Harvest & White Crush And Fermentation

Wine 3
Introduction to Enology

Tonight’s Lecture
- Review preliminary 2013 Grape Crush Report
- Harvesting grapes
- Crushing
- Pressing
- Settling and pre-fermentation operations
- Barrel vs. tank fermentation
- White grape varieties

2013 Grape Crush Report
- This report is compiled by the State and shows production levels and pricing for all of the grapes (wine, table, and raisin) produced in the State.

2013 Grape Crush Report
- The report divides the state into 17 grape growing districts and collects data by district.

2013 Grape Crush Report
- Very important information for growers and wineries alike.
- Sonoma County is district 3

2013 Grape Crush Report
- The preliminary report is published February 10th and the handout includes information on pricing from table 10 of the report.
- A link to the website for the complete report is at the class website.
- State wide price/ton is very low compared to Sonoma County.
- Final report with updated figures is released in March.
White Crush

2013 Grape Crush Report ~ Highlights

Yield up 7%

![Graph showing California grapes crushed from 2004 to 2013 with a 7% yield increase.]

CA prices down 4%
Sonoma prices up 3%

![Graph showing grape crush dollars per ton from 2004 to 2013.]

White vs. Red Winemaking

- The two methods are not mutually exclusive.
- White grapes make white wine and visa versa, (obviously), but their processing is also different.
- Although they are inherently different, both red and white winemaking use a lot of the same equipment and processes in slightly different ways.

White Wine Styles

- White wines are generally more focused on fruity flavors than reds, and are usually not aged for long periods of time.
- Whites have less phenolic compounds (responsible for color, astringency, and bitterness)
- They can be made with no, low, or a lot of oak character.
- They can be made dry, off-dry (slightly sweet) or very sweet.

Efficiency vs. Quality

- Many times the best method for making quality wines is not the most efficient.
- The right method for each wine depends on its style, target market, and price.
- Winemakers must weigh both factors before making winemaking decisions.
Grape Harvesting

- Harvest: The first part of this lecture equally applies to both whites and reds.
- Picking Hand vs. Mechanical
- Both methods have advantages and disadvantages and each work for particular situations.

Hand Harvesting

Advantages:
- Selective, picks only the good fruit, skips rot, mold, second crop etc.
- Less damage to fruit (very gentle).
- Less up front cost compared to mechanical harvesters, but you can rent mechanical harvesters.

Mechanical Harvest

Done with picking machines that shake the clusters & berries off the vine. May become the industry standard due to labor shortages.

Advantages:
- Delivers cool fruit (picks at night with lights) important for white grapes grown in warm areas.
- Fast, can do 100+ tons a night no problem.
- Gives you de-stemmed berries (wineries don’t pay for stems).
- Cheaper about $175 an acre compared to $750+ for hand.
- Easily available, you don’t have to find pickers.
Hand vs. Mechanical

- Hand is generally better for high end winemaking.
- That being said, mechanical harvest done well delivers better grapes than hand harvest done poorly.

Night Hand Harvest

- Second Crop This is when fruit clusters are formed on a lateral shoot. Small quantity and less flavor than first crop.
- Usually not picked commercially because of economics, good source of grapes for home winemakers.
Fruit Delivery

- **Lug Boxes** 40 to 60 pounds, provide the very least amount of damage to the fruit so they are great for sparkling wine, but are a logistical headache.

- **1/4 to 1/2 ton bins** good compromise not too much damage to fruit but a lot easier to handle mechanically, although it does require some specialized equipment.
- Bins are towed on trailers through the vineyard then loaded onto trucks, 1/4 ton bins can be used for less bruising.

Fruit Delivery

- **Gondolas**, 2 1/2 to 6 ton trailers, traditional California method, loaded in the vineyard towed behind a tractor then transferred to a pickup for trip to the winery.
- They are dumped in hopper with hoist. Not as popular as they used to be.

Bins on Trucks (Valley Bins)

- 2 to 3 ton bins. Similar to gondolas but are loaded on the back of a semi. Requires a forklift in the vineyard, one semi truck and trailer can haul 20 to 25 Tons.

- **This is a good compromise between quality & efficiency. Used for both mechanical and hand harvest.**
Large Bins

- **5 to 10 ton Bins**, these stay on the truck and the fruit is dumped into them in the vineyard. Double dumping means less gentle than Valley Bins.

Field Crushing

- **Crushing in the Field** Lets you add SO₂ quickly (if you want to), and crushed grapes need less space for transport, not often used because of poor quality control.
- Can be used by home winemakers who do not have enough lug boxes. (crushed fruit takes up less space).

Inspection and Weighing

- **Load of fruit is weighed** and the weigh tag is filled out; sometimes this is done away from the winery. Valley bins can be weighed as they are loaded on trucks.
- More about weigh tags in the lecture on wine law.

Inspection and Weighing

- **Visual inspection** for variety (in 1980’s one winery crushed more Zin than was grown in the entire state) and **MOG** (Material Other than Grapes); important at large wineries where there is less contact with growers.
- If the grapes are mechanically harvested it can be difficult to tell what the variety is because the fruit is crushed.

Inspection and Weighing

- **Lab Analysis** of the load, done from a stab, must line, or press sump sample, analysis is similar to a vineyard sample. Check Brix, pH, TA, temperature, Brix measurement done in detail in lab and wine chemistry lecture.

Inspection and Weighing

- It is very important that this analysis is accurate because you have to know what you are getting and the growers pay is often determined by these numbers.
- Analysis is only as good as the sample.
- This is sometimes done by a state agency or third party inspector to avoid bias.
Sugar Shack
- Truck sampling at a large winery

Sugar Shack
- Getting a stab sample from a 5 ton bin of mechanically harvested fruit

Inspection and Weighing
- Truck sampling is more rigorous at large wineries where there is less contact between the grower & vintner.
- Ideally at smaller wineries you should know what you are getting before the grapes are picked.
- Rejecting a load after harvest is sometimes done, but it is always a hassle for all concerned.

Unloading the Fruit

Unloading
- Fruit is dumped into a hopper and transported by either *augers* or *conveyor belts*. Augers are easier to clean, and belts are gentler to the fruit.

Receiving Hopper
- Progressive Auger
Sorting
- At high end wineries sorting is done after the fruit is received to remove MOG and poor quality fruit.

Hand Sorting
- Sorting can be done before or after crushing. After crushing is good for reds because you can remove stem “jacks”.

Automated (optical) Sorting
- Automated sorters use cameras and jets of compressed air to remove MOG; they can process up to 10 to 15 tons/hour.

Automated (optical) Sorting
- After sorting
- Extra protein in Green Beans
- Cull

Crushing and De-stemming
- The equipment for this is the same for whites or reds but they handled slightly differently. Tonight we will concentrate on how they are used for white wine making.
- Traditionally grapes were trodden and then pushed through screens. The first vintage of Fern Cellars (my old homemade wine) was done with a garbage can and a bike basket.

Crushing and De-stemming
- Crushers have rotating bars inside a perforated cage to de-stem the grapes, then a set of rollers to crush the fruit
- Crushers have a sump underneath with a high capacity pump that can handle high solids to transport the must.
Why Crush or De-stem?

- Crushed grapes are easier to move (pump)
- They drain better and fill presses more evenly
- Reds fermented on stems can pick up a phenolic "stemmy" taste.
- Crushing makes the juice accessible to the yeast.

White Wine Crush

- Now we will be dealing with white wine processing only. Reds get their color from fermenting on the skins and whites are separated from the skins (pressed) before fermentation.

Must

- Now that the grapes are crushed, the resulting combination of juice, skins and seeds is called Must. Must is approximately 80% Juice, 16% Skins, 4% seeds by weight, this varies a lot by variety, vineyard & vintage.

Dejuicing

- The act of separating the juice from the must without any kind of pressure (besides gravity) is called dejuicing. This step is not needed for whole cluster pressing and it is optional for crushed grapes.
- If done properly it will improve quality and ease processing. You lose much of the advantage if the grapes are mechanically harvested.

Dejuicing

- Static dejuicing tanks (DJs) usually hold one press load, originally designed for skin contact when it was trendy (now becoming popular again).
- They also act as a surge tank for matching a continuous process (crusher) with a batch process (press).
Dejuicing Tanks (DJs)

Skin Contact

- Pre-fermentation skin contact of 4 to 24 hours will increase varietal character in white varieties such as Sauvignon Blanc and Muscat.
- Skin contact of whites before pressing will affect color and increase phenolic content.

Dejuicing

- **Mechanical**, Often an incline wedge-wire screen in line to a press. Allows for separation of 50% to 80% of the juice.
- Works very fast and gives high yield, but lower juice quality due to high solids & phenolics due to sheering action. Works well on mechanically harvested grapes.

Mechanical Dejuicer

Whole Cluster Pressing

- **But...** you don't have to crush whites.
- This is where white grapes are loaded **whole cluster** into the presses without being crushed first. Excellent quality but more difficult, it works well with delicate white varieties and sparkling wines.

Whole Cluster Pressing

- **Advantages**: Clusters have stems for a natural press aid and the fruit is not as macerated so there is less extraction of phenols from skins.
- Generally results in higher quality wine.
Whole Cluster Pressing

- **Disadvantages:** Cuts press capacity by 1/2 and extends press cycle, labor intensive because the press is more difficult to load.
- More costly because of the extra presses you need to buy, good for sparkling and high-end white wines because of the low level of extraction from the skins.

Temperature Factors

- **Temperature** affects the rate of oxidation of phenols (browning) done by enzyme tyrosinase (phenol oxidase). Must is more sensitive to temperature than grapes due to the rupture of the cells. Controlled by:
  - Morning picking is used to keep grapes cool.
  - Cooling tunnels and must chillers.
  - Temperature also affects the rate of growth of spoilage organisms.

Enzymes

- **Enzyme addition** Pectinases are enzymes that can be added to the must in the DJ that break down Pectins (the substance grape skins are made of that hold in the juice).
- Increases yield of free run, frees sugar and other flavor compounds in the pulp, needs 2 to 4 hours contact time.

Enzymes

- **Settling enzymes** aid in juice clarification and are added to the juice after pressing or during skin contact.
  - Added on skins gives better yield, added on juice aids in clarification.
  - This can result in better aroma and cleaner juice but can also increase quantity of lees. Counter fining with a little gelatin helps compact the lees.

Pressing

- Pressing is the act of squeezing the must against a screen that separates the juice from the skins and seeds.
  - **Whites** are pressed before Fermentation
  - **Reds** are pressed after Fermentation
  - Two general types of presses: Mechanical Presses & Pneumatic Presses

Mechanical Presses

- **Vertical basket press,** The oldest design, gentle and slow used most by home winemakers & small high-end wineries. Operated by screw or hydraulic rams.
Mechanical Presses

- Home winemaker versions sometimes they have a bladder that can be pressurized with water to squeeze out the juice.

Basket presses are still used by some commercial wineries.

Horizontal basket press

- Loads and unloads easy and has big doors for whole cluster pressing, lots of O₂ though. Has high mechanical pressure 6 ATMs.

Horizontal basket press video

http://www.cognac.fr/cognac/_en/modules/cognac_pressoir_plateaux/pressoir_plateau.html

Measuring Pressure

- There are several ways to measure pressure, both US and Metric
  - 1 Atmosphere (atm) is equal to the air pressure at sea level (approximately)
  - 1 atm = 14.7 PSI (pounds/square inch)
  - 1 atm = 1 bar
  - 1 bar = 1000 millibars

Continuous Presses

- Belt and Screw type, high speed and high solids & phenols. Press fractions are possible; best suited to bulk wine processing.
Pneumatic Presses

- **Bladder** Horizontal basket can be hard to load drains well because it pushes to the sides, lots of O₂ (Oxygen) pickup.

Pneumatic Presses

- **Membrane**, also called tank, presses made by Deime, Vaslin/ Bucher, and Willmes; these are the workhorses in premium wineries. They are programmable and can do central (Axial) filling (this increases solids). Complicated and expensive.
- Complete cycle takes from 1.5 to 4 hours, the slower you go, the more gentle the process.

Membrane Press

Tank or Membrane Press, good quality and high yield

Membrane Press

Interior of Tank or Membrane Press

Juice Pan

Membrane Press Operation

Filling Pressing Emptying

Juice Quality

- **Press Fractions** The highest quality juice comes from the middle layer of the berry. It is the first juice that comes off during dejuicing or from the beginning of the press cycle. This is called the **free run**.
Juice Quality & Press Fractions

- In big (low quality) wineries the separation of fractions is often not done.
- For homemade wines it is not as important because you usually do not press hard enough to get a big difference between free run and press.

Press Aids

- Press Aids Can be added to aid dejuicing and get better and faster yields by breaking up the cake and allowing juice to exit.
- Rice Hulls or stems can be added back.
  Mainly needed for "slippery skinned" varieties like Chenin Blanc, Sauv Blanc or Muscat.
- Not needed for whole cluster pressing.

Sulfur dioxide, SO₂

- Sulfur dioxide or SO₂ Is a preservative that inhibits destructive enzymes and undesired microbes. It can be added to the juice coming out of the DJs or the presses at a level of 30 to 50 PPM.
- This is a big topic that we will go into much more depth in a later lecture.

Press Aids

- Rice hulls used as a press aid

Juice Quality & Press Fractions

- Free Run it makes up about 75% to 85% of the juice. The free run is usually kept separate from the press juice (the second fraction).
- The change is evidenced by a drop in sugar, a rise in pH and a darker color in the juice.
  Chosen by gallons pressed, pressure, or by taste.
**Sulfur dioxide, SO\(_2\)**

- In certain cases passive oxidation is used to try and improve white wine quality, oxidation causes phenols to turn brown and loss of fruity compounds.
- This is the called “Post Fermentation SO\(_2\)” PF SO\(_2\) method for white wines (usually Chardonnay).

**Sulfur dioxide, SO\(_2\)**

- **Passive Oxidation** combined with PF SO\(_2\) uses no SO\(_2\) but lots of inert gas (N\(_2\) or CO\(_2\)) blanketing, some oxidation occurs during pressing and crushing and the must turns brown.
- The oxidized phenols settle out leaving good, stable color after fermentation. PF SO\(_2\) helps ML fermentation to complete.
- Good for whites aged in oak such as Chardonnay & Viognier.

**Sulfur dioxide, SO\(_2\)**

- **Protective** SO\(_2\) added before fermentation at the press sump or in the tank. Stops oxidation before it gets too far, poorer color as the wine ages but more fruitiness.
- Good for varieties with a lot of fruit character such as Pinot Gris, Sauvignon Blanc, Riesling, Muscat, and Gewürztraminer.

**Sulfur dioxide, SO\(_2\)**

- It is a good idea though to keep SO\(_2\) as low as possible, and the PF SO\(_2\) method has a lower level of SO\(_2\) at bottling. Neither method is best, it is mainly a stylistic consideration.
- Generally speaking, PF SO\(_2\) gives you better color, body and ageability while the SO\(_2\) before fermentation method gives you more fruity flavors.

**Sulfur dioxide, SO\(_2\)**

- **Organic wines vs. Organic Grapes** There is a distinction between the passive oxidation and the no SO\(_2\) at all (organic) method, in all wine some SO\(_2\) is produced by yeast.
- Organic wines must also be made from organically grown grapes.
- In the EU it is OK to add SO\(_2\) to Organic wines.

**Juice Clarification**

- Purpose is to remove excess solids in the juice. Solids are soil, fragments of stems & skins, fibers from pulp and insoluble proteins. If it is left in the juice it can leave a high solids character (musty, chalky, H\(_2\)S, low fruit).
- Whole cluster pressing leaves 3% to 8%
- Free run with crushing gives 10% to 20%
Juice Clarification

- You want about 0.5% to 1% solids in clarified juice before fermentation. Less than 0.5% you can get stuck fermentations from low nutrients.
- This corresponds to between 100 and 600 nephelometric turbidity units (NTU). We will learn more about these in a later lecture.

Juice Clarification

- **Tank Settling** Juice is placed in tank and allowed to settle for 12 to 72 hours, then clean juice is decanted or "racked" off. Lees are what is left behind (about 10% of volume).
- Lees can be filtered through a **lees filter** (covered in the wine processing lecture).

Racking a Tank

- **Pump**
- **Racking Door**
- **Hose or transfer line**
- **Racking Valve**
- **Bottom, or Transfer Valve**
- **Lees at Bottom of Tank**
- **Lees at Transfer Valve**
Racking a Tank

- Racking Arms, these fittings allow you to rack the wine clean right down to the level of the lees without opening the tank door.

Settling in Large Tanks

- Settling is more efficient in smaller tanks. In tanks over 15,000 gallons it can take too long to settle so large wineries often employ centrifuges or filters to clarify juice.
- Mechanically harvested fruit and soft-skinned varieties can have higher solids and take longer to settle.

Centrifuging

- Two types: (we will go over how they work in the wine processing lecture). These used to be much more popular.
  - Decanter Centrifuge input is 25%, output is 2%-5%.
  - Desluging Centrifuge does better with lower solids (> 10%), but cleans it up better so is more common because it is more versatile. It is good at stopping fermentations (expensive and loud).

Juice Clarification by Floatation

- Relatively new technology for wine; it separates solids by floatation using nitrogen gas combined with pectinase enzymes.
- Takes about 6 to 8 hours and can result in very clean juice.

Juice Clarification by Floatation

- Enzyme addition to help with settling (optional)
- SO₂ addition (optional) to protect it from spontaneous fermentation.
- Cooling jackets are turned on to help preserve the juice (50 degrees).
- Analysis for nitrogen, TA (titratable acid), pH and sugar is done and the tank is gauged.
Operations done after racking
- After settling/clarification the wine is transferred into its fermentation vessel.
- If needed acid addition is done at the end of settling when the juice is racked.
- Cooling jackets are set to fermentation temperature (45 to 60ºF.)
- Yeast is added (if not using the native yeast)

Fermentation vessels
- Stainless Steel Tanks
  - Stainless is great for cleaning, durability, and temperature control.
  - White wines are usually fermented cool (45º - 55º) to preserve the floral & fruity aromas.
  - For a compound to have an aroma it must be volatile (able to evaporate) and if a fermentation is hot many of the aromatic components evaporate away.

Stainless Steel Tanks
- Top manway
- Double wall cooling jacket
- Racking Door
- Thermo wells
- Racking valve
- Bottom Valve

Venting tanks
- Tanks must be vented before emptying or filling.
  - Pressure relief valve

Venting tanks
- Atmospheric pressure causes unvented tanks to collapse.

Barrel Fermentation
- Barrels, used for some white wines gives a “toasty” flavor. Barrels usually ferment at a higher temperature so the juice ferments more quickly; small volume helps them to settle. Harder to clean and control the rate of fermentation.
- Usually inoculated (started) in tanks and when fermentation starts they are sent to barrels.
### Barrel Fermentation
- Start the juice to be fermented in a tank, inoculate with yeast, and then just as it is starting to ferment (1 or 2 days), transfer to barrels.
- Since barrels do not have cooling jackets it is best to chill the juice to 40 to 45°F the night before filling.
- As the barrels are being filled it is important to mix the tank occasionally to keep the yeast homogenized.

### Other fermentation vessels
- **Wooden Tanks**, similar to barrels but usually don’t get toasty effect because of lower surface to volume ratio.
- For home winemaking fermentation vessels, olive drums, barrels, plastic picking bins, beer kegs, glass carboys. You need an wide-opening top for reds but not for whites.

### Filling a fermentation tank
- **When filling a tank** for white juice fermentation you can only fill it to about 90% capacity to allow room for foam.
- The amount is dependent of type of yeast and temp of fermentation.
- Barrels have to be left down 10% to 20% because of the fact they ferment faster and generate more foam than wine fermented in stainless.

### During Fermentation
- Monitor the wine daily checking for:
  - Temperature
  - Brix,
  - Sensory (smell)

### After fermentation
- After fermentation the yeast settles out to the bottom the tank and the wine is racked off (yeast lees are much more compact and are usually not filtered).
- After the yeast has settled in one to two weeks the wine can be racked off the lees.
Sur lie aging

- Barrels can also be racked off the lees, or they can be topped up and left in the barrel to age sur lei, pronounced soor-lee.
- Yeast lees are different from primary lees.
- Gives the wine a "yeasty" character and adds viscosity.
- The presence of yeast also helps protect against oxidation.

Advantages of Sur lie aging

- Stirring (batonage) is intensifies the flavor effect.

Blush Wines

- Blush wines are white or pink wines made from red grapes, White Zin is the classic example.
- They are made in much the same style as a white wine and the grapes are handled very gently and there is a little skin contact as possible to keep the color extraction to an absolute minimum.

Blush/ Rose Wines

- Rose wines are pink wines that are made with limited skin contact or by mixing a red and a white wine together to form a pink wine.
- They are also made by fermenting a light colored red variety on the skins and pressing it very early.
- Generally taken more seriously than blush wines.
Rose Wines
- Roses can also be made from “bleed-off” or saignée (pronounced san-yay) from red fermenters when 10 to 15% of the juice is removed to concentrate the flavor of the must that is left behind (higher skin/juice ratio).
- We will talk more about saignées next week.

White Grape Varieties
- We will cover some of the most popular white grape varieties that are grown in California. Next week we will cover red varieties.
- The % planted numbers are a little different than the handout.

Next week
- Red Crush & Fermentation
- Lab this week is processing equipment for white wine, and small scale fermentations.