic ripeness (through an increase of skin thickness) and how elevation or degree of the slope influences temperature and degree day accumulation.

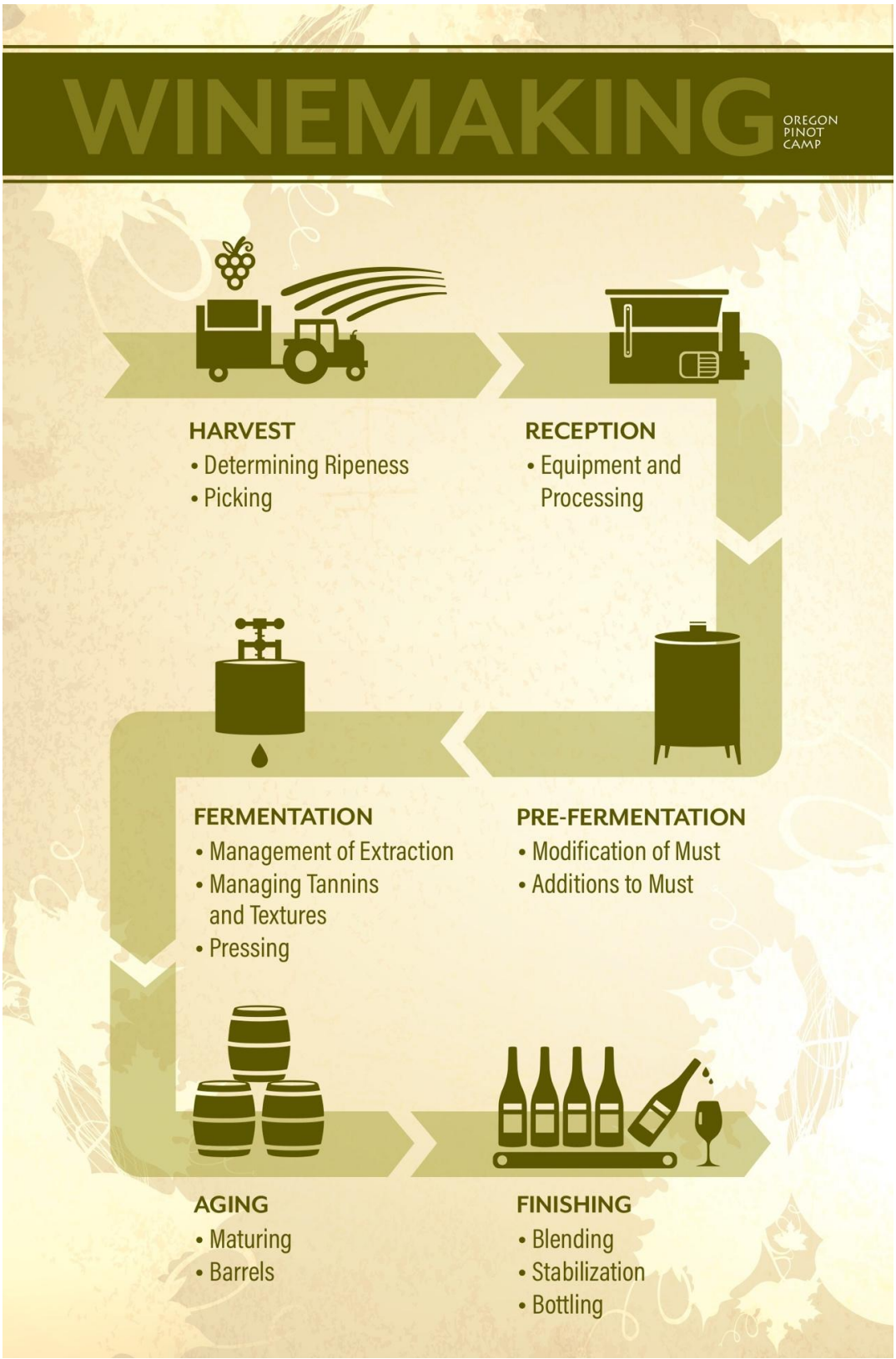
Site specific/Panelist tasting
Each Panelist presents their own set of wines that showcases significant differences based on soil/aspect/microclimate differences within the parameters of roughly consistent winemaking practices.
Wines are tasted blind in pairs followed by panelist presentation.

WORKSHOP DETAILS
More information available at this link following OPC.

POINTS TO INVESTIGATE

- Deciding when to harvest based on intent
- Fruit handling from the vineyard to the fermenter

- Modifications to the grape must
- Fermentation management and its relation to the winemaker's intent
- Aging decisions and their impact on stylistic goals
- Finishing, filtering and bottling



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 and the wines.

The winemaker will have input and some control over seasonal variables in the vineyard. Pruning, crop load, canopy management, spray programs and soil management can all be manipulated in response to seasonal conditions. The timing of picking will affect the specific wine chemistries and flavor profile. Each of these decisions in the vineyard will affect the flavor spectrum, tannin development, color intensity and wine chemistries; primarily pH, acidity and sugar content (Brix).

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_2) and ethanol in roughly equal quantities by weight.

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 that we harvest, and to influence the wines that are made.

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, kinetics 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 vintage, development of the wine and stylistic goals. 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.

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.

After fermentation, the must is pressed to separate 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, which can be very difficult to achieve.

After pressing, the wine is aged before bottling. The choice of aging vessels, the size and construction of these 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.

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:

a. Harvest
b. Reception
c. Pre-fermentation
d. Fermentation and Pressing
e. Aging
f. 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 with cooler weather. Warm weather increases the rate of sugar accumulation, pulp softening, skin fragility and the loss of acidity. 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, texture and condition. Seeds are examined both visually and by tasting to see how the level of tannin ripeness is developing.

The sample 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.

Grape maturity 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 between 100 and 110 days post-bloom. 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 and fertilization varies from vintage to vintage.

In western Oregon's cooler climate, winemakers do not always have the luxury of making a picking decision based solely on ripeness of fruit. Winemakers are faced with several factors that can affect picking decisions: weather predictions, risk of disease and level of 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, sun and soil permeability.

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 other 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.

The grapes are usually picked by hand. This allows the whole cluster to reach the winery intact. 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. 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.

RECEPTION

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 moved by hand to the destemmer or tank. It can also be very complicated, with bin dumpers, shaker tables, conveyers and elevators to give the winemaker a chance to remove any debris or damaged fruit.

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. This is simply a device that tumbles the 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. Some winemakers choose to use a percentage of whole clusters in their fermentation. This is achieved by bypassing the destemmer and simply dumping the chosen amount of clusters directly into the fermenter or by adding selected stems into the tank.

From the destemmer, the berries are transferred to the fermenter. This can be as simple as locating the destemmer above the tank, with the must dropping vertically into the tank. 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 are protected from any damage during the transfer process.

Cooling

As the fermentation tank is being filled with fruit from the sorting/destemming 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, which has a direct impact on berry structure and cell walls. This is the time the winemaker may choose to add sulfites to the juice to prevent oxidization and limit fermentation by indigenous yeasts and bacteria.

PRE-FERMENTATION

Modification of Must

Once the grapes are in 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.

At this stage, the winemaker has the opportunity to adjust the composition of the must in order to better suit their intent based on vintage parameters. Some common modifications include concentrating the must and increasing sugar in cool years or diluting the must to reduce sugar in warm years. Acid may also be adjusted to better balance the wine. Winemakers may also choose to modify extraction through the use of dry ice, enzymes or heat. Finally, they may manage the ferment through their choice of yeast strain and microbial nutrient management.

> **Concentration** is simply the removal of water from the must. Removing pure water requires advanced technology such as reverse osmosis (RO) and vacuum evaporation. 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. A much more common practice in Oregon is the technique known as saignée, 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.
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> **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 potential of the must. The sugar added to chaptalized wine cannot be tasted. The Oregon Liquor Control Commission (OLCC) regulations strictly limit the amount of sugar that can be added to musts.

Reduction of Alcohol: the most common way to reduce alcohol potential in wine is by adding small amounts of water to the must prior to fermentation. This is occasionally used to modify alcohol in warm vintages. Alcohol reduction may also be achieved through technology in the finished wine. Vacuum evaporation (and a version of it called "spinning cone") and reverse osmosis can be used to remove some of the alcohol from the finished wine.

Addition of Acid: tartaric acid is unique to grapes and is the most abundant acid in wine musts. Tartaric acid is often added to musts to modify the sensory attributes of the wine. Heat, especially at night, reduces acidity in the grapes. Tartaric acid can be added to ensure 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.

Dry ice is frozen carbon dioxide (CO_2). It can be used at higher rates to cool and rupture 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. 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.

Sulfur Dioxide (SO_2) 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_2 acts as both an oxidase enzyme inhibitor and as a microbial growth inhibitor. SO_2 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_2 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_2. Almost all of the SO_2 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_2 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_2 to control the growth of unwanted bacteria and prevent oxidization of the must. High levels of SO_2 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 SO2 is used varies widely between winemakers and according to the conditions at harvest.

Addition of Tannin: 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.

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.

Heat may be used to elevate the temperature of the must, which increases extraction and enhances fermentation. 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 and Yeast Nutrients: the winemaker may choose to utilize the natural microbiome of the must to start the fermentation, or they may select a commercial yeast strain. 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. High temperature, competing flora and alcohol may 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 if the must is deficient in the major nutrients required for a healthy fermentation. Once fermentation begins, the required amounts of nutrients can be added to ensure a healthy, clean and complete fermentation.

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 level of extraction.

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

Plastic Bins: these lightweight 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 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 two to three 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.

Stainless Steel Tanks: these have become the industry standard. 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 and have doors to make must removal simple. 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.

Roto-fermenters are horizontal, closed tanks that can be rotated to mix the cap with the must in a pre-programmed manner.

Wood Fermenters are usually of moderate capacity—from two to seven tons—and offer extraction of oak character when young, which affects the texture of wine. They are also more insulative, which affects the kinetics of the fermentation and often results in different management strategies.

Concrete and clay fermenters are gaining popularity in the Oregon wine industry. One advantage of these tanks is the slow rate of temperature exchange; thus, the must is slow to warm up and then slow to lose its accumulated heat, which affects extraction and fermentation kinetics. These vessels can be lined or unlined and are available in various shapes and sizes.

MANAGEMENT OF EXTRACTION

Temperature and Maceration

The juice in Pinot noir grapes is colorless. Thus, 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.

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 pre-fermentation 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 may be used to enhance sensory attributes. 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 fermentation kinetics and may vary the temperature through the course of the fermentation in order to shape the wine and provide the color, structure and flavor that they desire.

As fermentation nears completion, less heat is produced and the must begins to cool. Eventually the sugar is consumed and the fermentation finishes, at which point many winemakers choose to press.

Post-fermentation maceration occurs when winemakers choose to postpone pressing beyond the completion of fermentation. During this period, wine texture and flavor continues to evolve due to the complex reactions of phenolic compounds. This gives winemakers the opportunity to achieve the shape, structure and mouthfeel that they desire.

Cap Management

When fermentation begins, grape skins are buoyed up by the carbon dioxide that is produced by the yeast. Once the skins become dry, the extraction from those skins stops. The winemaker decides how often to re-immerse 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 skins 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 winemaking style. Those techniques include:

Punchdowns: 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. The frequency and intensity of punchdowns changes the level of extraction and is a stylistic decision. For small tanks, a manual plunger is used to resubmerge the cap. For larger tanks, fixed devices may be suspended over the tanks, allowing semi-automatic operation.

Pumpover: fermenting juice can be pumped over the top of the cap to keep it moist and manage extraction. Pumpovers are often selected as a way to minimize extraction while still wetting the cap. Pumpovers can consist of a simple pump and hose setup or may involve a more complex system of irrigators.

Pigeage (literally "by foot"), involves walking on the fermenting must to mix the cap in a shallow tank. 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.

Délestage ("rack and return"): the winemaker removes some of the juice from the fermenter into another vessel and then returns that juice over the top of the fermenter.

It can be very gentle as there is literally no manipulation of the skins. It can also provide the opportunity to reduce temperature.

Pulsair is commonly used in large tanks. 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.

Pressing

When the winemaker has achieved the texture, mouthfeel and flavor that they desire, they make the decision to press off of the skins. This timing is an important stylistic decision made by the winemaker.

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

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, 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 attached to the interior sidewall. After filling with must, the area behind the bladder 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, 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.

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. This is an important stylistic consideration that diminishes the potential for off aromas and flavors. However, some winemakers may choose to leave some amount of solids in their wine when going to barrel which can contribute to texture and flavor.

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 that result 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 decision that adds flavor, aroma and texture to wine. Wines of the highest quality are generally 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 oxygen 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 oak products, metered amounts of oxygen, and lees stirring.

Alternatives to Barrel Aging

> **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. 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.
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> 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. 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 involves injecting extremely small measured amounts of pure oxygen into the wine in tank. 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 oxygen added provides the raw material for the development and polymerization of tannins. Micro-oxygenation can be used to shape and impact flavors and aromas, allowing the winemaker to achieve their stylistic goals.

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 to autolyse, or break down, into the wine. This may result in added richness, creaminess and elevated mouthfeel. 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. This is an oxidative process and a stylistic decision.

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 in barrel, and the settling time will be minimized before barrel down. 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_2 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 decision to rack and the method used may or may not include air contact. Racking may result in softening of tannins, blowing off of any H_2S/sulfides, fermentation and malolactic characters and separating the wine from its lees in preparation for bottling.

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 ubiquitous malic acid bacteria. As the acid is reduced, the pH is elevated. Almost every Pinot noir produced completes malolactic fermentation, which makes it more microbially stable.

Winemakers' attitudes and practices on the use, or non-use of ML cultures vary widely from cellar to cellar. Many winemakers do not inoculate for ML while others inoculate the wine in barrel or fermenter. Some winemakers prefer a protracted ML fermentation because they believe it makes better wines. By delaying ML and the accompanying pH shift, the wine may achieve better color stability by allowing the polymerization of anthocyanins and tannins to occur at a lower pH.

Barrel Aging

The primary effect of the barrel is to allow the wine to develop body and flavors that help achieve the desired style. Oak barrels contain natural sugars and alcohols and other phenolic derivatives that structure wines and add flavor. 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 and during the topping process when the barrels are briefly opened. The tannins soften and the flavors integrate during this aging (or "élevage") process. 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.

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 are also available. Traditionally, fine Pinot noir has been aged in small French oak barrels after fermentation. The staves are split from logs and stacked and aged on pallets out in the weather anywhere from 18 to 40 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, toasting level, and shape. Other oak sources include Hungarian, Russian and other Eastern European forests, as well as American and Oregon sources.

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 oak flavors and can mask some more delicate wine flavors and aromas. A lighter toast may 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 barrel. 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 barrel for a specific vineyard may take many vintages to achieve. 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. Most Pinot noirs will spend at least 10 months in barrels. Wines may be held in barrel past the vintage for as much as 20 or more months.

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.

Cellar humidity has a significant impact on wine aging in barrel. Evaporation of water from barrels occurs through the wood pores. All of the other components of wine stay in the barrel. The net effect is that the wine is concentrated during barrel aging. The portion lost has been called the "angels' share." This is usually about one-quarter of a percent per month. Below 80% relative humidity the barrel will lose a higher proportion of water into the air. 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. Final adjustments or additions to the wine may also be made at this time.

Blending

Blending is probably one of the most important tools that a winemaker has. 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.

Stabilization

Laboratory Analysis: just prior to bottling, the winemaker runs tests to determine the wine's pH, acidity, alcohol and SO_2. If SO_2 needs to be adjusted, it is done now. The activity of SO_2 depends on the wine's pH and quantity of the active form of SO_2 in the wine. SO_2 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.

Fining is a tool used for clarification and for modification of structure and flavor. Some wines have bitter and unpleasant tannins or other negative flavor compounds that need to be removed or modified. The decision to fine a wine depends on the specific problem that needs to be addressed, such as bitterness or astringency. The most common fining agents are egg whites, gelatin, 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.

Filtration is a tool for clarification and microbial stability. In certain circumstances, filtration is preferred. Every wine with a partial or no malolactic fermentation or residual sugar must be filtered due to the potential for microbial growth and refermentation in bottle. Crossflow membrane filtration is the current industry standard, as it is believed to have lower sensory impact.

BOTTLING

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 can be selected for variable oxygen permeability to meet the style goals of the wine.

Natural cork contains air cells and has been shown to allow the entry of very small amounts of oxygen over the span of years. A wine sealed by cork will age differently over many years than a wine sealed with a screw cap. 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. Natural cork is the most common closure for premium Pinot noir in Oregon.

Synthetic and conglomerate corks eliminate the possibility of TCA contamination or "corked" wines. They vary widely in their specific permeability to oxygen.

Glass closures are another option. Originally developed in Germany, they provide a very secure seal, do not absorb aromatic compounds and provide an almost anaerobic seal.

Bottling Machines

The critical task of the bottling line is to fill the bottles gently, cleanly and with a minimal amount of oxygen uptake during the bottling process. Bottles are most commonly sparged with nitrogen to reduce the amount of oxygen in the bottle. Vacuum corkers are commonly used to reduce the pressure in the headspace during corking. Because of the specialized nature of the bottling equipment, many wineries in Oregon use mobile bottling services.

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. Through evaluation, decision, and action, the winemaker is able to achieve intent, with each step further defining the wine.